Welcome to your preview of SLEEP 2019, the 33rd Annual Meeting of the Associated Professional Sleep Societies, which will be held in San Antonio, Texas on June 8–12, 2019.

This abstract supplement unites the journal SLEEP, and the science of SLEEP 2019. All abstracts presented at SLEEP 2019 are included in this special issue. This year, 1,014 abstracts will be presented at the meeting. 212 will be presented in an oral presentation format, and the remainder will be presented in a poster format. Many authors of oral presentations will also be presenting their science in the poster hall, providing additional dedicated time to network with the authors of these important studies. In addition, this abstract supplement contains case reports submitted by individuals in Sleep Medicine Fellowship and other training programs.

Abstracts in this supplement are divided between Basic and Translational Sleep Science, and Clinical Sleep Science and Practice and then assigned to one of 27 subcategories. Each abstract has a unique four-digit number to facilitate identification and location both within this issue and at SLEEP 2019. The four-digit number in the abstract supplement matches the four-digit code published in the SLEEP 2019 Mobile App.

The SLEEP meeting fosters an environment in which members and attendees learn about the latest basic, translational and clinical science and technologies, promoting the continued growth of the field through the dissemination of new knowledge. We look forward to sharing in the success of this pivotal event and hope you consider joining the American Academy of Sleep Medicine and Sleep Research Society in San Antonio, Texas in June.

Ronald Szymusiak, PhD
Editor-in-Chief
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**0001**

**THE INNERVATION OF HYPOGLOSSAL MOTONEURONS THAT ORIGINATES FROM A7 AND/OR SUBCOERULEUS NORADRENERGIC NEURONS IS IMPAIRED IN MICE TREATED WITH CHRONIC INTERRUPTED HYPOXIA**

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**Introduction:** Noradrenergic (NA) neurons of A7 and SubCoeruleus (SubC) pontine nuclei project to the hypoglossal (XII) nucleus and provide excitatory input to XII motoneurons that play a role in the pathology of obstructive sleep apnea (OSA). We sought to investigate whether chronic interrupted hypoxia (CIH), one of the major morbid factors of OSA, affects the NA innervation of XII motoneurons that originate from A7 and SubC neurons.

**Methods:** We used five DBH-cre mice that received unilateral injections (100 nl) of an adeno-associated viral (AAV) vector (AAV8-EF1a-DIOhChR2(H134R)-mCherry) aiming at A7 region and were exposed to CIH (O2: 10% 4 min/21% 3 min, 10 hours daily for 35 days; 3 mice) and sham control (2 mice). After the exposure, animals were perfused and brainstem sections processed for tyrosine-hydroxylase and DsRed immunohistochemistry. We calculated the number of DsRed-positive neurons in A7/SubC regions and the number of DsRed-positive axonal projections within the dorsal and ventral compartments of XII nucleus at rostral, central and caudal antero-posterior levels, ipsi- and contra-laterally to the injected side. The DsRed-positive fibers that visually appeared as thick and thin were counted separately.

**Results:** The average proportion of AAV-transfected NA neurons found in SubC and A7 nuclei was similar in CIH- (SubC/A7=1.4) and sham-treated mice (SubC/A7=1.3). In all mice, the mean ratio of “thin”/“thick” fibers was higher in ventral compartments (“thin”/“thick”=2.7) as compared to dorsal compartments (“thin”/“thick”=1.0, p<0.05) calculated at all three levels of XII nucleus. In CIH-treated mice, numbers of the “thin” fibers within the ventral compartments on ipsilateral side at the rostral and caudal levels, and on contralateral side at the central level, were 50-60% of that calculated in sham-treated mice. The “thick” fibers did not show a consistent trend between CIH- and sham-treated mice.

**Conclusion:** These data suggest that CIH may have detrimental effects on the NA innervation of the ventral compartment of the XII nucleus by A7/SubC nuclei, which would further impair the patency of upper airway muscles in OSA patients.

**Support (If Any):** R01HL133847

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**0002**

**LEPTIN RECEPTOR POSITIVE NEURONS IN THE DORSOMEDIAL HYPOTHALAMUS MAINTAIN UPPER AIRWAY PATENCY DURING SLEEP**

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**Introduction:** Both deficiency of adipocyte-produced hormone leptin and resistance to leptin’s effects cause obstructive sleep apnea (OSA) and obesity hypoventilation syndrome (OHS), which are reversed by leptin delivery to the brain. However, mechanisms of leptin’s effect on sleep disordered breathing remain unknown. We previously shown a retrograde neuronal tracer pseudorabies virus injected in the genioglossus muscle of the tongue spreads to the dorsomedial hypothalamus (DMH), which abundantly expresses leptin receptor LepRb. We hypothesized that LepRb+ neurons in DMH project to the hypoglossal motoneurons and upon excitation with leptin activate these neurons to prevent OSA.

**Methods:** LepRb deficient db/db mice (15.9±0.3 wks, 49.1±0.7 g, 42 mice) underwent stereotactic administration of adeno-virus harboring LepRb (Ad-LepRb) or green fluorescent protein (Ad-GFP) in DMH. An intracerebroventricular (ICV) catheter was inserted into the lateral ventricle of mice implanted with EEG/EMG leads. Polysomnography was performed 9 and 12 days after surgery, and hypercapnic ventilatory response (HCVR, 8%CO2) during NREM sleep, both with or without ICV leptin (10µg/2µl). Upper airway obstruction was defined by the presence of inspiratory airflow limitation (IFL), characterized by early inspiratory plateau in airflow at a maximum level (Vmax) while effort continued to increase. For optogenetics, LepRb-Cre mice were crossed to channelrhodopsin (ChR2) floxed mice and brains were harvested at 21 days.

**Results:** At baseline, db/db mice infected with Ad-GFP and Ad-LepRb showed severe OSA in REM sleep (55±5% IFL). Leptin had no effect on breathing in Ad-GFP mice. In contrast, in Ad-LepRb mice, leptin significantly decreased IFL during REM sleep (8±3%,p<0.001) and increased minute ventilation (V̇E) and Vmax during IFL breathing in NREM and REM sleep. Leptin did not affect the HCVR in both groups. LepRb was predominantly expressed in neurons and not in astrocytes, and LepRb+ cells were nearly uniformly melanocortin receptor 4 (+). Optogenetic studies showed that while hypoglossal motoneurons lacked LepRb, LepRb+ fibers projected extensively to these cells. Optogenetic stimulation of DMH activated hypoglossal motoneurons.

**Conclusion:** Leptin acts upon LepRb+ neurons in DMH which project to the hypoglossal motoneurons and maintains upper airway patency during sleep.

**Support (If Any):** 5R01HL128970-04

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**0003**

**DEEP-BRAIN IMAGING IDENTIFIES CATAPLEXY-ON NEURONS IN THE AMYGDALE**

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**Introduction:** Amygdala is involved in emotion, and cataplexy is triggered by emotions. We have rescued cataplexy through orexin gene transfer into amygdala neurons (Liu et al., 2017), but seek to further identify culprit neurons triggering cataplexy. We use deep-brain imaging to visualize the activity of the central nucleus of amygdala (CeA) neurons in narcoleptic mice. This method uses a miniature microscope to visualize changes in fluorescence in individual neurons (Ghosh et al., 2011).

**Methods:** GCaMP6s was transduced into CeA GABA neurons in narcoleptic VGAT-Cre mice (VGAT-Cre+/OXKO/anesthesia) and three weeks later fluorescent activity of individual GABA neurons were extracted with PCA-ICA analysis (Inscoptix).

**Results:** 128 neurons were recorded from three narcoleptic mice. Activity of CeA GABA neurons was significantly higher in active
Support (If Any): Curr Opin Neurobiol, 110-115

Shiromani, P.J. (2017) Rewiring brain circuits to block cataplexy (BX000798, PJS). (PJS), NS079940 (PJS), NS098541 (PJS), and Veterans Affairs of Pharmaceutical and Biomedical Sciences, Clovis, CA, USA, Chandra Kolli, PhD3, Dennis McGinty, PhD1,5, Ronald Szymusiak, 4Department of Medicine, UCLA, Los Angeles, CA, USA, 5Department of Psychology, UCLA, Los Angeles, CA, USA, 6Department of Neurobiology, UCLA, Los Angeles, CA, USA.

Introduction: Activation of corticotropin releasing factor (CRF) neurons in the paraventricular nucleus of the hypothalamus (PVN) regulates endocrine and behavioral responses to acute stress. We hypothesized that selective activation of CRF neurons in the PVN acutely disturbs sleep. We examined the effects of chemo-genetic activation of CRF neurons in the PVN on spontaneous sleep-wake and EEG measures in mice.

Methods: 6 male CRF-ires-Cre mice received bilateral injections of pAAV-hSyn-DIO-hM3Di(mG)-mCherry (excitatory DREADD) and 3 mice received pAAV-hSyn-DIO-mCherry (control vector) targeting the PVN. Mice were also implanted with EEG/EMG electrodes. Mice were maintained 12/12 hr light dark cycle. Three weeks after AAV injections, intraperitoneal injections of vehicle or CNO (0.1 mg/kg), were administered at zeitgeber time (ZT) 0 in a repeated measure experiments. EEG and EMG were recorded un-disturbed post-injection. EEG slow-wave activity (SWA) in NREM sleep (% change from baseline values) and sleep wake measures were quantified during 8 hour post-injection.

Results: During first 4-hr post-injection in mice expressing excitatory DREADD, percent time awake increased following 0.1 mg/kg CNO compared to vehicle (42.5±7.1%/75.0±10.7%, p=0.001) whereas NREM time (51.7±6.5%/24.1±3.8%, p=0.001) and REM time (5.4±0.5%/12.0±0.5%, p=0.001) decreased. In mice expressing control vector, these wake-sleep measures did not differ between 0.1 mg/kg CNO and vehicle injections. In the second 4-hr post-injection period, wake time (41.1±2.4%/39.1±2.5%, p=0.524), NREM time (50.9±0.8%/53.0±4.1%, p=0.640) and REM time (7.9±1.1%/7.9±1.9%, p=0.993) did not differ between and CNO and vehicle conditions. EEG slow-wave activity (SWA) in NREM sleep in first 4-hrs post-injection in mice expressing excitatory DREADD showed a significant decrease of 44%. Wake bout duration increased and NREM bout duration was decreased in first 4 hrs following CNO injection in mice expressing excitatory DREADD. There were no between treatment differences in REM bout duration.

Conclusion: Acute activation of CRF neurons in the hypothalamic PVN acutely suppresses sleep.

Support (If Any): By the Department of Veterans Affairs.

0005
THE EFFECT OF CHEMOGENETIC SILENCING OF CORTICOTROPIN RELEASING FACTOR NEURONS IN THE PARAVENTRICULAR NUCLEUS ON POST-STRESS SLEEP IN MICE

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Introduction: We have previously shown that pharmacological elevation of corticotropin releasing factor (CRF) signaling in the brain results in exacerbation of sleep disturbances evoked by the exposure of rats to the dirty cage of a male conspecific. In this study, we examined the effect of chemogenetic silencing of CRF neurons in the hypothalamic paraventricular nucleus (PVN) on sleep occurring after the exposure of mice to dirty cages from male rats.

Methods: To achieve Cre-dependent expression of hM4Di inhibitory DREADDs (designer receptors activated by designer drugs), a group of CRF-ires-cre male mice (n=5) received bilateral injections of AAV-hSyn-DIO-hM4Di-mCherry targeting the PVN. The other group of CRF-ires-cre mice (n=4) was injected AAV-hSyn-DIO-mCherry (control vector). All mice were implanted with EEG/EMG electrodes. Dirty cage experiments were started following a 4-week postsurgical period to allow gene recombination and expression. Mice were subjected to intraperitoneal (IP) administration of clozapine-n-oxide (CNO; 3 mg/kg) at ZT1, placed into dirty cages, and recorded for post-stress sleep.

Results: In mice expressing hM4Di inhibitory DREADDs versus mice injected with control AAV, IP CNO (3 mg/kg) resulted in a significant decrease of post-stress sleep onset latency, decrease of time spent in wakefulness (first hour, 76±5.5 vs. 88±11.3, second hour, 39.4±10.5 vs. 80.4±9.9%, third hour, 42.3±3.5% vs. 46.4±16.5%, fourth hour, 46.4±6.6 vs. 54.6±10.9), and increase in non-rapid eye movement (NREM) sleep time (23.8±5.6% vs. 11.9±11.3%, 59.3±26.7% vs. 19.6±9.9%, 56.2±3.1% vs. 51.4±14.7%, 52.5±6.6 vs. 44.9±11.4). The hM4Di expressing mice exhibited longer episodes of NREM sleep, compared to mice injected with control AAV (first hour, 131.3±80.4sec vs. 19.1±19.9sec, second hour, 437.6±85.7sec vs. 77.8±45.4sec, third hour, 467.5±142.8sec vs. 142±82.7sec; fourth hour, 230.3±86.7sec vs. 194±74.9sec).

Conclusion: Chemogenetic silencing of CRF neurons in the PVN attenuates acute stress-induced sleep disturbance in mice.

Support (If Any): Department of Veterans Affairs Merit Review Grant # BX00155605

0006
NOVEL SLEEP LATENCY TESTING IN C57 MICE DURING PERIODS OF NICOTINE ADMINISTRATION AND ABSTINENCE

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A. Basic and Translational Sleep Science

Introduction: Increased sleep latency is reported and observed during periods of nicotine consumption and withdrawal, in humans. Using mice, our lab has previously shown an increase in active phase latency during nicotine administration, and a decrease during nicotine abstinence. The present study utilized mice to characterize inactive phase sleep latency during periods of nicotine administration and abstinence and to measure corticosterone following a series of sleep latency testing trials.

Methods: In experiment one (n=14), mice were implanted with EEG/EMG recording devices. During a pre-nicotine condition, mice had access to 2% saccharin water. To generate nicotine dependence, 200μg/ml of nicotine was added to the saccharin solution. After 14 days of nicotine, abstinence was initiated by excluding the nicotine from the water. Multiple sleep latency testing (MSLT) consisted of three consecutive trials spaced one hour apart under three conditions: baseline (BL), nicotine day 8 (N8), and withdrawal day 1 (WD1). During each trial, mice were kept awake for 5 mins by gentle handling or exposure to a novel object. In experiment two (n=4), an ELISA was use to assess plasma corticosterone following a third gentle handling sleep latency trial.

Results: An increase in sleep latency was observed on WD1 in the gentle handling group. No changes in latency were observed in the novel object group. Following a series of gentle handling MSLT, a significant decrease in corticosterone was observed during WD1, relative to BL.

Conclusion: These data suggest gentle handling increases sleep latency during withdrawal, whereas a novel object does not. Additionally, changes in the gentle handling group might be mediated by a blunted corticosterone (stress) response.

Support (If Any): Grant: 5T32DA017637-14

0007
THE ROLE OF BROWN FAT ACTIVATION IN SLEEP RESTRICTION AND OBESITY
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Introduction: Diabetes and obesity are growing healthcare concerns throughout the world. Current strategies have not proven effective to stem the epidemic. Individuals with short sleep duration are at increased risk for obesity, while evidence is incomplete as to how sleep affects all aspects of energy expenditure (EE). Brown adipose tissue (BAT, brown fat) has recently emerged as a thermogenic tissue that may play a role in preventing obesity and diabetes-related disorders. Animal studies have suggested that adequate, high-quality rebound sleep after sleep restriction (SR) may be dependent upon functional BAT. The goal of the study is to evaluate the impact of SR on BAT activation and to assess the role of BAT in recovery sleep (RecS) after SR in healthy adults.

Methods: After a 3-d period of habitual sleep (HS, 8 h) and sleep restriction (SR, 4 h) under identical, controlled, weight-maintenance feeding conditions, BAT activities were assessed by a PET/MR combined scanner with simultaneous acquisition. The SUVmean and SUVR (ratio of SUV BAT/muscle) of 18F-FDG were calculated. The fat fraction (FF) and R2*(= 1/T2*) in BAT were quantified using a new, improved MR sequence. Circulating levels of metabolites and hormones were assayed and correlated with BAT thermogenesis.

Results: Ongoing results have shown an increase in FDG-SUVR in 4 (avg. 29±16) out of 5 subjects after SR, compared to HS. A similar trend of increase in FF in BAT was also observed (avg. 13±8), supporting our hypothesis that BAT activation was greater after sleep loss as compared to HS. There were good correlations between BAT activation and various metabolic markers: SUVR_HIS and BMI (Pearson’s r=-0.85), SUVR_SR and insulin (r=-0.99), SUVR_SR and HOMA-IR (r=-0.98). It was noted that the subject who had least BAT activation had highest insulin, HOMA-IR and leptin levels, and worst RecS.

Conclusion: These ongoing results suggest that BAT activation may play an important role in maintaining a healthy metabolic state. Inadequate BAT function may increase the risk for obesity and diabetic disorders.

Support (If Any): NYUSoM and CUMC

I. Mechanisms of Sleep and Circadian Disorders

0008
IMPAIRED POST ILLUMINATION PUPIL RESPONSE IN INDIVIDUALS WITH DELAYED SLEEP WAKE PHASE DISORDER
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Introduction: Delayed sleep wake phase disorder (DSWPD) is characterized by a delayed sleep/wake cycle with respect to the external environment. Although it is the most commonly diagnosed circadian rhythm sleep wake disorder, its pathophysiology remains unclear. We tested the hypothesis that individuals with DSWPD have impaired phototransduction of their melanopsin containing intrinsically photosensitive retinal ganglion cells (ipRGCs) as measured by the post illumination pupil response (PIPR).

Methods: Twenty-one individuals with DSWPD and 18 controls were recruited for the study. Subjects were screened via an eye exam and medical/sleep history interview by a board certified sleep physician. Reported rest-activity patterns were confirmed through two weeks of actigraphy and sleep log data. Subjects then underwent testing consisting of 5 minutes of dark accommodation followed by 30 seconds of blue light stimulus and 120 seconds of post illumination pupillary diameter recording using a pupillometer. This process was repeated afterwards with a red light stimulus. The PIPR was calculated by subtracting post illumination pupil diameter from baseline pupil diameter. Statistical differences between groups were predicted using unpaired t-tests.

Results: Average sleep onset (3:36±0:26 (DSWPD) vs. 23:41 ± 0:41 (control)) and sleep offset (12:25±0:22 (DSWPD) vs. 7:45 ± 0:33 (control)) were significantly later in DSWPD subjects compared to controls. The PIPR to blue light was significantly smaller for DSWPD subjects compared with controls (0.97±0.18 mm vs. 2.12±0.26 mm, p<0.0005). There was no significant difference between groups when comparing the PIPR to red light (0.03±0.21 mm vs. 0.21±0.12 mm, p=0.46).

Conclusion: One function of ipRGCs is to transduce photic input to the suprachiasmatic nucleus to entrain intrinsic circadian rhythms to external light cues. The decreased blue light PIPR in DSWPD subjects suggests that impairment of ipRGC phototransduction may have a role in the pathophysiology of this disorder.

Support (If Any): American Sleep Medicine Foundation (award 155-JF-16) and the Northwestern Center for Circadian and Sleep Medicine.
0009  
RESTLESS LEG SYNDROME: DOES IT START WITH A GUT FEELING?  
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Introduction: Emerging research links gut microbial health with sleep. One common sleep disorder in which the microbiome may play a role is restless legs syndrome (RLS). While the pathogenesis of RLS is not fully understood, a relative state of brain iron deficiency has been described in patients with RLS and appears to induce changes in several pathways (adenosinergic, glutamatergic and dopaminergic) known to be involved in the disease. Insufficient iron may be secondary to dietary iron deficiency or, potentially, gut inflammation. We hypothesized that small intestinal bacterial overgrowth (SIBO), a condition associated with gut dysbiosis (i.e., normally rare gut-residing bacteria are over-represented in the gut), is associated with RLS and may moderate the observed inter-patient variability in serum iron availability.

Methods: Participants are being recruited at the Stanford Sleep Center for three groups: RLS and low peripheral iron stores (<50ng/mL and/or transferrin saturation <18%), RLS and normal peripheral iron stores, and insomnia (control). Participants complete questionnaires concerning sleep and SIBO symptoms and are sent home with a fecal collection kit (Fecal Swab Collection and Preservation System, Norgen Biotek) and a SIBO kit (SIBO Home Breath Test Kit, Quinton). Fecal samples are assayed by the University of Minnesota Genomics Center with microbial community profiling evaluated by 16S ribosomal RNA (16S rRNA) gene sequencing protocols. SIBO breath samples are evaluated by Aerodiagnostics for hydrogen and methane abnormalities.

Results: Seven participants diagnosed with RLS (3 men, 4 women) have thus far completed the protocol. All indicated poor sleep quality (PSQI ≥ 5) and moderate to severe symptoms of RLS (RLS scores ranging from 13 to 34/40). SIBO was present in all 7 participants (100%) whereas general population rates are estimated to be 6-15%. One common sleep disorder in which the microbiome may play a role is restless legs syndrome (RLS). While the pathogenesis of RLS is not fully understood, a relative state of brain iron deficiency has been described in patients with RLS and appears to induce changes in several pathways (adenosinergic, glutamatergic and dopaminergic) known to be involved in the disease. Insufficient iron may be secondary to dietary iron deficiency or, potentially, gut inflammation. We hypothesized that small intestinal bacterial overgrowth (SIBO), a condition associated with gut dysbiosis (i.e., normally rare gut-residing bacteria are over-represented in the gut), is associated with RLS and may moderate the observed inter-patient variability in serum iron availability.

Conclusion: These preliminary data suggest that SIBO may be more prevalent among patients with RLS. Additional analyses will examine fecal microbial composition, subtypes of RLS iron deficiency, and comparisons with insomnia.

Support (If Any): Pau Innovation Gift Fund Seed Grant

0010  
WHAT IS THE IDEAL BEDTIME? DATA FROM A COMMUNITY SAMPLE  
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Introduction: Advancing bedtime can decrease sleep efficiency, and the delay of bedtime may result in insufficient sleep. In pursuit of an empirically-supported, real-world bedtime recommendation, the present study examined community-level data on typical bedtime as it relates to sleep problems.

Methods: Data from our SHADES study were used for the present analysis, consisting of N=1,003 working-age adults age 22-60 in the Philadelphia area. Typical bedtime was assessed and compared to insomnia symptoms (Insomnia Severity Index [ISI]), self-reported typical sleep latency, typical wake after sleep onset, sleepiness (Epworth Sleepiness Scale [ESS]), PHQ9 depression scale, and GAD7 anxiety scale. Results were adjusted for age, sex, race/ethnicity, education, and body mass index.

Results: Distribution of bedtimes were as follows: ≤8pm (2.4%), 8-10pm (8.5%), 10-11pm (20.4%), 11pm-midnight (29.1%), 12-1am (17.8%), 1-2am (10.9%), and ≥2am (10.9%). Compared to 11pm-midnight, higher ISI scores were seen for ≤8pm (B=4.3, 95%CI[1.79,6.79], p=0.001), 1-2am (B=2.65, 95%CI[1.36,3.94], p<0.0005), and ≥2am (B=5.79, 95%CI[4.50,7.08], p<0.0005). Longer sleep latency was reported by those going to bed ≤8pm (B=14.38, p=0.03), 1-2am (B=8.48, p=0.01), and ≥2am (B=26.88, p<0.0005). Longer WASO was seen for ≤8pm (B=20.76, p=0.04) and ≥2am (B=20.94, p<0.0005). Higher ESS was seen for 1-2am (B=1.16, p=0.02) and ≥2am (B=2.27, p<0.0005). Higher PHQ9 was seen for ≤8pm (B=3.19, p=0.02), 1-2am (B=2.43, p<0.0005), and ≥2am (B=4.47, p<0.0005) and lower PHQ9 was seen for 10-11pm (B=-1.39, p=0.01). Finally, higher GAD7 was seen for 1-2am (B=1.64, p=0.009) and ≥2am (B=2.80, p=0.0005).

Lowess plots of continuous values show that the minimum value for ISI and other outcomes seems to occur around 11pm.

Conclusion: Overall, those who go to bed at a typical time generally have fewer problems than those who attempt to sleep outside of this window, and in particular those who go to bed close to 11pm have fewer sleep problems and better daytime function. More work examining how modifying bedtimes to promote sleep and daytime functioning is warranted.

Support (If Any): R01MD011600, R21ES022931

0011  
MODELING ENDOGENOUS AND EXOGENOUS SOURCES OF SLEEP TIMING VARIABILITY  
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Introduction: Sleep regularity is an important predictor of health. Understanding factors that promote irregular sleep patterns is therefore valuable for the design of sleep interventions. Mathematical models of human sleep/wake have shown how exogenous factors, including work schedules, impact sleep regularity. However, endogenous sources of variability in sleep timing - including self-selected bed times and difficulty initiating sleep (e.g., due to rumination) - have not been explored.

Methods: A previously validated mathematical model of human sleep/wake neurophysiology was extended to incorporate both exogenous and endogenous sources of sleep timing variability. The model is based on neurophysiological circuits in the brainstem and hypothalamus that regulate sleep/wake patterns, including the central circadian clock (suprachiasmatic nucleus) and its response to light. Exogenous factors were modeled as constraints on when sleep could occur, following a weekly pattern (5 work days, 2 free days). Endogenous factors were modeled as day-to-day variability in the threshold for sleep onset. The model generated sleep/wake patterns. To summarize model outputs, we used social jetlag, the sleep regularity index, and the standard deviations of sleep onset.
and offset. Sensitivity analysis was performed to simulate differences between early, intermediate, and late types.

**Results:** When exogenous factors were applied, the model reproduced empirical population-level patterns of sleep variability, including social jetlag. However, it did not reproduce typical intra-individual variability in sleep timing. When endogenous variability was also incorporated, the model reproduced empirical distributions of intra-individual sleep onset and sleep offset times. Excessive endogenous variability gave rise to sleep patterns that resembled insomnia and delayed sleep-wake phase disorder. Disordered sleep patterns arose more readily in late type simulations.

**Conclusion:** Simple rules in a mathematical model of sleep/wake patterns can recapitulate key features of human sleep behaviors, including typical variability in healthy individuals, as well as disordered sleep patterns.

**Support (If Any):** -

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**0012 MOLECULAR CORRELATES OF OPERATIONAL BLAST AND ASSOCIATED SLEEP DISTURBANCES**

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**Introduction:** Injuries from exposure to explosive blasts rose dramatically during Operation Iraqi Freedom and Operation Enduring Freedom. Over 80% of the traumatic brain injuries incurred in Iraq and Afghanistan are classified as mild, with sleep disturbances being one of the most commonly reported comorbid chronic symptoms. We have undertaken human studies involving military and law enforcement personnel involved in operational breaching where they are typically in close proximity to repeated low-level blasts. Sleep disturbances are also in the top three reported symptoms by these participants of operational training, motivating investigations of blast-related neurotrauma and associated sleep disturbances.

**Methods:** Although the data collected involves multiple operational breaching sites, here we present data from one site including 34 participants where blood samples are collected pre-post operational training. We performed genome-scale DNA methylation profiling using the Illumina Infinium HumanMethylation 450K BeadChip platform covering all coding genes and whole genome transcription profiling via RNA-seq.

**Results:** We examined at baseline (pre operational breaching) whether the number of accumulative blast exposure events during a career in military service is associated with changes in transcriptional regulation. We defined low exposure as those with ≤39 reported blast exposures and the high group with ≥40 blast exposures. We found differences in transcriptional regulation (differential DNA methylation) in the PAX8-AS1 gene promoter region which is an antisense transcript overlapping the paired box 8 (PAX8) gene. Recently, genome-wide association studies have implicated genetic variants associated with PAX8 and sleep duration.

**Conclusion:** These data are compelling in establishing the framework for studies of operational blast samples for identification of chronic biomarkers of blast-related TBI in relation to sleep disturbances, which will allow us to gain further insight into the molecular mechanisms underlying blast-related TBI and associated chronic sleep disturbances. These are crucially relevant in studies of sleep disturbances and mild TBI in our Veteran population.

**Support (If Any):** Research supported by CX001395 and RX001705.

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**0013 SLEEP PROBLEMS AND BINGE DRINKING AMONG URBAN MULTIRACIAL AND MONORACIAL YOUTH: ROLE OF DISCRIMINATION EXPERIENCES AND NEGATIVE MOOD**

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**Introduction:** Multiracial (versus monoracial) youth may be at increased risk for adverse health outcomes, including sleep problems and risky alcohol use. Theoretical frameworks (e.g., Integrative Temporal Model of Youth Sleep and Substance Problems; Edwards et al. 2015) posit that exposure to stressors induces emotional dysregulation, which in turn increases risk for both sleep problems and risky alcohol use in youth. This study examined a stressor-emotional dysregulation (i.e., discrimination experiences frequency and negative mood) pathway that may underlie racial disparities in concurrent sleep problems and binge drinking.

**Methods:** Cross-sectional data were drawn from an ongoing longitudinal study of adolescent health behaviors, Project Teen. Participants were 414 9th - 11th graders (mean age=15.39 years, SD=1.15, range=13-19), 57% female, 17% multiracial, 83% monoracial [41% Black, 22% White, 18% Asian, 2% Other] at an urban, socioeconomically-disadvantaged high school. Students completed a web-based survey assessing health behaviors and correlates, such as sleep problems, alcohol use, discrimination experiences, and negative mood.

**Results:** Insomnia symptom severity was positively correlated with discrimination experiences frequency and negative mood (r=.22-.38), but not binge drinking frequency (r=.08). Multirace (versus monorace) status was positively correlated with binge drinking frequency (r=.06), but not insomnia symptom severity (r=.02). Path analysis results demonstrated that the relationship of multirace (versus monorace) status with insomnia symptom severity was fully explained by an indirect effect of discrimination experiences frequency and in turn negative mood (95% bootstrapped CI=0.11, 0.56); also, multirace (versus monorace) status was directly and positively associated with binge drinking frequency (b=1.39, SE=0.63, IRR=4.00, p=.01) after accounting for the indirect effects.

**Conclusion:** Discrimination experiences frequency and negative mood may function as intermediate factors contributing to racial disparities in sleep problems (but not alcohol behaviors) among multiracial and monoracial adolescents. To our knowledge, no previous studies have tested this theory-based, multifinal risk pathway involving stressor exposure and emotional dysregulation underlying youth sleep and alcohol problems. Given the current cross-sectional design, replication with longitudinal data is a critical next step.

**Support (If Any):** NIAAA grant R15 AA022496 awarded to Aesoon Park.
0014
GENOME-WIDE ASSOCIATION STUDY OF SLEEP LATENCY IN DROSOPHILA MELANOGASTER
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Introduction: One of the hallmarks of insomnia in humans is difficulty initiating sleep. Sleep latency, the amount of time it takes to fall asleep initially, is one way to quantify this difficulty. Sleep latency can be easily measured in flies as the time to the fly’s first night sleep bout. In this study, we leveraged raw sleep and activity data from a previous genome-wide association study (GWAS) of Drosophila melanogaster. Our goal was to assess the extent of genetic variation in sleep latency in a wild-derived population of flies and to identify polymorphic variants explaining that variation.

Methods: Using the raw data, we calculated the average sleep latency over six days per fly in the Drosophila Genetic Reference Panel (DGRP). We associated 1,920,276 polymorphic variants with sleep latency in a mixed model that accounted for population structure, Wolbachia pipiens infection status, and the presence/absence of large chromosomal inversions.

Results: Sleep latencies averaged 41.4 minutes in the DGRP and ranged from 4.1 to 178.0 minutes. Genetic variation for sleep latency was relatively high; broad-sense heritability was H² = 0.443 for both sexes combined. We observed sex-specific effects for sleep latency; the cross-sex correlation was 0.656, with male sleep latency being somewhat higher on average than that of females. We found 855 polymorphisms significantly associated with sleep latency. Of these polymorphisms, 91 were significant for both sexes combined and were located ± 1000 bp of 67 candidate genes. We are currently confirming the predicted effects on sleep latency for 24 candidate genes using readily available knock-down insertions.

Conclusion: Sleep latency is highly variable among wild-type flies and heritable. GWAS results suggest that the genetic architecture of sleep latency is polygenic and maps to genes with roles in central nervous system development and morphogenesis.

Support (If Any): NA

0015
HOMEOSTATIC RESPONSE TO SLEEP DEPRIVATION IS SUPPRESSED IN THE EVENING IN DROSOPHILA
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Introduction: How the circadian and homeostatic drives for sleep and wake are integrated remains an open question. Some, but not all, clock gene mutants display altered homeostatic responses. But it is unclear if this is due to their role in the circadian clock or not. To address this question, we used the fruit fly Drosophila melanogaster which exhibits conserved circadian clock and homeostatic regulation of sleep as well as conserved core clock mechanisms. Here we sleep deprived flies at different times of day and assessed the rebound increase in subsequent sleep.

Methods: Sleep and activity measurements were assayed using the Drosophila activity monitoring (DAM) system. Sleep deprivation (SD) was mechanically induced using a vortexer at 7 h intervals with 2.5h of SD followed by 4.5h of baseline, allowing rebound. 24 cycles of SD during a normal 12 h light:12 h dark condition will administer SD at each hour of the diurnal day. To calculate rebound sleep, sleep during a 4.5 h pre-deprivation baseline period at the same time of day was subtracted from the post-deprivation rebound period.

Results: Under standard LD conditions, wild-type (WT) flies display a time dependent change in rebound sleep where more rebound sleep is associated with times of less baseline sleep. One exception to this is during the evening bout of wakefulness where rebound sleep is suppressed. This pattern is evident in constant darkness (DD), abolished in arrhythmic pero mutants in DD, and is phase advanced in the short period mutant perp in LD conditions, indicating that the suppression of rebound sleep is clock regulated. While sleep latency is generally reduced after sleep deprivation, sleep latency is also elevated in the evening relative to morning.

Conclusion: The circadian clock selectively suppresses the sleep rebound response to SD during the evening phase, suggesting the involvement of evening cells in modulating the homeostat or the behavioral response to the homeostat. Future studies aim to understand the circuits which link clock neurons that govern evening wake behavior to those regulating sleep homeostasis.

Support (If Any): NA

0016
AUTOIMMUNITY TO HYPOCRETIN AND MOLECULAR MIMICRY TO FLU IN TYPE 1 NARCOLEPSY
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Introduction: Type 1 narcolepsy (T1N) is caused by hypocretin/orxexin (HCRT) neuronal loss. Association with the Human Leukocyte Antigen DQB1*06:02/DQA1*01:02 (98% vs 25%) heterodimer (DQ0602), T cell receptor (TCR) and other immune loci suggests autoimmunity but autoantigen(s) are unknown. Onset is seasonal and associated with influenza A, notably pandemic 2009 H1N1 (pH1N1) infection and vaccination (Pandemrix®).

Methods: Peptides derived from HCRT and influenza A including pH1N1 were screened for DQ0602 binding and presence of cognate DQ0602 tetramer-peptide specific CD4+ T cells tested in 35 T1N cases and 22 DQ0602 controls.Tetramer-reactive CD4+ T cells from 14-20 subjects were FACS single sorted and their T cell receptor (TCRαβ) sequenced in control and T1N patients.

Results: Higher reactivity to influenza pH1A271-287 (pH1N1 specific), PR8 (H1N1 pre-2009 and H2N2)-specific NP17-31, and C-amidated but not native version of HCRT54-66 and HCRT56-67 (HCRTNH2) were observed in T1N. Single cell TCR sequencing revealed sharing of CDR3β TRBV2-4 CASSQETQGRNYTF in HCRTNH2 and pHA273-287-tetramers, suggesting molecular mimicry. This public CDR3β uses TRBV4-2, a segment modulated by T1N-associated Single Nucleotide Polymorphism (SNP) rs1008599, suggesting causality. TCRαβ CDR3 motifs of HCRT54-66-NH2 and HCRT56-67-NH2 tetramers were extensively shared notably public CDR3α, TRAV2-CAVETDSWKGLQF-TRAJ24, that uses
TRAJ24, a chain modulated by T1N-associated SNPs rs1154155 and rs1483979. TCRβ CDR3 sequences found in pHA235-247, NF7,17,31 and HCR2_7,18 tetramer positive CD4+ cells were also retrieved in single IFNγ-secreting CD4+ sorted cells stimulated with Pandemrix©, independently confirming these results.

**Conclusion:** Our results provide evidence for autoimmune and molecular mimicry with flu antigens modulated by genetic components in the pathophysiology of T1N.

**Support (If Any):** https://www.pnas.org/content/early/2018/12/11/1818150116

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**0017**

**MULTIPLE TYPES OF PATHOGEN-ASSOCIATED MOLECULAR PATTERNS ACTIVATE DIFFERENT TYPES OF INFLAMMASOMES THROUGH CASPASE-1 TO ALTER SLEEP AND SLOW-WAVE ACTIVITY**

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**Introduction:** Inflammasomes are protein complexes that are activated by specific pathogen-associated molecular patterns (PAMPs) through corresponding pattern recognition receptors (PRRs) that stimulate caspase-1 to activate interleukin (IL)-beta (IL-1β) and IL-18 into their mature forms. Multiple inflammasomes exist that are activated by unique stimuli. The nucleotide-binding domain leucine-rich family pyrin containing 3 (NLRP3) inflammasome is activated by lipopolysaccharide (LPS) through toll-like receptor 4, NLRP1 is activated by muramyl dipeptide (MDP) through the nucleotide-binding oligomerization domain-containing protein-2 receptor, and retinoic acid-inducible gene-1 (RIGI) is activated by double-stranded DNA including the synthetic deoxythymidylic acid sodium salt (poly dA:dT) through RIG-I-like receptor.

NLRP3 inflammasomes are activated by sleep loss and LPS to enhance non-rapid eye movement (NREM) sleep and slow-wave activity (SWA). We determined if additional PAMPS and inflammasomes are involved in modulating sleep.

**Methods:** Caspase-1 knockout (KO) mice and wild-type (WT) controls were given LPS, MDP, poly dA:dT or the vehicle intracerebroventricularly. Sleep architecture was analyzed by polysomnography. Inflammasome-related markers including NLRP3, NLRP1, RIG-I, caspase-1, IL-1β, and IL-18 were determined in somatosensory cortices by real-time polymerase chain reaction analysis. Significance was set at p < 0.05.

**Results:** LPS, MDP, and poly (dA:dT) significantly enhanced NREM sleep and SWA in WT mice. However, LPS, MDP, and poly (dA:dT) did not significantly alter sleep states or SWA in caspase-1 KO mice. In the somatosensory cortex, LPS enhanced the expression of NLRP3, caspase-1, IL-1β, and IL-18 but not NLRP1 or RIG-I in WT mice. Additionally, MDP enhanced the expression of NLRP1, caspase-1, IL-1β, and IL-18 but not NLRP3 or RIG-I in WT mice. Poly (dA:dT) enhanced the expression of RIG-I, caspase-1, IL-1β, and IL-18 but not NLRP3 or NLRP1 in WT mice. Caspase-1 KO mice showed similar enhancements in gene expression of upstream inflammasome components with the corresponding stimuli but not for IL-1β or IL-18.

**Conclusion:** Our findings suggest that multiple types of inflammasomes modulate sleep by the activation of their specific corresponding PAMPs and PRRs.

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**0018**

**REV-REBA-MIR122 AXIS ACTIVATION MEDIATES SLEEP DEPRIVATION-INDUCED HEPATIC INFLAMMATION BY ENHANCING HMGB1 EXPRESSION**

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**Introduction:** Health consequences of sleep loss or insufficient sleep have been proved to be associated with increased inflammation, which is considered as a risk factor for various diseases, including cardiovascular, metabolic, neurodegenerative diseases and cancer. However, the inflammation occurred in targeted or injured tissues after sleep loss has not been fully revealed. High-mobility group box 1 (HMGB1) plays a critical role in triggering and sustaining inflammatory responses by inducing cytokine releasing and recruiting leucocytes. The aim of this study is to address whether sleep deprivation (SD) could induce hepatic HMGB1 upregulation and the underlying mechanism involved.

**Methods:** Samples of rat liver, blood and urine were collected after 48 h of SD. The expression levels of HMGB1, REV-ERBα and miR-122 were determined by ELISA, PCR and western blot assays. Binding sites of miR-122 within HMGB1-3’UTR were identified by luciferase reporter assay.

**Results:** SD induced increasing of HMGB1 expression in the rat liver, serum and urine. Interestingly, liver HMGB1 upregulation was only observed at the protein levels, while HMGB1 mRNA levels remained stable under the same conditions. Then, two miR-122 binding sites were identified within the 3'-UTR region of HMGB1. And the liver miR-122 expression levels were significantly decreased after SD. Furthermore, HMGB1 protein expression levels dramatically decreased in miR-122 by siRNA-transfected cells and significantly increased in miR-122 inhibitors-transfected cells compared with those in the control cells. Besides, SD inhibited the expression of central clock gene, REV-ERBα, in the liver. Knockdown of REV-ERBα expression significantly decreased miR-122 expression and increased HMGB1 expression.

**Conclusion:** Down regulation of liver REV-ERBα and miR-122 is involved in local HMGB1 upregulation induced by SD. In addition, HMGB1 might function as potential biomarker for indicating the hepatic inflammatory responses induced by SD.

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**0019**

**IDENTIFYING THE TARGETS OF ESTRADIOL IN HUVECS EXPOSED TO INTERMITTENT HYPOXIA: THE POSSIBLE INVOLVEMENT OF ATMi-CAp PATHWAY**

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**Introduction:** Chronic intermittent hypoxia (CIH) contributes to the increased risk of cardiovascular diseases in obstructive sleep apnea (OSA) through inducing oxidative stress and increasing endothelial cell apoptosis. We previously reported anti-oxidant and anti-apoptotic effects of estradiol (E2) on IH-exposed human umbilical vein endothelial cells (HUVECs). In this study, we employed a proteomic analysis to elucidate the molecular mechanisms of protective effects of estradiol under IH exposure.

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Methods: HUVECs were divided into the four groups: control, IH, IH+E2 (cells were exposed to IH with 17β-estradiol treatment), and IH+si-Tnixip (thioredoxin-interacting protein-knock-down cells were exposed to IH) group. Then, isotopic tags for relative and absolute quantification (iTRAQ) was performed to compare protein profiles among the groups.

Results: A total of 185 proteins changed significantly in IH+E2 compared to IH group. Bioinformatics analysis indicated that the effect of estradiol may be linked to the regulation of cellular stress response. We further identified that serine-protein kinase ataxia telangiectasia mutated (ATM), and its downstream target cellular inhibitor of apoptosis protein (cIAP) were up-regulated by E2. Since thioredoxin/thioredoxin-interacting protein (Trx1/Tnixip) pathway is involved in the effect of E2 on IH-exposed HUVECs, we also compared the protein expression profiles between IH+si-Tnixip and IH group. We identified that 15 proteins, including ATM, changed significantly in both IH+E2 and IH+si-Tnixip group compared to IH group.

Conclusion: These results indicated that estradiol may protect against oxidative stress and endothelial apoptosis through promoting ATM and c-IAPs expressions under IH exposure. This effect of estradiol may involve its regulation of Trxl/Tnixip pathway. The findings may provide valuable clues for exploring the target(s) for prevention and treatment of the cardiovascular complication in OSA patients.

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0020
EVALUATING GENETIC VARIATION AS A POSSIBLE METHOD FOR INCREASING SURVEILLANCE AND MANAGING RISK OF DEVELOPING OBSTRUCTIVE SLEEP APNEA
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Introduction: Obstructive sleep apnea (OSA) has been increasing within the Air Force, with a slight trend appearing to level off more recently. Untreated, OSA’s detrimental effects harm the Airman and jeopardize military operations, placing both human and materiel assets at risk. Current practice within the Air Force sleep standard of care is to evaluate a patient for OSA after appearance of symptoms and after referral from a primary care manager (PCM). When recommending sleep studies, PCMs consider many social, physiological, and environmental risk factors including age, race, obesity, and marital status. As symptoms occur at random, including during flight operations, and that lack of sleep can severely decrease aircrew alertness, we considered options for developing a proactive approach to OSA management, specifically intending to show utility in developing a genetic risk screen to provide PCMs.

Methods: We evaluated five genetic markers associated with OSA in civilian populations for confirmation within a military cohort of 34 members. Using minimally invasive cheek swabs and commercially available PCR assays, we were able to rapidly genotype subjects for all markers in less than 2 hours post-collection, at less than $10 per subject.

Results: The results of our pilot study suggest that there may be a significant relationship between genetic predisposition and risk of OSA. We found that the diagnosis of OSA showed a significant dependence with three of the five polymorphisms tested. We also found that we could create a genotype score that resulted in accurately predicting 81% of the subjects, with a diagnostic odds ratio of 6.3 and a number needed to misdiagnose of 5.2.

Conclusion: Evaluating new military accessions could increase force readiness by identifying indicators of sleep apnea during annual preventive check-ups for aviators and enablers, thereby mitigating the potential detrimental sequelae of sleep apnea. Further studies increasing the subject numbers and controlling for other known risk factors are necessary before determining a tool’s utility in aeromedical screening.

Support (If Any): Funding was provided by an intramural award to RRC.

II. Cell and Molecular Biology and Genetics

0021
LOWER OXYGEN SATURATION DURING SLEEP IS ASSOCIATED WITH REDUCED EXPRESSIONS OF CD1D AND RAB20 THAT IS POTENTIALLY REVERSED BY CPAP THERAPY
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Introduction: Obstructive Sleep Apnea (OSA) is associated with a wide range of physiological changes, many of which are secondary to overnight hypoxemia. Prior associations studies of OSA and gene expression in blood were performed in small, clinic based samples. Here we study OSA and hypoxemia-related gene expression associations in large population-based studies, and in a small sample of individuals with OSA before and after treatment using continuous positive airway pressure (CPAP) who participated in the Heart Biomarkers in Apnea Treatment Study (HeartBEAT).

Methods: We performed discovery analysis in two population-based studies: the Multi-Ethnic Study of Atherosclerosis (MESA; N = 580), and the Framingham Heart Study (FHS; N=571). We studied the association of gene expression in blood with three correlated traits that characterize the severity of OSA: the Apnea Hypopnea Index (AHI), defined as the number of apnea and hypopnea events accompanied by oxygen desaturation of at least 3% experienced per hour of sleep; average oxygen saturation (AveO2); and minimum oxygen saturation (minO2) during sleep. Associations with FDR q-value<0.05 in one study and p-value<0.05 in the other study, or with FDR q-value<0.05 in a meta-analysis of FHS and MESA, were then tested for gene expression change in the blood of 15 participants from the HeartBEAT study who had moderate or severe OSA and were studied before and after three months of treatment with CPAP.
**A. Basic and Translational Sleep Science**

**Results:** We identified 22 genes associated with OSA traits in both MESA and FHS, with most associations observed in AveO2 and minO2. Two of these genes further showed evidence of change with treatment in HeartBEAT: Lower CD1D and RAB20 expressions were associated with lower AveO2 in MESA and FHS, and CPAP therapy increased their expression in HeartBEAT.

**Conclusion:** Gene expressions in CD1D and RAB20 were associated with OSA traits and appear to respond to CPAP therapy. CD1D encodes the CD1d antigen, and is associated with autoimmune diseases; RAB20 is a GTPase enzyme which is a Hypoxia-inducible transcription factor (HIF) target.

**Support (If Any):** R35 HL135818.

**0022 PROSPECTIVE ASSESSMENT OF SLEEP AND EPIGENETIC AGING: PRELIMINARY FINDINGS**

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**Introduction:** DNA methylation is affected by the environment and provides an index of biological (epigenetic) age. Factors associated with poor health (e.g., smoking, inactivity) accelerate epigenetic aging. We hypothesize that shorter and irregular sleep impact epigenetic age.

**Methods:** Twelve women (chronological ages 18.2 to 19.8 y) were selected as shorter or longer sleepers (extreme quintiles) from 503 first-semester college students with daily sleep diary across 9. Sleep Regularity Index (SRI) was computed from diary data. Participants gave blood samples at study start and end. DNA methylation ages were determined at each time from Infinium HumanMethylation450 (Illumina, San Diego) arrays corrected for cell type; epigenetic ages were computed using Horvath’s method. Chronological ages were subtracted from epigenetic ages at each time to compute age-difference.

**Results:** Epigenetic ages at Time1 ranged from 15.8 to 26.3 y (mean=20.8[SD=3.3]); epigenetic ages computed from Time2 ranged from 16 to 25.9 y (20.1[3.2]). Mean age-difference at Time1 was 2.1[3.3]y and 1.2[3.4] at Time2. Participants were grouped using median splits for TST (median=7.19) and SRI (median=76.44), resulting in three groups: Good Sleep (TST and SRI above median; TST=8.0[0.1]; SRI=80.6[3.1]), Mixed Sleep (either TST or SRI above median; TST=6.9[1.6]; SRI=74.8[9.6]), and Poor Sleep (both TST and SRI below median; TST=6.1[0.4]; SRI=65.8[9.9]). Epigenetic aging patterns were consistent with hypotheses: Good Sleep group decreased age-difference across time; Mixed Sleep group showed inconsistent patterns; Poor Sleep group increased age-difference. One-way ANOVA showed statistically significant differences in group patterns (F(2.9)=5.58, p=.03); Group Marginal Mean Estimate[95%CI]; Good Sleep=-4.06[-7.24,-0.88]; Mixed Sleep=-1.10(-4.28,2.08); Poor Sleep=2.57[-0.61,5.75].

**Conclusion:** Poorer sleep was associated with epigenetic aging acceleration in all Poor Sleep participants; better sleep was associated with decelerated epigenetic aging in three of four Good Sleep participants. More work is needed to confirm findings in a larger sample, determine mechanism, and assess epigenetic aging in clinical sleep patients.

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**0023 EFFECTS OF GENOTYPE AND TRAUMA EXPOSURE ON COMMON SUBJECTIVE SLEEP MEASURES IN HEALTHY YOUNG ADULTS**

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**Introduction:** While poor sleep is common and both genetic (G) and environmental (E; e.g., trauma exposure) factors influence its etiology, there has been minimal success in identifying specific genetic contributions. Examination of individual differences in the sleep quality of healthy individuals represents an approach that can provide insight into both risk and resilience for poor sleep, which in turn may influence the development of other physical and mental health conditions.

**Methods:** Participants with available genetic data (N=168, 54% female, 71% European ancestry, mean age 23.8) were taken from an existing study investigating the effect of sleep loss on neural responses to threat and reward cues. Individuals with current psychiatric or sleep disorders were excluded. Sleep measures included sleep quality (Pittsburgh Sleep Quality Index [PSQI]) and daytime sleepiness (Epworth Sleepiness Scale [ESS]). Trauma exposure was assessed utilizing a variant of the Trauma History Questionnaire. Hierarchical linear regression analyses were conducted to examine main genetic and GxE effects on sleep as follows, using a Bonferroni-adjusted p=0.025: demographics (Step 1), genotype (BDNF [Val/Met], SLC6A4 [HTTLPR], or PER3 [VNTR]; Step 2), GxE and main effects of childhood trauma exposure (Step 3), and adult trauma exposure (Step 4).

**Results:** Regression analyses demonstrated a significant main effect of BDNF genotype (Val/Val vs. Met carriers) on PSQI global score (β=-0.20, p=0.02; model R²=5.4%), in addition to a significant GxE effect with childhood trauma (β=0.53, p=0.00; model R²=11.1%). Results were robust to inclusion of adult trauma and sensitivity analyses restricting to European ancestry. In contrast, there were no significant main genetic or GxE effects of SLC6A4 or PER3 polymorphisms on PSQI global scores, and no significant associations between any polymorphism and ESS scores.

**Conclusion:** These results add to the small body of literature implicating BDNF genetic variation in sleep phenotypes. We provide evidence for a role of BDNF in inter-individual variation in sleep quality, demonstrating that while the Val/Val genotype is associated with better sleep quality, its interaction with childhood trauma exposure results in worse subjective sleep.

**Support (If Any):** MOMRP LOG#11293006 (Germain)

**0024 GENOME-WIDE ASSOCIATION STUDY REVEALS TWO NOVEL RISK ALLELES FOR INCIDENT OBSTRUCTIVE SLEEP APNEA IN THE EPISONO COHORT**

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**Introduction:** No major genetic association studies have found replicable results for obstructive sleep apnea (OSA) in adults in the past. A recent genome-wide association study (GWAS) in the Episono cohort identified eight genetic loci (p=3.16×10⁻⁵) with genome-wide significant association for OSA; however, the replicated association with the same allele at the 5q.22 locus (p=2.63×10⁻⁵) was not confirmed in a recent meta-analysis of three independent GWAS studies.

**Methods:** This study presents the first genome-wide association study (GWAS) for OSA in the Episono cohort and identifies novel loci at 1p.44 and 10q.21 associated with OSA (p=3.17×10⁻⁵ and 4.92×10⁻⁵, respectively). These loci are associated with putative and likely causal variants in the loci associated with OSA. These results provide new insights into the genetic architecture of OSA and highlight novel potential targets for the development of novel therapeutic approaches.

**Conclusion:** Future studies should focus on replicating these novel loci in independent cohorts to confirm their association with OSA and to explore their potential role in the pathogenesis of OSA.
**Introduction:** Obstructive sleep apnea (OSA) is a sleep-related breathing disorder that has a complex phenotype. Currently, few genes have been linked with OSA in cross-sectional studies. Thus, the aim of this study was to conduct a genome-wide association study (GWAS) of the apnea-hypopnea index (AHI) variation along time in a prospective cohort, and to correlate its possible alleles frequencies with the development of new cases of OSA.

**Methods:** We used data derived from EPISONO follow-up cohort. Our phenotype of interest was delta-AHI and incident OSA. DNA was genotyped for 730,525 SNPs. Our final GWAS model used delta-AHI as a dependent variable and the SNPs and covariates as independent variables. We also performed a gene-set and pathway analysis using Magma software.

**Results:** We found 2 significant and 23 suggestive loci associated with delta-AHI. The strongest association (rs12415421, (SE)=0.2782 (0.04932), p=3.36×10⁻⁸) was observed at ST8SIA6 gene and with delta-AHI. The strongest association (rs12415421, (SE)=0.2799 (0.05009) mins/allele, p=4.4×10⁻¹⁰) was in an intergenic region in linkage disequilibrium with our third hit (rs12669165, (SE)=0.2782 (0.04932), p=3.36×10⁻⁸) in the ASB15 gene. We found an independent effect of the allele rs11245421 for the incidence of OSA (OR=5.1, CI=1.7-15.4, p=0.004). Additionally, we found that individuals with both risk alleles presented a higher incidence of OSA when compared to those with one (OR=17.3, CI=1.4-216.7, p=0.027) or without any risk alleles (OR=20.1, CI=1.7-232.7, p=0.016).

**Conclusion:** In conclusion, this study found two novel genomic regions significantly associated with the increase in AHI that seem to be involved in the growth and stability of the muscle and bone; and the allele frequencies of these SNPs were independent risk factors for the incidence of OSA in the EPISONO longitudinal cohort.

**Support (If Any):** This work was supported by grants from AFIP, FAPESP and CAPES.

### 0025

**GENE-BASED ANALYSIS OF IRON RELATED PATHWAYS ASSOCIATED WITH SLEEP-DISORDERED BREATHING IN TRANSONICS IN PRECISION MEDICINE (TOPMED)**

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**Introduction:** Although OSA is heritable, few significant genetic associations have been observed in genome-wide association analyses largely because of limited power. Recent research suggest a novel role of iron metabolism in the pathophysiology of OSA, including metabolic and inflammatory pathways as well as ventilatory control mechanisms involving carotid body respiratory chemoreceptors. We aim to further study the underlying genetics linking iron metabolism pathways and OSA using deep sequencing data collected by NHLBI Trans-Omics for Precision Medicine (TOPMed) program.

**Methods:** We focused on 72 genes from three iron/heme-related pathways (heme metabolism process, iron ion homeostasis, and cellular iron ion homeostasis), and performed gene-based association analyses with four OSA-related phenotypes (apnea hypopnea index [AHI], average and minimum oxygen saturation during sleep, and percentage sleep time with oxygen saturation <90%) in 8,021 individuals of multi-ancestry from 7 cohorts. OSA phenotypes were rank normalized and adjusted for age, sex, BMI, smoking, ancestry, and relatedness. Secondary analyses were performed in specific for each ancestry group. The significance level was P<0.0007 after correcting for multiple comparisons.

**Results:** The overall sample was 58 years old and included 56% women with a median AHI of 7.4. Primary multi-ancestry analysis identified that AHI was significantly (P=5.02×10⁻⁴) associated with an aggregate effect of functional variants in the enhancer region of BTF4D9, a gene previously associated with restless leg syndrome and circadian rhythm. Gene-based analysis using variants at gene enhancer regions demonstrated stronger associations than using variants at gene coding regions, which may reflect regulatory role of gene enhancers. Secondary ancestry stratified analyses additionally identified significant associations in CYBRD1, SOD1, and TFR2. Suggestive evidence was observed in multiple iron-related genes, including the previous identified FECH.

**Conclusion:** This study supports the important role of iron/heme-related pathway in OSA independent of obesity and smoking. In next step, we will incorporate gene expression data from TOPMed to further understand the biological mechanisms behind the genetic associations.

**Support (If Any):** Sleep Research Society Foundation (SRSF) Career Development Award 018-JP-18 (HW) and NIH grants R01HL113338 (SR), R35 HL135818 (SR).

### 0026

**GWAS OF NIGHTMARES DISCOVERS GENETIC RISK VARIANTS AND SHOWS STRONG OVERLAPPING RISK FOR SLEEP AND PSYCHIATRIC DISORDERS**

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**Introduction:** Nightmares are dreams that can inflict intense fear, sadness or anxiety. However, the biological mechanisms underlying nightmares have remained unexplored.

**Methods:** To address this question, we examined the genetics of nightmares in over 30,000 individuals from three independent cohorts.

**Results:** We describe genetic loci associated with nightmares in PTPR7 (rs11039471, p=3.7e⁻⁸) - a gene previously associated with sleep duration. In further adjusted analysis we found an additional association intronic to MYOF (rs701873, p=2.18e⁻⁸). Furthermore, we describe a striking genetic correlation in the frequency of nightmares and psychiatric and sleep disorders; major depressive disorder (rg=0.68, p=7e⁻⁴), neuroticism (0.61, p<1e⁻⁴), schizophrenia (rg=0.23, p=0.02) and insomnia (rg=0.38, p=0.003). Furthermore, partitioned heritability showed enrichment in the developing brain (p=0.03).

**Conclusion:** Together these findings are the first evidence showing individual genetic associations in nightmares and the role of nightmares in disease predisposition. Finally, the findings show that nightmares are an integral part of neuropsychiatric and sleep problems.

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0027
ADOLESCENT SLEEP TIMING AND DIETARY PATTERNS IN RELATION TO DNA METHYLATION OF CORE CLOCK GENES
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Introduction: Mistimed sleep/wake and eating patterns put adult shift workers at increased risk for chronic disease, and epigenetic modification of core clock genes has been proposed as a mechanism. Although not as extreme as shift workers, adolescents often have delayed sleep timing. Our aim was to assess whether sleep midpoints in adolescents are associated with DNA methylation of circadian genes. A secondary aim was to examine associations between dietary patterns and circadian gene methylation.

Methods: The study population included 142 Mexican youth (average age 14.0 (SD=2.0) years, 49% male) enrolled in a cohort study. Average sleep midpoint (between bed time and wake time) over 7 days was estimated with actigraphy. Diet was assessed with a semi-quantitative food frequency questionnaire, and three dietary patterns were derived from principal components analysis (a vegetable-based pattern, a meat and starch-based pattern, and a breakfast pattern). DNA methylation was quantified in blood leukocytes with the Infinium MethylatinEPIC BeadChip. We selected 166 loci (CpG sites) within CpG islands of core ‘clock’ genes known to regulate circadian rhythms (CLOCK, BMAL, PER1, PER2, PER3, CRY1, CRY2, RORA, RORB, REV-VERBA, REV-VERBB). Linear regression was used to analyze associations between sleep midpoint or dietary patterns and logit-transformed percent methylation at the 166 CpG sites. All models were adjusted for sex and age.

Results: The average midpoint was 3:41 AM (SD=1 hr 15 min); average bed time was 11:29 PM (SD=68 min) and average wake time was 7:53 AM (SD=97 min). Sleep midpoint was positively associated with DNA methylation of CRY1 (P=0.003). The breakfast dietary pattern (rich in eggs, milk, and bread) was inversely associated with DNA methylation at ROR1 (P=0.003).

Conclusion: Sleep timing and dietary habits are associated with DNA methylation of core clock genes in adolescents. Epigenetic modification of clock genes could in part underlie relationships between sleep, diet, and metabolic health among adolescents.

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0028
SIK-HDAC4 SIGNALING IS REQUIRED FOR THE METABOLIC REGULATION OF SLEEP
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Introduction: Sleep is intricately connected with metabolism, and reciprocal interactions between sleep and metabolic processes underlie a number of clinical pathologies. Yet, mechanisms underlying integration of sleep and energy homeostasis are largely unknown. The simplicity of the nematode Caenorhabditis elegans along with powerful experimental tools available in this system offer an opportunity to decipher these mechanisms.

Methods: C. elegans sleep behavior was measured using the WorMotel (Churgin et al, Elife 2017). Total body ATP levels were measured using a luminometer-based ATP determination kit (ThermoFisher). Total body phosphoAMPK levels were measured by Western blotting using a panAMPK specific antibody. Fat stores were assessed using fixative Oil Red O, fixative Nile Red, a triglyceride assay kit (Biovision), and by assessing lipid droplet morphology and number. Standard recombinant DNA methods were used to generate plasmids, which were injected into worms to generate transgenic animals.

Results: Mutants lacking KIN-29, the C. elegans homolog of a mammalian Salt-Inducible Kinase (SIK) that signals sleep pressure, have defective sleep. They also have low cellular ATP levels despite high fat stores, indicating a defect in responding to cellular energy deficits. Liberating energy stores by overexpressing a lipase gene corrects adiposity and behavioral defects of kin-29 mutants. kin-29 acts in sensory neurons upstream of central sleep-controlling neurons. Removing the histone deacetylase hda-4 corrects the kin-29 mutant’s sleep defects, suggesting that KIN-29 acts via HDA-4 to regulate sleep.

Conclusion: We propose that KIN-29/SIK transduces low cellular energy charge into the mobilization of energy stores from adipocytes, which in turn promotes sleep. SIKs are therefore key nodes integrating sleep and energy homeostasis.

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continuous wakefulness in mice. This is accomplished through hooking mice in a continuous state of arousal accompanied by repetitive food intake providing evidence that the hypothalamic BSX network is able to regulate cortical activity dependent on the metabolic demand of the body. We further demonstrate that BSX function is necessary for BSX neuronal network integrity and prolonged wakefulness and food foraging. We will present the molecular and functional characterization of the neuronal identity that constitute the BSX neuronal circuitry.

Conclusion: Our findings nicely illustrate why BSX harbors the most highly conserved homeodomain throughout the animal kingdom as its activity is required to establish a neural circuit that is essential to balance wakefulness and sleep dependent on the metabolic state.

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ABNORMAL ENERGY METABOLISM PERSISTS AFTER REMOVAL OF CHRONIC RESISTIVE LOADING IN RATS
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Introduction: Obstructive sleep-disordered breathing (SDB) in rats leads to a substantial cascade of complex endocrine derangements that affect longitudinal growth, body weight, energy metabolism, and decreased body temperature (Tb). During upper airway obstruction (AO) the respiratory system undergoes adaptive changes in order to maintain respiratory homeostasis. Here, we investigated the effects of AO obstruction removal (OR) on energy cost and thermogenic capacity required to maintain respiratory homeostasis.

Methods: The tracheae of 22-day-old rats were narrowed; on day 14 the AO group was randomized and OR was surgically performed on half of the animals. Animals were monitored for 7 weeks; energy expenditure (EE), ventilation, and Tb were measured by metabolic system, plethysmography, and telemetry system, respectively. Brown adipose tissue (BAT) recruitment was performed following norepinephrine injection. Temperature-dependent changes in EE were tested by modified Scholander procedure, and BAT uncoupling protein 1 (UCP1) level was analyzed.

Results: Energy expenditure (EE) increased by 45% and 15% in the AO and OR groups, respectively (p<0.001). Increased EE was related to increased CO2 production and O2 consumption (p<0.001) in AO/OR groups. The OR group had 15% elevation of resting EE despite similar to control trachea diameter. The increased metabolism in AO and OR was accompanied by 72% and 40% up-regulation of ventilation, respectively (p<0.001), to maintain normal arterial blood gases. Tb decreased by 0.75°C (p<0.01) and was normalized in AO and OR groups, respectively. AO animals cannot maintain a thermal neutrality zone, i.e., EE was similar at all ambient temperatures, and normalized in the OR group. UCP1 level decreased by 28% (p<0.01) and was not different from that of controls in AO and OR groups, respectively. AO animals had poor EE response following norepinephrine administration that tended to normalize in the OR group.

Conclusion: The need to maintain respiratory homeostasis in AO animals is associated with abnormal energy metabolism and thermogenic capacity. This abnormality may lead to persistent endocrine derangements affecting sleep and energy metabolism, commonly observed following removal of upper airway obstruction.

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beginning at lights-on. Mice subjected to sleep deprivation were then restrained (canonial tube method) or gently handled for 1 h (n=9 - 11 per group).

Results: Through a proteomic screen of brain tissue (cortex) and plasma subjected to bioinformatics analyses, we found two key patterns of hits supporting the muscle-brain axis of sleep regulation. In both cases, the peak analyses for significance was set at > 60. First, there was a significant difference in PLMN (plasminogen) expression between mice sleep deprived for 1 h vs 24 h. Recent evidence has found sub-cellular localization of a plasminogen factor in the SCN circadian clock that is necessary and sufficient for photic phase re-setting (Hunley et al. 2015). Second, we found a significant hit for a muscle function protein (COL5a1) in only brain and not plasma of sleep-deprived mice that were restrained. COL5a1 is a genetic determinant of Ehlers-Paulos syndrome - chronic pain in joints and muscle (Pabalan et al. 2018). Chronic fatigue is a symptom of EDS (Hakim et al. 2017).

Conclusion: To conclude, our proteomic screen has further narrowed down a putative mechanism of action for the ability of skeletal muscle to regulate sleep processes.

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0033 SLEEP DISRUPTION DOES NOT MODIFY SODIUM INTAKE AMONG RATS FED A CAFETERIA-STYLE DIET

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Introduction: Hypertension is a modifiable risk factor for cardiovascular disease. Sleep disruption (SD) and high sodium diets increase hypertension. We determined if SD increased sodium intake, preference for high sodium foods and if sex modified this effect when rats were fed a cafeteria-style diet (CAF-D). Since SD increases calorie intake and weight gain, we hypothesized that SD would increase sodium intake and preference for high sodium foods equally in males and female rats.

Methods: After verifying normal estrous cycles for 9d, Sprague-Dawley rats (n=8 male and n=20 female) were randomized by bodyweight and sex to sleep undisturbed or SD due to environmental noise exposure during the light cycle (8h/d) for 16d. All rats were fed a CAF-D (rotating selection of 12 sweet and 12 savory human foods) and rodent chow ad libitum. Calorie intake, weight gain and estrous cycle phases were determined daily. The ratio of calories (sweet:savory) from CAF-D foods was used as an indicator of preference.

Results: Prior to treatment, males gained significantly more weight than females. Undisturbed females gained significantly more weight (% of initial bodyweight) compared to undisturbed males but sleep disrupted males and females had similar weight gain. SD significantly increased CAF-D calorie intake in males only. Regardless of treatment, males and females had a significantly higher preference for sweet than savory foods. Treatment did not affect sodium intake but sleep disrupted males consumed significantly more sodium than females. Sleep disturbed males ate significantly more calories from savory foods than undisturbed males.

Conclusion: SD failed to increase CAF-D intake in females because females that slept undisturbed were more sensitive to the CAF-D than males. All rats preferred sweet foods independent of their sleep status because sweet foods contributed more to overall calorie intake than savory foods. SD increased savory food intake only in males but SD did not increase total sodium consumption independent of sex since savory foods had a minor contribution to overall calorie intake.

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0034 AGE AND SEX DIFFERENCES IN SLEEP-WAKE ORGANIZATION OF FISCHER 344 RATS

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Introduction: Rats are extensively used for studying various behavioral, physiological, and pathophysiologic processes, including sleep and aging. While sex and aging have been recognized as critical risk factors for sleep disruption, most of the sleep studies have used only male subjects. The effects of aging on the sleep-wake organization in both sexes of rats are not well studied. We systematically examined the effects of aging on sleep-wake architecture in both sexes of Fischer-344 rats.

Methods: EEG and EMG electrodes were surgically implanted in young male (n=6), young female (n=5), old male (n=6), and old female (n=7) rats. We compared spontaneous sleep-waking and homeostatic response profiles of these rats to 6h of sleep deprivation.

Results: While the sleep-wake profiles of male and female rats were comparable, aging significantly affected sleep-wake organization in both sexes. Compared to old, young rats: a) exhibited higher non-REM sleep amounts (55% versus 63%, p<0.01, male; 58% versus 63%, p<0.01, female) and longer bouts of nonREM sleep (87s versus 116s, p<0.01, male; 94s versus 113s, p < 0.01, female) during the light-phase; b) more AW amount (51% versus 69%, p <0.01, male; 55% versus 65%, p<0.01, female) and longer bouts of AW (145s versus 249s, p<0.01, male; 138s versus 179s, p<0.01, female) during the dark-phase; c) higher REM sleep amount and longer episodes of REM sleep during the light-phase; and d) significantly higher delta power in nonREM recovery sleep (140% versus 168%, p<0.05, male; 162% versus 218%, p<0.05, female) during the light-phase; and e) significantly higher delta power in nonREM recovery sleep in young male was also significantly lower than in young female (168% versus 218%, p<0.05).

Conclusion: Preliminary analysis suggests that sleep-wake architecture in both sexes of corresponding ages did not differ significantly and that aging significantly affected the sleep-wake organization in both male and female rats. Furthermore, despite hormonal differences, the general characteristic of sleep-wake architecture, except for higher nonREM delta power in recovery sleep, remains similar in both sexes.

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0035 GENDER DIFFERENCES IN SLEEP HOMEOSTASIS: CHEMOGENETIC APPROACH TO EXAMINE THE ROLE OF MELANIN CONCENTRATING HORMONE.

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A. Basic and Translational Sleep Science

Male and female have minimal differences in spontaneous sleep-wakefulness. However, gender differences have been observed in homeostatic response to sleep deprivation. Recent studies suggest that neurons containing melanin-concentrating hormone (MCH) play a crucial role in sleep regulation. More importantly, the expression of MCH and its receptors is modulated by female sex hormone, estrogen. Does MCH play a differential role in the regulation of sleep homeostasis in males and females?

Methods: To address this question, we used sleep deprivation (6 hours; second half of light period)-recovery sleep (3 hours) paradigm to examine sleep homeostasis and performed two experiments in C57BL/6J-cre mice (expressing cre-recombinase in MCH neurons) instrumented with sleep recording electrodes. In addition, inhibitory Designer Receptors Exclusively Activated by Designer Drug (DREADD; AAV/hSyn-DIO-hM4Di-mCherry; 300nl/site) was bilaterally infused in MCH-rich lateral hypothalamus.

Experiment 1 verified if there were any gender differences between males and females in spontaneous S-W and, in recovery sleep.

Experiment 2 determined the effects of MCH inhibition on spontaneous S-W and recovery sleep. Chemogenetic inhibition of MCH neurons was achieved by infusion of clozapine-N-oxide (CNO, a selective DREADD receptor ligand; 5mg/kg, intraperitoneally), at light onset or during the last hour of sleep deprivation. On completion of the experiment, animals were euthanized, brains removed and processed for MCH immunofluorescence.

Results: DREADD was expressed in >70% of MCH neurons. No gender differences were observed during spontaneous S-W. However, gender differences were observed in recovery sleep. Females during proestrus stage (high estrogen levels) spent significantly more time in recovery sleep as compared to males or females in diestrus (low estrogen levels) stage. Silencing of MCH neurons suppressed recovery sleep in both, males and females. However, the amount of recovery sleep suppressed was significantly higher in females during proestrus stage as compared to males or females during diestrus stage.

Conclusion: Based on the results described above, we suggest that MCH may have a causal role in increased recovery sleep observed in females during proestrus stage.

Support (If Any): Department of Veterans Affairs Merit Research Award (I01BX002661)
A. Basic and Translational Sleep Science

0036
THE IMPACT OF NIGHTTIME EATING: A RANDOMIZED CONTROLLED TRIAL OF DAYTIME VS. DELAYED EATING ON WEIGHT AND METABOLISM IN ADULTS OF NORMAL WEIGHT
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Introduction: The timing of eating is a significant contributor to body weight regulation. The effects of a consistent, prolonged delayed eating pattern compared with a daytime pattern on weight and metabolism remain unclear, however, since few highly controlled, rigorous human trials exist. We report on the final dataset of such a controlled trial.

Methods: Twelve healthy adults (age: 26.3±3.4y; BMI: 21.9±1.7 kg/m²; 5 females) participated in a randomized cross-over study in free-living conditions. Three meals and two snacks consisting of comparable energy and macronutrient content were provided during two, 8-week counterbalanced phases: 1) daytime (food consumed between 0800h-1900h) and 2) delayed (food consumed between 1200h-2300h). A 2-week washout period occurred between the conditions. Participants were asked to maintain a sleep-wake cycle between 1200h-2300h (verified by wrist actigraphy) and to limit physical activity. Weight, adiposity, energy metabolism, and hormonal markers were assessed during four inpatient visits: 1) baseline; 2) after the first eating condition; 3) after the washout period, before the second eating condition began; and 4) after the second eating condition. Two-way ANOVAs and Cohen’s d effect sizes examined changes in anthropometrics and metabolic measures affected by eating schedule (daytime vs. delayed) and time (before vs. after each eating schedule).

Results: Weight, the trunk to leg fat ratio, respiratory quotient, and fasting insulin, total cholesterol, and glucose decreased (improved) vs. delayed) and time (before vs. after each eating schedule).

Conclusion: This controlled trial provides the first experimental evidence that an 8-week daytime eating schedule, as compared to an 8-week delayed eating schedule, promotes weight loss and a positive profile for energy metabolism and hormonal markers in healthy adults of normal weight. Thus, nighttime eating contributes to weight gain and metabolic dysfunction independent of calorie intake. Our findings have implications for other eating paradigms including time-restricted feeding.

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0037
DEGRADED CIRCADIAN REGULATION PREDICTS INCIDENT PHYSICAL DISABILITY AND ALL-CAUSE MORTALITY IN COMMUNITY-BASED OLDER ADULTS
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Introduction: Circadian/sleep disturbances are common in people with physical disability that is linked to mortality. We tested whether circadian disturbances predict incident physical disability and mortality in community-based older adults.

Methods: We studied 1,256 older adults (age: 81.2±7.4 [SD]) in the Rush Memory and Aging Project who have been followed for up to 13 years. Motor activities of up to 10 days were recorded at baseline and were used to quantify the interdaily stability (IS) and intraday variability (IV) of the circadian activity rhythm. Disability was assessed annually using three tests for basic activities of daily living (ADL; using the Katz scale), instrumental activities of daily living (IADL; adapted from the Duke Older Americans Resources and Services project), and mobility disability (using the Rosow-Breslau scale), respectively. Cox proportional hazards models were performed to examine the associations of IS and IV with incident physical disability and separately with all-cause death while adjusted for age, sex, and education.

Results: Of 1,047 participants without ADL disability at baseline, 514 developed ADL disability in 4.2±2.8 years. Of 625 participants without IADL disability, 431 developed IADL disability in 3.0±2.3 years. Of 665 participants without mobility disability, 429 developed mobility disabilities in 3.2±2.3 years. Of all 1,256 participants, 519 died in 5.7±2.9 years after baseline. For 1-SD decrease in IS (0.13), the risk of disability increased by 24% in ADL (95%CI: 0.13-0.36, p=0.0001) and the risk of all-cause death increased by 12% (95%CI: 0.02-0.22, p=0.01). We did not observe an association of IS with incident IADL or mobility (both p’s>0.5). For 1-SD increase in IV (0.20), the disability risk in ADL, IADL, mobility, and the death risk increased respectively by 34% (95%CI: 0.23-0.46, p>0.0001), 14% (95%CI: 0.05-0.26, p=0.005), 17% (95%CI: 0.06-0.13, p=0.002), and 32% (95%CI: 0.23-0.42, p<0.0001).

Conclusion: Old subjects with less stable or more fragmented daily activity rhythms had increased risk for developing physical disability and all-cause death.

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0038
SLEEPING WITH LOW LEVELS OF ARTIFICIAL LIGHT AT NIGHT INCREASES SYSTEMIC INFLAMMATION IN HUMANS
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Introduction: Artificial light at night (ALAN) has become a ubiquitous part of our society. Animal studies have shown that ALAN...
exposure promotes a depressive-like mood and increases peripheral inflammation likely due to circadian disruption. We hypothesized that sleeping with ALAN will increase systemic inflammation in humans.

**Methods:** We enrolled 64 subjects [32 with obstructive sleep apnea (OSA) adherent to treatment and 32 without sleep disorders] in a randomized, crossover study to determine the effects of sleeping with ALAN (40 lux) or the usual dark condition (control) for 7 nights at home. Sleeping with ALAN was confirmed by an actigraph with an ambient light sensor. Outcome measurements were done at baseline and after sleeping in each condition. The primary outcome was changes in the high-sensitivity C-reactive protein (hsCRP) levels. Secondary outcomes include scores on the Pittsburgh Sleep Quality Index (PSQI), Center for Epidemiologic Studies Depression Scale (CES-D), Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10), and Epworth Sleepiness Scale (ESS); Psychomotor Vigilance Testing (PVT); actigraphic sleep measures; and homeostatic model assessment of insulin resistance (HOMA-IR). A random effects linear regression model was used to assess differences adjusting for schedule, visit, and baseline levels. Post-hoc analyses combined results from OSA and non-OSA subjects.

**Results:** Fifty-eight (30 OSA and 28 non-OSA) subjects, aged 38.4±14.9 years, 33 of whom are male completed the protocol. A log transformation was used so the difference in hsCRP was expressed as a mean ratio. In the combined analysis, the mean hsCRP was 39% higher with ALAN than control (mean ratio=1.39; 95% CI: 1.08-1.80; p=0.012). The effects of ALAN for OSA and non-OSA subjects were not different. ALAN increased the CES-D score by 1.81 (p=0.017) and ESS score by 0.62 (p=0.071) points, and decreased the FOSQ-10 score by 0.36 (p=0.038) points while the PSQI score was unchanged (p=0.860). There were no significant differences in the PVT values, actigraphic sleep measures, or HOMA-IR.

**Conclusion:** Sleeping with ALAN for seven days significantly increased hsCRP levels and modestly increased depression scores in humans.

**Support (If Any):** Rudi Schulte Research Institute

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**0039 CIRCADIAN VARIATION OF PLASMA TRIGLYCERIDES IN HEALTHY ADULTS**

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**Introduction:** The lipid panel is a commonly ordered laboratory test used to determine cardiovascular disease event risk. Although numerous plasma lipids exhibit diurnal variations, clinical instructions for the lipid panel typically do not specify a time of day for testing. We used a forced desynchrony (FD) protocol to examine whether the lipids in the fasting lipid panel vary with circadian phase in healthy adults.

**Methods:** Six healthy adults (38-69 years; 3f) participated in a 37-day inpatient protocol with a regular (25-27% fat) or high-fat diet (45-50% fat). Three participants completed the study twice, once in each diet condition. Subjects’ rest-activity 3 of the study weeks were scheduled on 24-hour FD “days” with 11.67-h sleep opportunities. Fasting blood samples were collected <2 hours after wake time, and assayed for cholesterol, triglycerides, HDL, LDL, and VLDL (LabCorp). Continuous core body temperature was recorded throughout FD to estimate circadian period and phase, and lipid data were averaged across 4h circadian phase bins.

**Results:** Plasma triglyceride levels varied by circadian phase (p<0.001), and did the ratio for triglycerides/total cholesterol and triglycerides/HDL (p<0.0001). All were highest at circadian phase ~0° (late biological night, ~1-2h before usual waketime), and lowest at phase ~180 (biological day). Depending on the diet, the range in triglycerides was ~15-25mg/dL. In this small sample we did not find a significant rhythm in cholesterol, HDL, LDL, or VLDL. There was a significant effect of diet on triglyceride levels (p=0.0270) but not other lipids.

**Conclusion:** The plasma triglyceride/HDL cholesterol ratio, which predicts insulin resistance and the incidence of coronary artery disease, is highest during the late biological night. Our results therefore have implications for routine clinical testing of lipids, where the time of day at which the sample is taken relative to the patient’s internal rhythms should be considered when interpreting the results.

**Support (If Any):** Study supported by P01AG009975 and conducted in the Brigham and Women’s Hospital Center for Clinical Investigation, part of Harvard Clinical and Translational Science Center supported by UL1TR001102. RKY supported by T32HL007901 and F32HL143893. NV supported by T32HL007901 and F32AG051325.

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**0040 EFFECTS OF CHRONOTYPE, INSOMNIA, DEPRESSION, AND AGE ON MARKERS OF SYSTEMIC INFLAMMATION IN NURSES**

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**Introduction:** Insomnia, depression, and older age have been associated with elevated levels of systemic inflammation. Even chronotype also is associated with impaired health, which may be partially mediated through increases in inflammation. However, it is not well understood how insomnia, chronotype, and depression may interact with age to predict inflammation. Nurses are an important population in which to study these associations, as rates of insomnia and depression are prevalent, which may be attributed to stressful work environments and rotating schedules. This study examined associations between insomnia, chronotype, age, and depression with inflammatory biomarkers in nurses.

**Methods:** Participants were 400 nurses ages 18-65 (mean age = 39.03 ± 11.07; 91% female) recruited from two hospitals for a parent study (“Sleep and Vaccine Response in Nurses,” PIs: Taylor & Kelly). Participants completed surveys to assess demographics, mental health, insomnia symptoms, and chronotype. Approximately one month later, blood serum was obtained.
and analyzed for inflammatory biomarkers interleukin-6 (IL-6), C-reactive protein (CRP), interleukin-1 beta (IL-1β), and tumor necrosis factor alpha (TNF-α).

**Results:** Controlling for age, gender, and race/ethnicity, chronotype was not associated with any of the inflammatory biomarkers. Greater insomnia symptoms were associated with higher IL-6 (b = 0.01, SE = 0.003, p = .003), and greater depressive symptoms were associated with marginally higher IL-6 (b = 0.01, SE = 0.005, p = .05). Older age was associated with higher levels of all inflammatory biomarkers (r = -10.17, p &lt .05). There was an interaction between age and depressive symptoms, such that older individuals had a stronger positive relationship between depressive symptoms and IL-6 (b = 0.001, SE = 0.0005, p = .04). (Results are preliminary and will be confirmed with forthcoming additional data.)

**Conclusion:** Our preliminary findings support previous research indicating positive associations between inflammation, age, and symptoms of insomnia and depression. Older nurses with greater depressive symptoms may be particularly at risk for elevated inflammation. Future longitudinal research should examine inflammation as a possible mediator between depression, insomnia, and other physical health outcomes.

**Support (If Any):** NIAID R01AI128359-01

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**0041 PRELIMINARY IDENTIFICATION AND VALIDATION OF A PLASMA METABOLOME-BASED BIOMARKER FOR CIRCADIAN PHASE IN HUMANS**

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**Introduction:** Identifying a reliable predictor of circadian phase is increasingly important to diagnose circadian disorders and circadian misalignment, inform treatment schedules, and support personalized medicine. Findings using blood transcriptomics to predict circadian phase show promise, but no published findings have utilized a metabolomics approach. Therefore, the potential utility of metabolomics to predict circadian phase is unknown. Here, we analyzed the plasma metabolome during adequate and insufficient sleep to identify a circadian phase biomarker.

**Methods:** 16 (8M/8F) healthy participants aged 22.4±4.8y (mean±SD) completed a randomized cross-over in-laboratory study with 3 baseline days (9h sleep opportunity/night), followed by control (9h sleep) and insufficient sleep (5h) conditions, each lasting 5 days. Circadian phase was determined by dim light melatonin onset (DLMO). Blood was collected every 4 hours across 24 hours on the final day of each condition and used for aqueous and lipid LCMS metabolomics analyses. Two models were built to predict DLMO using Partial Least Squares Regression using the full dataset and a rhythmic metabolite-only (determined by MetaCycle R package) dataset. Each model was created by randomly splitting the data, with 66% used to train the model and 33% used as validation samples.

**Results:** Using Leave-One-Out Cross-validation (LOOCV), R² for the full dataset was 0.58 using 7 components and 20 features. When validated on the holdout samples, R² was 0.37 with a median error of 3.5h±4.2 (median±IQR), and 31% of the validation samples had an error <2h. Using LOOCV, R² for the rhythmic metabolite-only dataset was 0.62 using 11 components and 50 features. When validated on the holdout samples, R² was 0.53 with a median error of 2.4±3.9, and 43% of the validation samples had an error <2h. During insufficient sleep, the rhythmic data set was non-significantly (P = 0.051, Wilcoxon t-test) better at predicting DLMO versus the full data set.

**Conclusion:** Our preliminary findings show promising trends for metabolomics, especially the rhythmic metabolite dataset, however additional analyses with more subjects are required.

**Support (If Any):** NIH-R01HL085705; NIH-R01HL109706; NIH-R01HL132150; NIH-F32DK111161, and NIH-UL1TR000154; and Sleep Research Society Foundation 011-JP-16

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**0042 PROTEOMIC BIOMARKERS OF CIRCADIAN TIME**

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**Introduction:** Our ability to incorporate circadian timing into clinical decision-making is impaired by our inability to measure circadian phase efficiently. This impacts treatment for patients with suspected circadian rhythm disorders and insomnia or hypersomnia. The current Dim Light Melatonin Onset (DLMO) method for assessing circadian time is expensive and necessitates multiple samples over several hours. We utilized an aptamer approach to quantify circadian time.

**Methods:** A high throughput aptamer array was used to profile 1013 plasma proteins in 28 individuals assigned to three multisite cohorts. Cohort1 had 6 participants sampled every 4 hours in a 24-hr interval in constant routine and after a night of inverted sleep. Cohort2 consisted of 9 individuals sampled every 2hrs over a 36hr constant routine. While 70% of Cohort1 and Cohort2 were used as a training set in the process of building a circadian time predictor, Cohort3, comprised of 13 individuals sampled at 12 timepoints in a 24hr interval was left untouched to be used as a validation cohort along with 30% of Cohort 1 and 2. Harmonic regression was used to find circadian regulated proteins. A machine learning multivariate circadian time predictor with elastic net regularization was built on the training data and validated in two independent cohorts.

**Results:** Harmonic analysis revealed 129 plasma proteins (FDR p=0.005) to be circadian regulated; strikingly ACTH and pro-opiomelanocortin peaked in early morning and tapered as the day progressed, consistent with established circadian time stamps. In
addition, we observed TSH, PTH, pancreatic hormone precursor and ghrelin proteins to show diurnal rhythmicity. A circadian time predictor that was trained on 70% of samples from Cohort1 and Cohort2 performed robustly, achieving an overall mean accuracy of 86% and median absolute error of 1.40hrs and 1.58hrs across the two validation cohorts, respectively. In 80% of the samples, the prediction error was less than 2hrs. **Conclusion:** A proteomic-based approach to quantify circadian time is a reliable and robust alternative to conventional DLMO and gene expression based methods. **Support (If Any):** Cohort2 sample collection supported by ONR award N00014-15-1-2408 and NIH grant UL1TR001102.

**0043 CIRCADIAN RHYTHM OF ENERGY EXPENDITURE AND SUBSTRATE UTILIZATION DURING CONSTANT ROUTINE CONDITIONS**

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**Introduction:** Findings from previous studies indicate daily variation in energy expenditure (EE) depends on circadian phase in humans, though findings have been inconsistent. Changes in energy expenditure throughout the day and night during non-fasting conditions are important to understand factors influencing energy metabolism. The aim of this study was to determine the circadian rhythm of resting EE, respiratory quotient (RQ), and substrate utilization using a constant routine protocol. **Methods:** Six healthy adults (3F, age 27.7±2.2 years, BMI 24.7±3.2; mean±SD) participated in a 26-hour constant routine study following 1 week of outpatient monitoring. Subjects arrived at the laboratory in the evening and were provided an 8-hour sleep opportunity. After waking at their habitual time, participants remained in constant conditions, which included dim light (<8 lux), constant posture (bed rest), ambient temperature, and consumed small identical hourly meals. Melatonin was measured from hourly saliva and EE was measured every 3 hours using hood indirect calorimetry. EE data were aligned to dim light melatonin onset (DLMO). **Results:** Average DLMO occurred at 20:10h (±18min). EE began to decline before DLMO and was lowest early in the biological night. RQ and carbohydrate oxidation (CHO-ox) were highest close to DLMO. However, current and prior assessments of EE and substrate utilization are needed to determine how circadian timing impacts energy metabolism. **Support (If Any):** This work was supported by the Colorado Nutrition Obesity Research Center P30 DK048520-21, KO1DK113063 to CR, KO1DK110138 to JLB, and a University of Colorado Vice Chancellor of Research Innovative Seed Grant to JLB.

**0044 THE CIRCADIAN SYSTEM MODULATES CARDIOVASCULAR RESPONSES TO STANDING DIFFERENTIALLY IN PEOPLE WITH OBSTRUCTIVE SLEEP APNEA COMPARED TO HEALTHY CONTROLS.**

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**Introduction:** Adverse cardiovascular (CV) events occur most commonly at ~9 AM in the general population, but ~3 AM in people with obstructive sleep apnea (OSA). Standing up after a night of sleep generates changes in blood pressure (BP) and heart rate (HR) and autonomic activation. We tested whether the CV reactivity to standing is different in OSA versus healthy controls (HC) across all phases of the circadian cycle. **Methods:** 21 HC (age: 52±7 [mean±SD] years) and 8 OSA (age: 48±7 years; AH1 range 15-74.1) participants with similar body mass indices completed a 5-day forced desynchrony (FD) protocol with 10 identical recurring 5 h 20 min sleep/wake cycles in dim light. Twenty-five minutes after awakening and continued supine rest, participants stood up. Systolic BP, diastolic BP and HR were measured during supine rest and after one min of standing at all circadian phases. Salivary melatonin was used as a circadian phase marker. Data were analyzed using mixed-model cosinor analyses. **Results:** While supine, mean HR was higher in OSA but there were no mean differences in BP between groups, and no group by circadian phase interactions for BP or HR. Similarly, there were no significant mean group differences upon standing in the changes in BP or HR (first minute CV reactivity; p>0.05). However, upon standing, the circadian time of the peak increase in diastolic BP was significantly different in OSA versus HC (peaks at circadian phases corresponding to ~11PM and ~1PM respectively, p=0.008). And there was a trend for systolic BP reactivity to be different in OSA versus HC (peaks at ~6AM and ~4PM respectively, p=0.059). There was no evidence of a group by phase interaction for HR reactivity to standing. **Conclusion:** In this preliminary analysis, the peak circadian phase of diastolic BP reactivity to change in posture differs between OSA and HC. These results may have implications for differences in time of adverse CV events in OSA and the general population. **Support (If Any):** NIH R01-HL125893; CTSA UL1TR000128

**0045 DECREASED ORAL GLUCOSE TOLERANCE AND INSULIN RESPONSE DURING BIOLOGICAL EVENING VERSUS MORNING AMONG ADULTS UNDER FREE-LIVING CONDITIONS**

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A. Basic and Translational Sleep Science

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Introduction: Melatonin secretion during the biological night impairs glucose tolerance in vivo and suppresses insulin secretion from beta-cells in vitro, yet its implication in adults under free-living conditions and its relevance for time-of-day assessment of glucose tolerance remain undetermined.

Methods: In the Shift work, Heredity, Insulin, and Food Time (SHIFT) Study (#NCT02997319), we tested the hypothesis that compared to the biological morning, an oral glucose tolerance test (OGTT) performed during the biological evening will reveal relatively impaired glucose tolerance and reduced insulin secretion. In this large randomized crossover study, participants completed two 2-hour 75-g OGTTs: morning (3 hours after self-reported habitual free day wake time) and evening (1 hour before self-reported habitual free day bedtime). Blood glucose, insulin, and melatonin were determined. Incremental 2-hour area under the curve (iAUC) for increases in glucose and insulin using the trapezoidal method, insulin sensitivity index (ISI), corrected insulin response (CIR), and oral disposition index (Dlo) were calculated. Morning and evening values were compared using paired t-tests.

Results: In 83 healthy, non-night workers (73% female; 33.3±11.8 years; 25.46±5.0 kg/m²), we confirmed 10-fold higher endogenous melatonin concentrations at biological evening compared to biological morning assessments (morning, 2.35±3.93 pg/ml vs. evening, 26.16±24.72 pg/ml; P<0.001). Compared to the morning OGTT, evening OGTT postprandial glucose was 91% higher (glucose iAUC: morning, 4,523±2587 mg.min/dl vs. night, 8,652±2775 mg.min/dl; P<2.2x10⁻¹⁶), while no difference in post-prandial insulin iAUC (P=0.82) was noticeable. Whereas time-of-day had no influence on ISI (P=0.87), the evening OGTT had significantly lower CIR (P=0.022) and Dlo (P=0.003) compared to the morning OGTT.

Conclusion: These observations from adults under free-living conditions extend earlier findings from in vitro and controlled human experiments by confirming impaired glucose tolerance likely from reduced insulin response to glucose during the biological evening relative to the biological morning. These findings provide first insights into how chronic exposure to nighttime eating, such as among night shift workers, may result in increased diabetes risk.

Support (If Any): NIH-R01DK105072

III. Circadian Rhythms Mechanisms and Physiology

0046

IS EATING CLOSE TO THE DIM LIGHT MELATONIN ONSET ASSOCIATED WITH BODY MASS INDEX?

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Introduction: Eating late negatively impacts health; however, few studies have examined meal timing in relation to circadian phase using objective markers. We assessed the relationships between DLMO, timing of feeding, body mass index (BMI) and body fat among a sample of adults without depression and with habitual sleep duration of at least 6.5 hours.

Methods: Participants (N = 97), ages 18-50 years, completed seven days of actigraphy and food logs. Subsequently, participants received a DXA scan to assess body fat and DLMO was assessed in the clinical research unit. Participants were free of sleep, neurological, and psychiatric disorders, and did not use medications or substances that impact sleep. Multiple linear regression analyses assessed the relationships between timing of feeding relative to DLMO (calculated as DLMO - last meal), body composition, and diet while controlling for age, sex, and sleep duration. BMI was controlled for in analyses examining diet. Post-hoc analyses examined the differences among those with earlier DLMO versus later DLMO (±10:30pm).

Results: Average time between last meal and DLMO was 2.29hrs and ranged from -6.67 to 10.33hrs. Meals occurring earlier in time before the DLMO were associated with less carbohydrate, b= -8.13, SE=3.13, p=0.1, and sugar intake, b= -4.52, SE=1.16, p=0.006. Timing of last meal relative to DLMO, was not related to BMI, body fat percentage, or Android-Gynoid (trunk/hip) Fat Ratio. When analyses were stratified by DLMO time, feeding closer to DLMO was associated with higher BMI, b= -8.4, SE=2.9, p=0.007, and AndGynFat Ration, b= -0.3, SE=0.1, p=0.01, among those with later DLMO, but not among those with earlier DLMO.

Conclusion: In general, eating close to DLMO was not associated with BMI or body fat. However, among those with later DLMOs, eating closer to DLMO was associated with greater BMI and a greater AndGynFat Ratio. Eating closer to DLMO may impact health in groups with later DLMO, such as college students and delayed sleep wake phase.

Support (If Any):
A. Basic and Translational Sleep Science

equation to meet each participant’s caloric needs. Lean (n=7; BMI: 23.1±2 kg/m²; age: 52±9 years) and non-lean (n=15; BMI: 30.6±5.4 kg/m²; age: 52±7 years) participants were identified. Hunger was measured regularly via visual analog scale and circadian phase was calculated relative to salivary dim-light melatonin onset (>3 pg/mL threshold). Data were analyzed using mixed-effect models and significance was set at p<0.05.

Results: On average, subjective hunger scores followed a significant circadian pattern (p=0.003) independent of all scheduled behaviors; hunger trough/peak for this cohort was ~4AM~/~9PM. The respective rhythms between lean and non-lean groups were not significantly different (p=0.19); furthermore, the interaction of circadian phase was not significant (p=0.45).

Conclusion: The present findings suggest that increased evening intake in non-lean individuals is not due to a different rhythm in hunger. Future work should assess the contribution of other behavioral factors leading to the later circadian timing of intake in non-lean individuals.

Support (If Any): Work reported in this poster was supported by the National Institutes of Health Common Fund and Office of Scientific Workforce Diversity (UL1GM118964, RL5GM118963, TL4GM118965).

0049
EFFECTS OF BLUE FILTERING LENSES ON SLEEP AND MELATONIN PRODUCTION IN GOOD SLEEPERS
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Introduction: Produced at night, melatonin is a hormone which regulates endogenous circadian rhythms and is suppressed by bright light exposure. The nighttime use of light-emitting devices has been associated with reduced melatonin production and disturbed sleep. Blue light has the most impact on melatonin production and hence on circadian rhythms. This pilot study evaluated whether a specific blue-light-filtering eyewear reduces the impact of bright light exposure on melatonin production.

Methods: We enrolled ten healthy, good sleepers, ages 21-40 (M=26.1, SD=4.98). We excluded those with known sleep disorders or health or mental conditions that could interfere with participation. Enrolled participants spent two nights in our laboratory. Subjects arrived 3 hours before their habitual bedtime and were given either blue-filtering or non-filtering eyewear, in counterbalanced order, to wear until they went to bed, with bedtime scheduled two hours after habitual bedtime. Subjects were placed in high, full-spectrum lighting for the 5-hours. They were seated in front of a laptop computer with brightness set to maximum intensity and a lightbox next to the computer. Participants provided saliva samples every 30 minutes. After the final samples, subjects went to sleep. Prior to being discharged in the morning, participants completed a sleep diary. An actigraph was worn for the duration of each stay.

Results: In a mixed methods model analysis, we found a significant effect of condition for melatonin profiles (F1, 171=12.6, p=0.0005), but not for time (F10, 171=1.78, p=0.068) or condition*time interaction (F10, 171=0.77, p=0.657). Melatonin levels were significantly higher on the night with blue-filtering eyewear for all timepoints expect the first two (all p=0.02 or lower). We found no significant differences on any sleep diary variables between nights. The only actigraphic sleep variable that was significantly different between nights was sleep latency (t7=2.4, p=0.047).

Conclusion: These results demonstrate that this novel, blue-light filtering eyewear was able to reduce the inhibition of melatonin production from blue light. Subsequent sleep was not impacted by the eyewear in this group of good sleepers.

Support (If Any): This work was funded by BluTech Lenses.

III. Circadian Rhythms Mechanisms and Physiology

0049
A HIGHLY SELECTIVE FILTER OF CIRCADIAN LIGHT IMPROVES SLEEP QUALITY AND LIMITS THE MELATONIN SUPPRESSION INDUCED BY LIGHT AT NIGHT
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Introduction: There is growing evidence of the negative impact of light at night (LAN) on sleep. The low levels of blue light emitted by screens and domestic lighting are sufficient to induce strong melatonin suppression on young adults. Only broadband dark-orange lenses evidenced to limit this effect but with highly compromised vision.

Methods: We performed a cross-over randomized clinical study in the evening home environment on young adults to compare the effects of an innovative selective filter of circadian light to non-filtering lenses and to dark-orange lenses (dark positive control) on sleep quality, melatonin production and visual comfort. Participants were evening screen users devoid of any major health problem and excluded for prescription medications or sleep disruption. Each eyewear was worn 7 consecutive evenings for 4 hours prior to the usual bedtime using screens, with 7 days of wash-out in between. Hourly saliva samples (Bühlmann) were collected and radioimmunoassayed for melatonin concentration. Sleep staging was analyzed with a digital tri-axial accelerometer (MotionWatch). Sleep and day alertness were assessed with standard Leeds and Karolinska Sleepiness Scale. Visual comfort and lens aesthetics were rated. MANOVA with Tukey tests were used for statistical analysis.

Results: 56 healthy young adults (27.9yrs ± 5.8SD) participated. 4-hour exposure to light from screens and domestic lighting with non-filtering lenses before bedtime significantly suppressed melatonin by 47% compared to the dark condition. Our selective filter reduced the suppression to 12% (p<0.001), improved objectively measured sleep duration by 27 min (p<0.001) and advanced L5 onset by 25 min (p<0.001). Leeds scores were increased with both filters, especially sleep quality (p<0.001). The visual experience was significantly improved with the selective filter compared to the darkorange one.

Conclusion: We bring confirmatory proof that low levels of LAN are sufficient to decrease sleep quality and melatonin production at bedtime, likely to lead to misalignment of circadian phase. Our highly selective filter significantly counteracted these effects, while considerably improving vision and lens aesthetics compared to current dark-orange lenses.

Support (If Any): ESSILOR RESEARCH FRANCE

0050
IMPACT OF THE CIRCADIAN SYSTEM AND CIRCADIAN MISALIGNMENT ON HUMAN SALIVARY MICROBIOTA
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Support (If Any): This work was funded by BluTech Lenses.
Introduction: Circadian rhythm disruption is prevalent in modern society, particularly in night shift workers. Circadian misalignment—the misalignment between the central circadian clock and behavioral/environmental cycles (including sleep/wake, fasting/feeding, dark/light)—results in adverse metabolic effects. Potential underlying mechanisms for these adverse effects include alterations in orogastrointestinal microbiota. However, it remains to be established whether human salivary microbiota have circadian rhythmicity and whether circadian disruption impacts circadian rhythms, community structure, and composition of the microbiota.

Methods: Six healthy young individuals (27.3±2.3y; 2 females) underwent a 14-day stringently controlled circadian protocol, with a baseline 36-h constant routine paradigm (CR: circadian assessment; semi-recumbent posture, ~3 lux, and hourly isocaloric snacks), a Forced Desynchrony protocol (four 28-h “days”; ~3 lux; outside the range of circadian entrainment), to induce circadian misalignment, and a post-misalignment 44-h CR protocol. Microbiota assessments were performed on saliva samples during CR every 4h. Total DNA was extracted and processed using high-throughput 16S ribosomal RNA gene amplicon sequencing. Cosinor mixed models were applied to saliva microbiota relative abundance at the taxonomical levels of phylum and genus to identify circadian rhythms.

Results: Our data indicate significant endogenous circadian rhythms in 1/6 of the dominant phyla (Proteobacteria; \( p=0.02 \)), with a peak in the middle of the biological day (~12PM) and nadir in the biological night (~12AM). Significant circadian oscillations were observed for 1/4 of dominant genera within the Proteobacteria taxa (i.e., Neisseria; \( p=0.004 \)). Following circadian misalignment, circadian rhythmicity for the Proteobacteria and their genera was abolished, while significant circadian rhythms arose for the phylum Bacteroidetes and their genera (i.e., Capnocytophaga; \( p=0.04 \)), with a peak in the biological morning (~8AM) and nadir in the biological evening (~8PM). Importantly, we observed significant effects of circadian misalignment on overall/average relative abundance in 5/6 of dominant phyla and in 5/8 of the dominant genera.

Conclusion: Our data show for the first time that human oral microbiota, particularly putative-proinflammatory taxa, exhibit circadian rhythmicity. Importantly, we show that circadian misalignment may result in changes in the relative abundance for a wide array of oral microbiota.

Support (If Any): R01HL118601

0051

ALTERED ENDOGENOUS CIRCADIAN RHYTHM OF THE ENDOCANNABINOID ANANDAMIDE BY BODY MASS INDEX

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Introduction: The endocannabinoid anandamide (AEA) signals ubiquitously throughout the body and has been shown to modulate endocrine systems and sleep/wake cycles. Previous analyses suggest a diurnal variation in plasma levels of AEA. We sought to determine the endogenous circadian profile of AEA and how this distribution may vary by body mass index (BMI) and sleep.

Methods: Thirteen healthy participants (mean age, 51 years; 9 females; 8 lean mean BMI, 24.5 kg/m²; 5 non-lean mean BMI, 36.7 kg/m²) underwent a laboratory protocol that balanced euclidean meals and sleep opportunities evenly across the circadian cycle (achieved by scheduling 10 identical, recurrent 5 h 20 min ‘days’ in dim light thereby desynchronizing the circadian and behavioral cycles). Blood was sampled before sleep and upon awakening through a midline catheter. AEA was quantified by liquid chromatography-mass spectrometry. Salivary melanotropin was used to assess circadian phase (phase marker = dim-light melatonin onset [DLMO]).

Results: Average plasma AEA was lower in lean compared to non-lean participants (means: 0.4 pmol/mL versus 0.8 pmol/mL, respectively; \( p=0.024 \)). The endogenous rhythm of plasma AEA was driven by non-lean participants: peak to trough range 0.65-0.96 pmol/mL; peaking in the biological afternoon (~2:45pm, ~18 hours after DLMO; \( p=0.01 \)) with no significant rhythm in lean participants. Finally, the circadian rhythm of AEA did not significantly differ when measured immediately before or after sleep.

Conclusion: The variation in AEA across 24 hours is modulated by the circadian system in non-lean individuals, whereas levels remain relatively constant in lean healthy adults. Future studies are needed to determine if the 1.5-fold increase of peak to trough in AEA in non-lean adults is related to an increase in hunger cues and caloric intake that may account for increased BMI. This initial analysis does not account for sleep efficiency, which may alter AEA levels across sleep.

Support (If Any): Ford Foundation, R01 HL125893, NCC 9-58, F32HL131308, and UL1TR000128.
0052
COCAINE AND CLONAZEPAM ASSOCIATION CAUSES PARADOXICAL SLEEP REDUCTION AND WITHDRAWAL BEHAVIORAL SYMPTOMS
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Introduction: There are reports of non-medical use of clonazepam, a benzodiazepine, after cocaine consumption in order to ameliorate cocaine side-effects. The potential impact of this combination on health is still scarcely studied, however. We aimed at evaluating the effects of cocaine and clonazepam association on behavior and sleep in male Wistar rats.

Methods: Animals were allocated in 4 treatment groups: CTRL group (1 ml/kg saline); COC group (7mg/kg cocaine); CLN group (1.25 mg/kg clonazepam) and COCCLN group (7mg/kg cocaine and, after a 1-hour interval, 1.25 mg/kg clonazepam). Animals received intraperitoneal injections according to their group for 16 days. Acute sleep recording was performed for 24 hours following the first injection, during light and dark phases, using cortical electrodes implanted through stereotaxic surgery. Open field and elevated-plus maze tests were performed in the day after treatment was ended, for evaluation of behavioral effects.

Results: In the light phase of the acute sleep recording, paradoxical sleep was significantly decreased in COCCLN rats, compared to CTRL animals. Paradoxical sleep onset latency was significantly increased in COC and COCCLN groups, compared to CTRL rats. In the dark phase, paradoxical sleep was significantly increased in these same groups, compared to controls. Regarding behavioral tests, COCCLN rats presented a reduction in peripheral squares crossed in open field, and a decrease in the number of risk assessment episodes in the elevated-plus maze.

Conclusion: Cocaine and clonazepam association caused a significant impact in paradoxical sleep in rats. These results suggest that sleep impairment is a possible outcome from this substance combination. Behavioral test results suggest increase in impulsivity and decrease in exploratory behavior. These effects might indicate appearance of withdrawal symptoms after treatment ceased.

Support (If Any): None

0053
SUVN-G3031: SAFETY, TOLERABILITY AND PHARMACOKINETICS OF A POTENT AND SELECTIVE HISTAMINE H3 RECEPTOR INVERSE AGONIST - SINGLE AND MULTIPLE ASCENDING DOSES IN HEALTHY SUBJECTS
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Introduction: SUVN-G3031, a potent histamine H3 receptor inverse agonist is being developed for the treatment of narcolepsy and other sleep related disorders. SUVN-G3031 has hKi of 8.7 nM at H3R with more than 100-fold selectivity against related GPCRs. SUVN-G3031 exhibited desired pharmacokinetic properties and brain penetration in preclinical species. SUVN-G3031 blocked R-α-methylhistamine induced water intake and increased tele-methylhistamine levels in brain and cerebrospinal fluid. Acute oral administration of SUVN-G3031 produced significant increase in acetylcholine, histamine, dopamine and norepinephrine levels in the cortex. SUVN-G3031 produced wake promoting effects in male Wistar rats and C57BL/6d mice. SUVN-G3031 was evaluated in Phase I clinical studies (US IND). It showed desirable pharmacokinetic profile with safety and tolerability in healthy human volunteers.

Methods: In the present study, effects of SUVN-G3031 on sleep/wake profile were evaluated in rats lesioned with neurotoxin orexin-2-saporin in lateral hypothalamus. EEG signals were acquired using telemetric device implanted intraperitoneally.

0054
SUVN-G3031, A HISTAMINE H3 RECEPTOR INVERSE AGONIST PRODUCES WAKE PROMOTING EFFECT IN OREXIN-2-SAPORIN LESIONED RATS
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Suven Life Sciences Ltd, Hyderabad, India.

Introduction: SUVN-G3031, a potent histamine H3 receptor inverse agonist is being developed for the treatment of narcolepsy and other sleep related disorders. SUVN-G3031 has hKi of 8.7 nM at H3R with more than 100-fold selectivity against related GPCRs. SUVN-G3031 exhibited desired pharmacokinetic properties and brain penetration in preclinical species. SUVN-G3031 blocked R-α-methylhistamine induced water intake and increased tele-methylhistamine levels in brain and cerebrospinal fluid. Acute oral administration of SUVN-G3031 produced significant increase in acetylcholine, histamine, dopamine and norepinephrine levels in the cortex. SUVN-G3031 produced wake promoting effects in male Wistar rats and C57BL/6d mice. SUVN-G3031 was evaluated in Phase I clinical studies (US IND). It showed desirable pharmacokinetic profile with safety and tolerability in healthy human volunteers.

Methods: In the present study, effects of SUVN-G3031 on sleep/wake profile were evaluated in rats lesioned with neurotoxin orexin-2-saporin in lateral hypothalamus. EEG signals were acquired using telemetric device implanted intraperitoneally.
Results: Rats lesioned with orexin-2-saporin in lateral hypothalamus produced narcoleptic-like behavior. SUVN-G3031 produced significant increase in wakefulness with concomitant decrease in rapid eye movement (REM) sleep in rats lesioned with orexin-2-saporin. Treatment with SUVN-G3031 decreased the DREM episodes indicative of anti-cataplectic effect in rodents.

Conclusion: Results from the current study provide a strong preclinical basis for potential of SUVN-G3031 in the treatment of sleep related disorders like narcolepsy with and without cataplexy. Phase 2 POC study for the treatment of narcolepsy is currently being planned in USA.

Support (If Any): None

0055
AN OREXIN 2 RECEPTOR-SELECTIVE AGONIST, TAK-925, AMELIORATES NARCOLEPSY-LIKE SYMPTOMS AND OBESITY IN OREXIN/ATAxin-3 TRANSGENIC MICE
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Introduction: The orexin system is a critical regulator of sleep/wakefulness states, and the loss of orexin-producing neurons in lateral hypothalamus results in narcolepsy type 1 (NT1). Orexin/atxain-3 transgenic (Tg) mice, a narcolepsy mouse model with orexin deficiency, show phenotypes similar to those of patients with NT1, such as fragmentation of sleep/wakefulness, cataplexy-like events, and obesity without increase in food consumption. Histaminergic neurons in tuberomammillary nucleus (TMN) have been reported to highly express orexin 2 receptor (OX2R), but not OX1R, and we previously reported that TAK-925, an OX2R selective agonist activated mouse histaminergic neurons by whole-cell patch-clamp techniques. Moreover, TAK-925 ameliorated both wakefulness fragmentation and cataplexy-like episodes in orexin/atxain-3 Tg mice. In this study, we further evaluated the effect of TAK-925 on neuronal activity at the TMN and body weight gain in orexin/atxain-3 Tg mice.

Methods: To investigate the effects of TAK-925 on neuronal activity in the TMN, TAK-925 was subcutaneously administered to orexin/atxain-3 Tg mice at Zeitgeber time (ZT) 5, and then neuronal activation was assessed by immunostaining of c-fos. To assess the effects of TAK-925 on weight gain, TAK-925 was subcutaneously administered to orexin/atxain-3 Tg mice or wild-type mice at ZT12 and ZT15 from experimental day 1 to day 14.

Results: TAK-925 significantly increased the number of c-fos-positive cells in the TMN. Fourteen day treatment of TAK-925 significantly attenuated the body weight gain in orexin/atxain-3 Tg mice, but not in wild-type mice. However, TAK-925 did not change the daily food intake in either the orexin/atxain-3 Tg mice or wild-type mice.

Conclusion: TAK-925 activates physiological OX2R and modulates neuronal activity in the mouse TMN when administered peripherally. Moreover, TAK-925 ameliorates multiple narcolepsy-like symptoms including weight gain in orexin/atxain-3 Tg mice.

Support (If Any): This work was conducted by Takeda Pharmaceutical Company Limited.
Introduction: Sleep disruption (SD) contributes to obesity. Women are more likely to report insomnia and display greater sensitivity to SD-induced weight gain than men. Suvorexant is a dual orexin receptor antagonist that improves sleep. The compound also augments energy expenditure in rodents, and thus, may affect weight gain due to SD with potential sex differences. To begin to address this, we utilized a validated method of SD (i.e., environmental noise exposure) that causes weight gain in rats and determined whether suvorexant prevented noise-induced SD in male and female rats. We hypothesized that suvorexant would ameliorate noise-induced SD independent of sex.

Methods: Three-month old male and female Sprague-Dawley rats (N=15) were surgically implanted with EEG/EMG electrodes connected to a radiotelemetric transmitter for determining vigilance states. Following recovery from surgery, suvorexant (0, 4, 40 and 80 mg/kg, i.p.) was administered both prior to, and without noise exposure (8h during the light cycle) in a repeated measures design with >96h between injections. EEG/EMG were recorded 8h post-injection. Females were tested in diestrous. Data were analyzed with one-sample t-test to determine the effect of noise alone and two-way repeated measures ANOVA followed by the FDR correction to determine sex differences.

Results: Noise alone significantly increased time awake and sleep fragmentation and reduced sleep relative to vehicle-control equally in all rats. Suvorexant significantly prevented the noise-induced increase in time awake and suppression of sleep compared to noise alone in all rats with no sex differences. In contrast, suvorexant increased noise-induced sleep fragmentation in males but had no effect in females.

Conclusion: The effects of noise exposure on vigilance states and sleep fragmentation, and suvorexant on vigilance states, occurred independent of sex. However, suvorexant exacerbated the sleep fragmentation due to noise in males only. This was an unexpected result and is the first demonstration that, under certain circumstances, suvorexant has a sex-dependent effect on sleep fragmentation but not sleep duration. These data suggest that suvorexant might have other sex-dependent effects.

Support (If Any): National Institutes of Health and US Department of Agriculture.

0058

SCIENTIFIC RATIONALE AND CLINICAL DEVELOPMENT OF AXS-12 FOR NARCOLEPSY.

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Introduction: Narcolepsy is a serious neurological condition causing sleep-wake dysregulation and is characterized by excessive daytime sleepiness (EDS) and cataplexy. Cataplexy is seen in approximately 70% of patients and is a sudden reduction or loss of muscle tone while a patient is awake. Narcolepsy interferes with cognitive, psychological, and social functioning, increases the risk of accidents, and is associated with greater mortality. Depression is reported in up to 57% of patients. Currently-approved treatments are few for this under-diagnosed orphan condition, and are limited by variability in efficacy, tolerability issues and the need for scheduling. AXS-12 (reboxetine) is a highly selective and potent inhibitor of norepinephrine reuptake. The scientific rationale for developing AXS-12 for the treatment of narcolepsy is based on in vivo nonclinical physiological and pharmacological studies suggesting a strong role for adrenergic neurotransmission in cataplexy, anti-cataplectic effects of reboxetine in orexin-deficient mice, and positive preliminary clinical evidence from an open-label pilot study of reboxetine in patients with narcolepsy.

Methods: Reboxetine has been investigated in animal models of narcolepsy as well as in an open-label study in patients with narcolepsy. AXS-12 is being evaluated in a randomized, double-blind, crossover, placebo-controlled Phase 2 trial in narcoleptic subjects with cataplexy and EDS. Subjects are randomized equally to placebo for three weeks followed by AXS-12 for three weeks, or to AXS-12 for three weeks followed by placebo for three weeks. Outcomes measured include the change in the number of cataplexy attacks, maintenance of wakefulness, and reduction in sleepiness.

Results: In orexin-deficient mice, reboxetine treatment markedly reduced episodes of cataplexy and sleep attacks. In an open-label pilot trial in patients with narcolepsy, reboxetine significantly improved EDS and cataplexy versus baseline. Results from the double-blind, placebo-controlled Phase 2 study of AXS-12 in narcolepsy may be presented.

Conclusion: There is strong scientific rationale for the clinical development of AXS-12 for narcolepsy. If nonclinical and preliminary clinical findings are confirmed in late-stage studies, AXS-12 would represent a significant advance in the identification of safer, more effective treatments for narcolepsy without abuse potential.

Support (If Any): Axsome Therapeutics Inc.
0059
3-D RECONSTRUCTION OF NEURONS DRIVING CIRCADIAN RHYTHMS
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Introduction: Mammalian circadian rhythms are regulated by a master circadian clock located in the suprachiasmatic nucleus (SCN) of the hypothalamus. SCN neurons display self-sustained oscillations that are maintained by a molecular transcriptional-translational feedback loop. Communicative processes between SCN neurons synchronize noisy oscillations at the single neuron level to generate coherent output rhythms at the tissue level that display selective robustness and plasticity to entrain the SCN and peripheral clocks throughout the brain and body. The aim of this study was to digitally reconstruct mouse SCN neurons using serial electron microscopy techniques to describe the synaptic and non-synaptic intercellular mechanisms between SCN neurons.

Methods: 1000 consecutive 50-nanometer ultrathin serial sections containing male mouse SCN tissue were cut and collected onto a reel of carbon-coated Kapton tape from the embedded tissue block using an automated tape-collecting ultra-microtome (ATUM). A180-μm x 330-μm x 50-μm (2.97 x 10^3 μm^3) ROI mosaic containing 18 images was imaged at 4-nm/pixel resolution from each consecutive section using a Zeiss Sigma single-beam scanning electron microscope. Images from each section were stitched into a single mosaic per section, and consecutive sections were aligned.

Results: The imaging project generated a 6-Terabyte digitized stack of sections containing SCN brain tissue ultrastructural data. Neurons and processes were traced in VAST, a manual segmentation software, to render a wiring diagram consisting of 3-dimensional reconstructions of neurons and communicative processes in the SCN.

Conclusion: We found 4-nm resolution to be sufficient for tracing and analyzing both synaptic and non-synaptic cellular processes across 50-nanometer sections. Describing part of the structural connectivity of the SCN will provide insight to the help to elucidate our understanding of key circadian mechanisms, namely the generation of synchronous output rhythms from independent cell autonomous oscillators.

Support (If Any): N/A

0060
HIPPOCAMPAL RESPONSE TO SLEEP-RELATED PICTURES MODERATES THE ASSOCIATION BETWEEN SLEEP DISTURBANCE AND IMPULSIVITY
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Introduction: Studies have shown that individuals with sleep disturbance showed greater impulsivity. The hippocampus is not only a brain region important for memory which is consolidated during sleep, but also constitutes a part of brain network involved in decision making. Therefore, hippocampus may play an important role in linking between sleep disturbance and impulsivity. In the present study, we aimed to examine whether hippocampal activity moderates the relationship between sleep disturbance and impulsivity.

Methods: 40 healthy participants (35.60 ± 10.81 years old, 53% male) without any sleep disorders based on nPSG completed a sleep-related picture task, which requires to view sleep-related and control pictures during a functional magnetic resonance imaging (fMRI) assessment using a 3T scanner. The Pittsburgh Sleep Quality Index (PSQI) and Barratt Impulsiveness Scale (BIS) were administered to assess sleep disturbance and impulsivity, respectively. The hippocampus, a region-of-interest (ROI), was defined based on the AAL atlas and hippocampal response to sleep-related pictures vs. control pictures was extracted. Moderation analyses were conducted using Hayes’ PROCESS macro in SPSS to test whether hippocampal response to sleep-related pictures moderates the relationships between sleep disturbance and impulsivity, controlling for age and gender.

Results: Results showed that the association between sleep disturbance and impulsivity was moderated by right hippocampal response to sleep-related pictures (β=7.76, t=2.18, p=0.04). The sleep disturbance and impulsivity relationship was stronger when hippocampal activity was high (β=1.75, t=2.29, p=0.03) compared to when hippocampus activity was low (β=-0.71, t=-0.99, p=0.33) in response to sleep-related pictures.

Conclusion: The current finding indicates that individuals with severe sleep disturbance may have high impulsivity when they show greater hippocampal activity in response to sleep-related pictures. This result suggests that the hippocampus may be an important brain structure for linking sleep disturbance and impulsivity.

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0061
SLEEP DURATION AND TIMING IN RELATIONSHIP TO TOXOPLASMA GONDII IGG SEROINTENSITY IN THE OLD ORDER AMISH
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Introduction: Disruption of sleep is associated with mental illness and suicidal behavior. Toxoplasma gondii (T. gondii), a neurotropic parasite has been linked with schizophrenia, mood disorders and suicidal behavior, and is able to synthesize dopamine and to elicit immune activation factors that may contribute to changes in sleep duration and timing. Our group proposed that sleep disruption could mediate in part a possible link between the parasite and mental illness. We previously found no associations between markers of T. gondii infection and sleep but did not account for relatedness within the Amish. We hypothesized that serointensity and seropositivity of T. gondii will be associated with shorter sleep
duration and delayed sleep in the Old Order Amish- a group with less lifestyle heterogeneity, no home exposure to network electric light and much lower rates of substance abuse in adults than in other populations. Methods: 787 Old Order Amish responded to questions regarding bedtime, sleep duration midsleep timing and sleep offset. We analyzed the T. gondii titer- sleep duration and midsleep association with linear mixed models by MMAP with adjustment for age, gender and family structure. Results: After accounting for family structure, higher T. gondii IgG titers were associated with longer (p<0.05), not shorter, sleep duration, and an earlier, not later, midsleep (p<0.01). There were no significant associations of sleep duration or timing with T. gondii seropositivity.

Conclusion: It is unlikely that the duration and timing of sleep are mediating the link between T. gondii and psychiatric illness and behavioral dysregulation. The positive association between titers and sleep duration and an earlier midsleep timing requires replication with better methods and longitudinal design

Support (If Any): Mid-Atlantic Nutrition Obesity Research Center Pilot P30 DK072488 and Joint Institute for Food Safety and Applied Nutrition/UMD, through the cooperative agreement FDU.001418 . This study was also supported by the VA Merit Review CSR&D grant I101CX001310-01A1.

0062

RAPID-EYE MOVEMENT SLEEP AND BRAIN-DERIVED NEUROTROPIC FACTOR AS PREDICTORS OF STRESS RESILIENCE AND VULNERABILITY

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Introduction: Post-traumatic stress disorder (PTSD) affects approximately 24 million people in America, and sleep disturbances are the primary symptoms. However, only approximately 20% of individuals exposed to trauma develop chronic problems with sleep indicating individual differences in stress-induced sleep changes. Currently, no methods exist to predict individual differences in sleep responding prior to stressor exposure. In this project, we examined REM changes after mild and intense stress as an index of stress resilience or vulnerability.

Methods: Male rats were implanted with electrodes for sleep recording and a datalogger to record body temperature. Rats were habituated to the necessary handling and tethering procedures. Baseline sleep was recorded on day 1. On day 3, rats were placed in a novel chamber (NC) and sleep was recorded. On day 4, rats were placed in a shock chamber and received shock training (ST: 20 footshocks over 30 minutes) and sleep was recorded. Animals were separated into vulnerable (Vul, n=21) and resilient (Res, n=25) groups based on whether or not they had a 50% or greater reduction in REM in the first 4 hours of sleep post-ST respectively. Blood plasma was obtained to measure BDNF.

Results: Analysis of the first 4 hours of sleep showed baseline REM was not significantly different between groups. Post-NC REM was significantly lower (p<0.001) in Vul rats compared to baseline and post-ST REM was significantly lower (p<0.05) than post-NC sleep in Vul rats. Res rats had no significant change in REM compared to baseline across training days. Post-NC and ST REM was significantly lower in Vul rats (p<0.05) compared to Res rats. Res rats had significantly higher BDNF concentrations compared to Vul rats (p<0.05). Body temperature and behavioral freezing was not significantly different between groups.

Conclusion: These data demonstrate that outbred rats can show significant individual differences in post-stress sleep, and that mild stressors may predict stress resilience and vulnerability without the long-term consequences of intense or traumatic stress. Future studies will evaluate other differences to predict stress resilience and vulnerability.

Support (If Any): MH164827

0063

PRELIMINARY EXAMINATION OF THE EFFECTS OF LONG-TERM SLEEP RESTRICTION ON INTRINSIC BRAIN CIRCUITRY

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Introduction: Short sleep duration promotes metabolic dysregulation and obesity. We have previously shown that acute sleep restriction increases neuronal activity in response to food stimuli in areas of interoception and reward, such as the insula and orbitofrontal cortex. However, whether chronic mild sleep restriction impacts food reward valuation in the brain remains unknown. In an ongoing study, we assess the effects of mild 6-week sleep restriction on intrinsic functional connectivity (iFC) across reward and interoception-related brain circuitry.

Methods: To date, 16 adult men and women (age 29.0±5.3 years and BMI 26.9±2.6 kg/m² at study entry) took part in this randomized, crossover, outpatient trial of 2 phases: habitual sleep (HS; ≥7 h/night) and sleep restriction (SR; ≤1.5 h/night relative to HS). All participants were screened with actigraphy over a two-week period to ensure adequate sleep duration of 7-9 h/night (average screening total sleep time: 7.6±0.5 h/night). Two resting-state (task-free) functional MRI scans (Siemens Skyra 3T, TR=2.5s, two 5-min runs) were collected during the final week of each phase. Here we report preliminary analyses using the Data Processing & Analysis of Brain Imaging V2.3_170105 toolbox with paired-sample t-tests across the whole brain.

Results: Average sleep duration in the HS phase was 7.55±0.55 h/night vs. 6.10±0.49 h/night during SR (p<0.0001). Examining iFC of 17 previously studied regions-of-interest relevant to food valuation and interoception yielded two significant results after correction for Gaussian Random Field (p<0.001 at voxel level, cluster p<0.05). iFC was greater following SR than HS for (1) left inferior frontal gyrus with medial prefrontal cortex (mPFC); and (2) mPFC with bilateral superior temporal gyrus.

Conclusion: This study provides preliminary evidence of decreased segregation between a key anterior node of the default mode network (mPFC) and nodes of the salience and somatosensory (auditory) networks under prolonged mild SR. Such iFC changes, suggesting atypical network coupling, if confirmed in the completed sample, will be examined in the future in relation to key measures of metabolism and cardiovascular risks.

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0064
DEEP-BRAIN IMAGING OF LATERAL HYPOTHALAMIC VGAT NEURONS DURING SLEEP
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Introduction: In-vivo electrophysiology has identified neurons that are selectively active in waking, NREM, or REM sleep (for review see Shiromani and Peever, 2017). However, this method has limitations. New tools are needed to disentangle the brain circuitry regulating complex behaviors such as sleep. We use deep-brain imaging to measure calcium (Ca2+) gradients associated with excitatory signaling (Tian et al., 2009)(Ghosh et al., 2011) in neurons that contain the vesicular GABA transporter (vGAT). The vGAT neurons are a distinct population juxtapositioned with the neurons that contain orexin or MCH in the lateral hypothalamus (Blanco-Centurion et al., 2018), but their activity in sleep in freely-behaving animals is unknown.

Methods: In vGAT-cre mice, rAAV-DIO-GCaMP6m was delivered stereotaxically to the lateral hypothalamus (isoflurane anesthesia) and a GRIN lens and sleep electrodes were implanted. Three weeks later a miniscopic (nVista; Inscoe.com) revealed single vGAT neurons.

Results: Thirty-eight vGAT neurons were automatically extracted (PC-AICA analysis; Mosaic software) from three vGAT-cre mice (female). The average fluorescence was significantly higher during both active wake and REM sleep compared to QW, NREM or REM transition [F(4,175)=14.05; P=0.001; Mixed Model SPSS25]. The fluorescence in NREM was the lowest compared to the other states [P=0.001]. In REM sleep and active waking, the fluorescence occurred in phasic volleys.

Conclusion: The activity of the vGAT neurons in the lateral hypothalamus is similar to the activity of the vGAT neurons in the amygdala, and suggests that these neurons may respond to activity in the sensory-motor system during active waking and REM sleep.

References


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0065
SLEEP AND WAKE BIOMARKERS OF PSYCHOTIC DISORDERS AND THEIR RELATIONS WITH THALAMOCORTICAL CONNECTIVITY
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Introduction: Recent data implicate abnormalities of the thalamic reticular nucleus (TRN) and thalamocortical circuitry in schizophrenia (SZ) risk. Sleep spindles are initiated by the TRN and propagated to the cortex via thalamocortical feedback loops. During wakefulness, TRN modulates sensory processing by gating thalamocortical communication. Patients with SZ and their first-degree relatives (familial-high-risk,FHR) exhibit sleep spindle and sensory gating deficits. In two studies, we investigated the two SZ biomarkers in relation to thalamocortical connectivity in chronic and early-course psychotic disorders and FHR.

Methods: Twenty-six SZ and 29 healthy controls (HC) participated in Study1; 10 early-course patients with psychotic disorders (PSY), 14 FHR and 16 HC participated in Study2. All participants completed a resting-state fMRI session and thalamocortical seed-to-voxel connectivity was computed. In a separate session, nocturnal sleep was monitored with PSG for Study1. Sleep spindles were identified using an automated wavelet detector. Study2 included a sensory gating event-related-potentials (ERP) experiment. Gating was calculated as the suppression of the auditory P50 for the second of a pair of identical clicks. Whole brain regression analyses were used to examine relations of thalamocortical connectivity with sleep spindles and sensory gating (we report p<0.05).

Results: SZ showed widespread reductions in spindle density (38 electrodes, pcor < 0.009). Reduced spindle density was associated with significantly greater thalamic connectivity with left sensory-motor cortex (MN1:x=-24,y=-16,z=64; BA4; no slope difference) in regions that overlap with those SZ patients show abnormal thalamocortical hyperconnectivity. Relative to HC, PSY exhibited marginally-reduced sensory gating (t(19)= -1.9, p=0.07; FHR vs HC non-significant). Reduced sensory gating correlated with weaker thalamocortical connectivity in the right dorsolateral-prefrontal cortex (DLPFC[44,44,-2]; BA46; no slope difference) connectivity in this cluster was significantly reduced in PSY vs. HC (t(19)= 2.2, p=0.04; FHR vs HC non-significant).

Conclusion: In two experiments, we show that two SZ biomarkers, sleep spindle and sensory gating deficits are associated with abnormal thalamocortical connectivity, suggesting that they arise from a common mechanism. Data collection for Study2 is ongoing and increased sample sizes will allow for analysis of the specificity of these abnormalities to SZ and SZ risk.

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0066
DISRUPTED THALAMOCORTICAL CONNECTIVITY FOLLOWING MILD TRAUMATIC BRAIN INJURY: ASSOCIATIONS WITH DAYTIME SLEEPINESS
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Introduction: Changes in sleep are commonly reported by upwards of 70% of individuals who have experienced a mild traumatic brain injury (mTBI). Among those with mTBI, increased daytime sleepiness is one of the most frequent self-reported complaints. Previous research demonstrates changes to thalamocortical connectivity associated with daytime sleepiness in healthy populations. The present study focused on identifying this association following a mTBI. We hypothesized that thalamocortical connectivity and daytime sleepiness associations would differ significantly between adults with mTBI and healthy controls (HC).

Methods: A total of 64 individuals participated in the study, including 23 HC and 41 individuals with mTBI. Individuals in the mTBI
group had a documented injury within the past 12 months. Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS), while functional connectivity was measured using resting-state functional magnetic resonance imaging. A seed-to-voxel analysis, using bilateral thalamic seed regions, was conducted in the CONN toolbox to identify differences in the association between thalamocortical connectivity and ESS between the two groups.

**Results:** Daytime sleepiness was significantly greater in those with mTBI (M=9.83, SD=3.86) compared to HCs (M=5.35, SD=3.58) (t=-4.57, p<.001). Significant anticorrelations between thalamocortical connectivity and ESS were found in the HC group, compared to limited associations in the mTBI group (whole-brain height threshold p<.001 uncorrected, two-sided; cluster threshold p<.05 FWE-corrected). Specifically, lower ESS scores were associated with greater functional connectivity between the thalamus and bilateral premotor cortices (BA6; R, p<.001; L, p<.05), left primary somatosensory cortex (BA1; p<.001), left primary motor cortex (BA4; p<.01), and the right hippocampus (p<.05), an association that was weaker in mTBI.

**Conclusion:** Lower daytime sleepiness was associated with greater thalamocortical connectivity, specifically to somatosensory and motor regions, in healthy controls, but not in those with mTBI. It is well-established that thalamocortical projections are critically involved in sleep and arousal states. Our findings suggest well-established thalamocortical associations with sleepiness are disrupted following mTBI. These findings may reflect a neurobiological underpinning for sleep disturbances in mTBI.

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**0067**
**HUMANIZED CHEMOGENETIC APPROACH TO TREAT SLEEP APNEA**

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**Introduction:** Obstructive Sleep Apnea (OSA) is a prevalent condition and a major cause of morbidity and mortality. OSA contributes to the development and progression of neurocognitive, metabolic, cardiovascular, and oncologic diseases. The tongue and specifically genioglossus (GG) muscle have been implicated in the pathogenesis of upper airway (UA) obstruction during sleep. Nasal positive airway pressure can treat OSA but poor adherence severely limits its effectiveness. We have previously shown that obese C57BL/6J mice have OSA, similar to humans. We have also shown that DREADDs deployed by intracranial injection in the XII nucleus and activated with specific ligand clozapine-N-oxide (CNO) increases UA patency in mice. Several challenges preclude the translational use of our previous approach including (a) intracranial injections; (b) CNO conversion psychotropic active clozapine. We hypothesized that, in mice, UA patency can be improved and sleep apnea can be treated by injecting DREADD carried by an adeno-associated virus type 9 (AAV9) capable of retrograde neuronal transport and activated by a novel ligand JHU37160 (J60).

**Methods:** Excitatory DREADD (AAV9-hSyn-hM3(Gq)-mCherry n=10) or Control AAV9-hSyn-GFP (n=5) was delivered bilaterally by tongue injection to mice with diet induced obesity. Six weeks after the delivery, mice were injected with J60 or saline intraperitoneally (IP) using a cross-over design and submitted to GG electromyography (EMGGG), UA dynamic MRI and sleep studies.

**Results:** In all mice 15 mice DREADDs or control virus were expressed in the hypoglossal nucleus confirming effective retrograde transport after the GG injection. DREADDs transfected mice showed a striking 7.05 fold increase in tonic EMGG activity and nearly 2 fold increase in EMGG activity after J60 injection (p<0.001). In MR imaging, axial dynamic images demonstrated significant pharyngeal dilation At the rim of the soft palate upon the ligand administration (0.46 ± 0.03mm² to 1.16±0.05mm²; p<0.05). Sleep studies currently in progress.

**Conclusion:** Lingual muscles can be successfully stimulated using retrograde transgenic approach to activate motor neuron groups in selected brain areas. Our results suggest that retrograde delivery of DREADD to the hypoglossal nucleus effectively controls pharyngeal patency and may treat OSA.

**Support (If Any):** R01HL138932-0 and ATS Unrestricted Grant.
Conclusion: to 72±5 mmHg; p=0.043), but not HR.

Results: episodes of alpha intrusion were associated with increases of SAP to 99±4 mmHg; DAP, 68±3 to 57±3 mmHg; p<0.01), but not HR. Continuously recorded BP are lacking. Moreover, while increases of alpha frequencies (i.e., alpha intrusion) during REM are reported in some pathological conditions, the relation between alpha intrusion and REM BP is unknown.

Methods: Thirteen participants (6 female, 22±1 years, 28±1 kg/m²) were equipped with overnight finger plethysmography (NOVA, Finapres) and standard 10-lead polysomnography. Central and occipital leads were analyzed using a short-term Fourier transform function to quantify 1) delta density using delta frequencies (0.5-4 Hz) in the first and second SWS cycles and 2) alpha intrusion using alpha frequencies (8-12 Hz) in the final REM episode. Continuous systolic arterial pressure (SAP), diastolic arterial pressure (DAP), and heart rate (HR) were recorded during wake and sleep.

Results: BP was significantly reduced during the first (SAP, 114±4 to 99±4 mmHg; DAP, 68±3 to 57±3 mmHg; p<0.01), but not second (SAP, 110±4 mmHg; DAP, 64±5 mmHg; p>0.05), cycle of SWS when compared to wake. Changes in delta density across the SWS stages were significantly correlated with changes in SAP (r = -0.69, p = 0.03) and DAP (r = -0.71, p = 0.02). During REM, acute episodes of alpha intrusion were associated with increases of SAP (119±5 mmHg to 123±5 mmHg; p = 0.039) and DAP (69±5 mmHg to 72±5 mmHg; p = 0.043), but not HR.

Conclusion: Our findings suggest that the intensity of SWS is associated with greater reductions in nocturnal BP, and that episodes of alpha intrusion increase REM BP. These findings support growing evidence that both SWS and REM are important to cardiovascular health.

Support (If Any): National Institutes of Health (AA-024892) and Portage Health Foundation.
Results: The POMS ratings on "Energy" was not affected by different conditions of light, but high CAF light (L4) decreased the ratings on "Tiredness". Alpha wave was highest for the condition with highest CAF (L4) and was lowest for lowest CAF light (L1). However, the two conditions with similar CAF but different color temperatures (L2 & L3) did not show consistent results. Theta wave also shows the same pattern but in the opposite direction as alpha wave.

Conclusion: The results of our study support that CAF do have positive correlation with alertness, the higher the CAF of a lighting, the more it can enhance alertness. In comparison to color temperature, CAF seems to be a better index for alertness-promoting effect of light.

Support (If Any): Industrial Technology Research Institute

0072
THE EFFECT OF CIRCADIAN ACTION FACTOR (CAF) OF ARTIFICIAL LIGHT ON THE LEVEL OF MELATONIN AND SUBJECTIVE ALERTNESS
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Introduction: The invention of artificial light promoted the development of civilization, but it disrupts the normal regulation of human physiology and psychology, such as hormone synthesis, sleep-wake cycle, and the level of alertness. Previous researches found that high color temperature and Illuminance of light suppress pre-sleep melatonin secretion as well as reduce subjective alertness. Lately, a newly proposed formula, Equivalent Meloopic Lux (EML) = Circadian Action Factor (CAF) * Lux, suggests that CAF could be a better predictor for melatonin suppression effect. Hence, the present study examine this hypothesis by comparing the effects of lights with similar color temperature but different CAF.

Methods: 6 healthy students (19-20yo) without sleep or psychiatric disorder, participated in the study. They spent 5 nights in the sleep lab for the exposure to different lights: one dim-light night as baseline and four randomly assigned light conditions with different color temperatures (A: 3419K/0.41; B:3453K/0.60; C: 5560K/0.65; D:5588K/0.91). They were exposed to the light condition starting at 1.5 hours before habitual bedtime to their habitual bedtime, CAF is a better index to predict the melatonin suppression effect of light. Moreover, the level of subjective alertness correlate positively with concentration of melatonin in the dim light. The correlation however is diminished with light exposure. This preliminary study suggest that CAF might be a better index to study the effects of light on human physiology.

Support (If Any): 1TRI

0073
ACTIVATION OF LEPTIN RECEPTOR POSITIVE NEURONS IN THE NUCLEUS OF THE SOLITARY TRACT (NTS) ALLEVIATES SLEEP DISORDERED BREATHING IN OBESE MICE
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Introduction: Obstructive Sleep Apnea (OSA) is a major cause of morbidity and mortality with high prevalence. The loss of motor input related to deeper sleep stages lead to recurrent pharyngeal collapse (apneas and hypoapneas), leading to oxyhemoglobin desaturations and arousals. There is still no effective pharmacotherapy for OSA. Leptin is a powerful respiratory stimulant and long isoform of leptin receptor, LepRb in the brain is an important therapeutic target in sleep disordered breathing.

Methods: Male LepRb-Cre mice with diet induced obesity (DIO) underwent bilateral stereotactic administration to NTS of an adeno-associated virus harboring the excitatory Cre-dependent Designer Receptor Exclusively Activated by Designer Drug (DREADD) rAAV5.2-hSyn-DIO-hM3(Gq)-mCherry (Virovec, 1 x 1011 vg/ml, 250 nl) (n = 4) and headmount with EEG and nuchal EMG leads under 1-2% isoflurane. Four-six weeks later, sleep studies were performed after DREADD ligand (JH37160) or saline i.p. injection in a randomized blinded manner. Treatment groups were crossed-over and sleep studies were repeated a week later.

Results: We successfully targeted NTS with DREADDDs. JH37160 dramatically increased non-flow limited minute ventilation (V_e) from 0.92±1.32 mL/min/g to 1.34±0.39 mL/min/g in NREM sleep and from 0.89±0.43 mL/min/g to 1.24±0.53 mL/min/g in REM sleep without change in body temperature suggesting up-regulation of ventilatory control rather than a metabolic response. There was no decrease in the frequency of obstructed breaths. However, upper airway obstruction significantly improved which was manifested by an increase in maximal inspiratory flow (from 2.1±2.3 mL/s to 3.8±0.9 mL/s in NREM and from 2.5±0.8 mL/s to 3.6±0.8 mL/s in REM) and minute ventilation (from 0.73±0.5 mL/min/g to 1.29±0.4 mL/min/g in NREM and from 0.96±0.46 mL/min/g to 1.19±0.49 mL/min/g in REM) during obstructed breathing. This improvement resulted in striking decreases in the oxyhemoglobin desaturation index, which decreased from 37.1 to 4.4 events/hr in REM sleep.

Conclusion: Activation of LepRb+ neurons in NTS alleviates sleep disordered breathing in DIO mice affecting both ventilatory and upper airway control.

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**0074**

**CAN WE IDENTIFY REPRODUCIBLE BRAIN-ACTIVITY MARKERS OF PTSD DURING SLEEP?**

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**Introduction:** Combat-exposed veterans with PTSD often report sleep problems. Unfortunately, prior efforts that attempted to identify PTSD markers during sleep have yielded inconsistent findings. Here, we aim to find brain-activity markers of PTSD during sleep that are both reproducible across nights and sub-populations.

**Methods:** During two consecutive nights of sleep, we obtained high-density (64-channel) EEG recordings from 78 combat-exposed Service men with (n = 31) and without (n = 47) a diagnosis of PTSD. We performed spectral-topographical analyses focusing on EEG activities considered to be functionally relevant to sleep, including delta activity (1-4 Hz) during non-rapid eye movement (NREM) sleep, theta activity (4-8 Hz) during rapid eye movement (REM) sleep, sigma activity (12-15 Hz) during N2 sleep, and high-frequency beta and gamma activities (>15 Hz) during both NREM and REM sleep. To assess reproducibility, we performed a primary analysis with the first 47 consecutive participants (18 PTSDs) and then a replication analysis with the remaining 31 participants (13 PTSDs).

**Results:** Compared to non-PTSD participants, PTSD participants exhibited 1) reduced NREM delta power over the centro-parietal brain regions (for both nights p < 0.036, Cohen’s d > 0.68) and 2) elevated NREM and REM high-frequency power, most prominent in the gamma frequency band (30-40 Hz) over the antero-frontal brain regions (for both nights p < 0.040, Cohen’s d > 0.74). No significant group differences were found for REM theta and N2 sigma powers. These findings were consistent across the two nights and, importantly, were reproduced in the replication analysis in terms of effect size (Cohen’s d > 0.34).

**Conclusion:** The reduced centro-parietal NREM delta power, indicating reduced depth of sleep, and the elevated antero-frontal NREM and REM gamma power, indicating heightened central arousal, are potential markers of PTSD during sleep. After independent validation, these putative EEG markers may offer new targets for the development of novel targeted sleep-specific PTSD treatments.

**Support (If Any):** None

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**0075**

**REM SLEEP IS BIMODAL**

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**Introduction:** The classic model of sleep and sleep scoring differentiates REM sleep, wake and stages of NREM which increase in depth grade. Alternate methods of sleep characterization include cyclic alternating pattern, sleep power kinetics (delta, alpha, etc), slow-oscillation density metrics, the Odds Ratio Product, network based approaches such as time delay stability, and ECG-spectrogram (cardiopulmonary coupling), the latter showing an intrinsic bimodality of NREM sleep. REM sleep has so far been considered a unitary state.

**Methods:** Fifty diagnostic or split-night polysomnograms of sleep apnea were reviewed to identify coexisting features of REM and NREM sleep, but using respiratory patterns as a key guide. Thus, periodic breathing in REM sleep, NREM EEG during REM-type sleep apnea and stabilization of NREM periodic breathing at the edges of REM sleep, before conventional REM sleep, were examples of mixed states identified. Oximetry patterns (hand-like for periodic breathing, V-shaped desaturation for REM-dominant obstructive disease) were also used to identify respiratory sleep stage. These mixed states are called "unstable REM sleep". The minimum period for this state was 60 seconds.

**Results:** The subject population characteristics were 37/50 males, BMI 32.3 Kg/M2, age: 54.3 +/- 8 years. There were a total of 127 REM periods of at least 15 minutes duration. In 78/127 periods, a segment of unstable REM across EEG and respiratory domains, were noted. These occurred exclusively at the transition into REM sleep, never at the end of a REM period. In 12 periods, periodic breathing occurred within REM sleep, when REM and NREM were admixed secondary to a arousal-shift to NREM-periodic breathing-return to REM sleep sequence.

**Conclusion:** Using both conventional EEG-based scoring and the respiratory phenotype, distinctly mixed states of REM and NREM occur at the transition into REM sleep. In the case of sleep apnea, these periods can be prolonged over several minutes. It may be conceptually useful to consider REM as bimodal, in stable and unstable forms. Such bimodality can inform models of sleep regulation, and pathological states such as narcolepsy, where state boundaries are less stable.

**Support (If Any):** None
Introduction: Non-rapid eye movement (NREM) sleep is known to play a critical role in episodic memory consolidation. Sleep spindles, EEG events in the 9-15 Hz range that are characteristic of NREM stage 2 sleep, are often implicated in this process. However, spindles also occur during slow wave sleep (SWS), and it remains unclear whether stage 2 sleep is sufficient to observe spindle-related memory benefits, if obtaining SWS is necessary as well, or if SWS spindles alone are essential for memory performance. Here, we tested the hypotheses that 1) episodic memory retention would be greater following a nap containing SWS than one without SWS, and 2) spindles during SWS but not stage 2 sleep would predict retention. We also sought to identify whether slow (9-12 Hz) and fast (12-15 Hz) spindles would be differentially associated with memory.

Methods: In the early afternoon, participants completed an unrelated word pair associates task, followed by a cued recall test to assess initial memory performance. They were then assigned to a 75-min nap opportunity (SWS+; n=31), a 20-minute nap opportunity (SWS-; n=18), or 20 min of active wakefulness (wake; n=18), followed by another cued recall test.

Results: Preliminary results indicate that participants in the SWS+ condition performed better than the wake condition on the task, although this difference did not reach statistical significance (t(47)=1.83, p=0.057). There were no significant differences between the wake and SWS- conditions, or between the two nap conditions. In addition, memory retention did not correlate with overall measures of spindle activity (i.e., total number, density, power) in either stage 2 or SWS; however, the total number of slow spindles in SWS did correlate with memory (r=0.44, p<0.05).

Conclusion: These findings provide initial evidence that the duration and composition of a daytime nap may affect memory consolidation. SWS, in particular, may be necessary to observe sleep-related memory benefits, but further research is needed to elucidate the role of spindles during SWS for episodic memory consolidation.

Support (If Any): No support was used.

0078 PARKINSON’S DISEASE PATIENTS WITH PROBABLE REM BEHAVIOR DISORDER HAVE GREATER EXECUTIVE CONTROL IMPAIRMENTS THAN PD PATIENTS WITHOUT PROBABLE RBD
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Introduction: Parkinson’s disease (PD) is a neurodegenerative and multisystem movement disorder associated with cognitive and sleep impairments. REM Sleep Behavior Disorder (RBD) is a harbinger of PD and its presence may represent a more severe disease prognosis. We investigated whether the PD patients with probable RBD (n=19) had greater cognitive impairment than PD patients without RBD symptoms (n=31) or healthy matched controls (n=47).

Methods: Participants received a clinical sleep assessment and a comprehensive neuropsychological examination. Probable RBD was determined using the REM Sleep Behavior Disorder Questionnaire (total score >5). PD severity was determined using a modified Hoehn-Yahr Scale and PD duration. Cognitive flexibility (i.e., color, word, inhibition, and switching speed) and verbal fluency (i.e., category, letter, and switching responses and accuracy) were assessed with the Delis-Kaplan Executive Function System subtests, working memory was assessed using accuracy on the 2- and 3-back tests, sustained visual attention was evaluated using a Continuous Performance Task, and visuospatial skills were measured using the Benton Judgment of Line Orientation test. Mann-Whitney U and t-tests were employed to analyze differences between groups (all PD patients vs. matched controls and PD patients with RBD vs. PD patients without RDB).

Results: PD patients had poorer sustained attention, working memory (3-back), and visuospatial skills than controls: Z=-2.59,
p<0.01, Z=-2.31, p<0.021, Z=-2.54, p<0.011, respectively. PD patients with probable RBD had poorer performance on cognitive flexibility tasks including word reading, switching verbal fluency, and category verbal fluency than the PD patients without RBD: Z=-2.49, p<0.013, Z=-2.26, p=0.024, t=2.51, p=0.016, respectively. PD severity did not differ in patients with or without probable RBD (p>0.05).

Conclusion: Given comparable disease duration and severity, the presence of probable RBD in PD was associated with greater executive function impairments than PD alone. RBD in PD may be associated with advanced impairment in brain circuitry implicated in verbal executive functions (i.e., left frontoparietal cortices).

Support (If Any): None

0079
THE EFFECTS OF A SINGLE NIGHT OF CONTINUOUS POSITIVE AIRWAY PRESSURE ON MEMORY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: During sleep-dependent memory consolidation, new memories are stabilized for long-term storage in a discriminative fashion, as memories relevant for future behavior are preferentially processed over others. Memory deficits have been observed in patients with obstructive sleep apnea (OSA) and may result from deficient sleep-dependent memory consolidation. This study investigated the effect of a single night of continuous positive airway pressure (CPAP) on memory consolidation for future-relevant versus future-irrelevant memories in treatment-naive OSA patients (no-CPAP group) and OSA patients receiving their first night of CPAP treatment (CPAP group).

Methods: Before sleep, all participants completed two study/test cycles of an object-location memory task. During study, objects from two categories were each presented in one of eight possible screen locations. During test, each object appeared centrally, and participants indicated the screen location where the object was studied. Participants also rated their confidence in each decision. Next, participants were informed that they would receive additional compensation if their memories from one (reward-relevant category) of the two studied categories improved overnight. Sleep was monitored via polysomnography, and participants in the CPAP group received CPAP treatment during sleep. After waking, participants again completed the test phase of the memory task.

Results: Both groups showed better memory accuracy on the evening test compared with the morning test, with no group differences. Furthermore, both groups showed better retention of reward-irrelevant compared with reward-relevant items. However, while memory confidence decreased in both groups from evening to morning, the no-CPAP group showed a greater decrease for reward-irrelevant compared with reward-relevant items. No significant group differences in sleep measures were present, although relationships between memory and specific sleep measures differed between groups.

Conclusion: The instruction regarding future relevance was more effective in the no-CPAP group, suggesting that consolidation may have been less disrupted in the no-CPAP group than in the CPAP group. Therefore, a single night of CPAP may not be sufficient to improve memory, perhaps due to the initial difficulty of adjusting to CPAP use.

Support (If Any): None
parasympathetic activity during wake associated with better working memory (WM). Compared with wake, sleep is a period with substantially greater parasympathetic tone, and sleep facilitates WM. Yet, the role of this sleep-dependent boost in parasympathetic activity for WM is not known.

Methods: 107 young (Age:17-23) and 101 older adults (Age: 60-85) were randomized to either have a 2-hour nap opportunity monitored with polysomnography (PSG) (Young: n=58; Older: n=54) or stay awake (Young: n=40; Older: n=47), where subjects engaged normal daily activities with activity watch monitoring. We tested WM using the Operation-Span task in the morning and evening, and measured autonomic activity, as measured by heart rate variability (HRV), during the inter-test period containing a nap or wake period. To assess the autonomic profiles, we used linear-mixed effect models (LME), with a within-subjects factor of stage (Resting, Stage 2, SWS, REM) and a between-subjects factor of age (Young vs. Older).

Results: Our analysis revealed a significant interaction between age and sleep stage, where young adults showed the expected boost in parasympathetic activity during sleep, while older adults showed a marked loss of parasympathetic tone during the nap. Also, young adults demonstrated sleep-dependent WM improvement, which was associated with relative parasympathetic power during sleep. In contrast, older adults showed no beneficial effect of nap and no correlation between parasympathetic activity and WM.

Conclusion: Parasympathetic activity during sleep, but not wake, has substantial implications for WM in young adults, but no such cardiovascular break occurs during daytime naps in the elderly.

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0082
CIRCADIAN INFLUENCES ON SLEEP-DEPENDENT CONSOLIDATION OF HIPPOCAMPUS-DEPENDENT MEMORY: PRELIMINARY RESULTS FROM ADOLESCENTS UNDERGOING 24-HOUR FORCED DESYNCHRONY
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Introduction: Sleep supports processes necessary for hippocampus-dependent memory consolidation. While experimental paradigms for sleep-dependent memory consolidation commonly involve comparing sleep/wake delays at opposing diurnal phases, whether the memory benefit of sleep is influenced by circadian phase is unclear. Using forced desynchrony (FD), this study tested the hypothesis that the sleep benefit upon hippocampus-dependent memory consolidation depends on the circadian phase at which sleep occurs.

Methods: 12 adolescents (6F, mean 13.6±0.8 years) completed seven cycles of 24-hour FD. Each 24-hour FD cycle included 17.5 hours scheduled wakefulness and 10.5 hours sleep, decoupling sleep timing from circadian phase. Participants trained on the hippocampus-dependent Mnemonic Similarity Task and tested approximately 12-hours later, in four conditions bracketing wake or sleep during either the biological day or night. Thus, both initial learning and delayed consolidation were tested at opposing levels of sleep pressure and circadian phase.

Results: Repeated-measures ANOVA found no evidence that sleep pressure, circadian phase, or their interaction predicted initial encoding ability (all p’s > 0.05). When assessing within-subject change scores, a trend emerged indicating an interaction of sleep and circadian phase (F(1,11)=3.56; p=0.086) affecting consolidation. Thus, when learning occurred in the circadian morning, a delay that included sleep was associated with reduced forgetting compared to a delay without sleep (t(11)=1.83; p=0.045 [one-tailed]). No benefit of sleep was present across the circadian night (t(11)=0.37; p=0.72 [one-tailed]).

Conclusion: These results provide preliminary evidence that circadian processes may influence the sleep benefit for hippocampus-dependent memory consolidation: a sleep benefit occurred only across the circadian day. Memory-regulating oscillatory properties of sleep, such as sleep spindles, are sensitive to circadian influences. Our future analyses will examine sleep EEG during FD as one potential factor mediating these results. While these results are preliminary and from a small sample, they suggest a need for more direct consideration of circadian timing when assessing sleep-dependent memory consolidation.

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0083
THE EFFECTS OF SLEEP EFFICIENCY AND DURATION ON COLLEGE STUDENTS’ PERFORMANCE ON THE STROOP TEST AND REACTION TIME TASK
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Introduction: There has been extensive research conducted on the effects of sleep factors on cognitive performance. The goal of the current study was to examine the relationship between sleep and cognition in college-aged students.

Methods: Twelve undergraduate students (5 males), average age M = 19.42 years, wore actigraph sleep monitors for one week to measure their normal sleep habits. After one week, participants were asked to perform a series of cognitive tasks, including the Stroop Color-Word test. Participants were shown a series of words on a computer monitor presented in different colors, and they were asked to focus on the color of the word rather than the word itself; errors were recorded. Incongruent Stroop stimuli were stimuli where the color and word did not match; congruent Stroop stimuli matched both color and word. Participants also performed a simple reaction time task.

Results: Average sleep efficiency was 84.85% (SD=3.30), and average sleep duration was 6.65 hours (SD=63.82 minutes). The preliminary Pearson correlation indicated that there was a significant positive, moderate association between sleep efficiency and Stroop incongruent errors, r(10) = .587, p = .045; sleep duration and incongruent errors were not related. Furthermore, the Pearson correlation indicated that there was a significant negative, moderate association between sleep duration and Stroop congruent errors, r(10) = -.619, p = .032; sleep efficiency and congruent errors were not related. The Pearson correlation showed a significant positive, moderate association between sleep efficiency and simple reaction time, r(10) = .727, p = .007.

Conclusion: Unexpectedly, these preliminary results demonstrated that, as sleep became more efficient, errors and reaction times increased. Our sleep duration results confirmed our hypothesis
and previous studies in that participants who slept less made more errors. With the collection of more data, these relationships may change. Thus, it is important to continue this research in order to learn more about sleep factors and cognitive function in college students in order to improve academic success.

Support (If Any): None.

0084
THE EFFECT OF SLEEP ON RETRIEVAL-INDUCED FORGETTING IN OLDER ADULTS
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Introduction: Retrieval-induced forgetting is the process by which memory for practiced stimuli suppresses memory for related but unpracticed stimuli. In young adults, these suppressed memories are restored after a night of sleep but not after a day of wakefulness, with evidence linking REM sleep in particular to this restoration. The duration and quality of REM sleep decline with aging, suggesting that restoration of suppressed memories may be impaired in older adults.

Methods: Older adults (58-81 years; N=16, data collection ongoing) viewed 240 word-pairs once each. They immediately practiced recalling 60 of the word-pairs with feedback (retrieval practice phase). After either a night of sleep recorded with polysomnography (sleep group) or a day of wakefulness (waked group), participants were tested on all 240 word-pairs, which comprised three categories: those that were practiced (RP+), those that were unpracticed but related to the practiced ones (RP-), and those that were unpracticed and unrelated to the practiced ones (NRP).

Results: Unexpectedly, older adults in the wake group failed to exhibit retrieval-induced forgetting, as they did not perform better on NRP word-pairs than RP- word-pairs (p=0.916). Nonetheless, participants in the sleep group performed significantly better on RP- word-pairs than NRP word-pairs (p=0.010), similar to the sleep benefit previously observed in young adults. Additionally, participants in the sleep group performed better on RP+ word-pairs than did those in the wake group (p=0.062).

Conclusion: Though we did not observe evidence of retrieval-induced forgetting in older adults over waking, sleep nonetheless benefitted RP- relative to NRP word-pairs. These results suggest that the process by which sleep boosts weakly-encoded (unpracticed) memories related to stronger (practiced) memories is preserved in older adults and are consistent with previous evidence suggesting that the benefit of sleep on declarative memories is preserved with aging. Ongoing analyses of polysomnography data will determine the relationship between specific sleep features and memory performance.

Support (If Any): NIH R01 AG040133 (PI: Spencer)

0085
EXECUTIVE FUNCTIONING PERFORMANCE ACROSS RANGES OF SLEEP DURATION AND SLEEP EFFICIENCY
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Introduction: The objective of this study was to investigate the impact of low (< 85%) versus good (≥ 85%) sleep efficiency across three ranges of sleep duration on cognitive performance using epidemiological data.

Methods: We used data from the Brain Health Registry, which is an internet-based cohort study (N=22,215; age=56.5±14.0; 74.7% female). Participants were split into 6 groups based on sleep data: (1) low sleep efficiency and short sleep duration (≤ 6 hours; N=3,802), (2) low sleep efficiency and normal sleep duration (6.5–8.5 hours; N=4909), (3) low sleep efficiency and long sleep duration (> 9 hours; N=69), (4) good sleep efficiency and short sleep duration (N=1,548), (5) good sleep efficiency and normal sleep duration (N=10,922), and (6) good sleep efficiency and long sleep duration (N=965). We examined differences in performance across groups using an analysis of covariance, covarying for age. Performance on four executive functioning tests from the CogState Brief Battery were the dependent variables.

Results: The good sleep efficiency normal sleep duration group consistently demonstrated the highest accuracy; while the low sleep efficiency short sleep duration group demonstrated the poorest accuracy across tasks. We observed a linear increase in performance from short to long sleep duration only in the low sleep efficiency group. In the good sleep efficiency group, we observed an inverted U-shape relationship between sleep duration and performance.

Conclusion: These results underscore the importance of examining sleep efficiency when studying the impact of sleep duration on executive function performance. We plan to look at these associations longitudinally to further unpack directionality.

Support (If Any): The Mental Illness Research and Education Clinical Center of the US Veterans Health Administration.

0086
TARGETED MEMORY REACTIVATION DURING SLOW-WAVE SLEEP MODULATES THE NEURAL CORRELATES OF EMOTIONAL MEMORY AND AROUSAL PROCESSING IN WOMEN
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Introduction: Sleep, and in particular slow-wave sleep (SWS), is critical to the consolidation of declarative memories with the hippocampus mediating this effect. Emotion may also modulate memory consolidation through the amygdala. Targeted memory reactivation (TMR) is a method used to investigate sleep-dependent memory consolidation by presenting cues from a learned task during sleep. This study investigated whether TMR modulates memory and associated emotional arousal of negative and neutral stimuli.

Methods: Participants (23 women, mean age 24.35±5.33 (SD) years) rated 36 negative and 36 neutral pictures and their matching sounds for arousal. These stimuli were then used in a spatial associative memory task on which participants were trained and tested before overnight sleep. Half of the sounds were presented during SWS. The next morning, participants performed both memory and arousal tasks again during fMRI acquisition. Behavioral and imaging data were analyzed using repeated measure models, with cueing and emotion as within-subjects factors and time in SWS and rapid-eye-movement sleep (REM) as covariates. All imaging results were small volume corrected at p<0.05, derived from 5,000 permutations.

Results: No cueing effects were observed at the behavioral level. Neuroimaging results of the arousal task showed an interaction between cueing and emotion at bilateral orbitofrontal cortex and...
right insula. This was driven by increases in negative uncued and neutral cued items, and decreases in negative cued and neutral uncued items. We also observed increased activation in bilateral insula and right orbitofrontal cortex as SWS duration increased for all uncued items, whereas there were no changes for cued items. For the memory task, there was an interaction between REM, emotion and cueing in areas of the limbic and memory systems and supplementary motor cortex.

Conclusion: Our results indicate that TMR in women during SWS modulates emotional salience and associated memories differently for negative and neutral stimuli at the neural level. SWS and REM may further modulate TMR effects on arousal and memory, respectively.

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0087
SLEEP STRENGTHENS MEMORY FOR INCIDENTALLY ENCODED INFORMATION
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Introduction: Individuals encode a staggering amount of information each day, and sleep strengthens memory for only some of this information. It remains unclear exactly which information benefits from sleep-dependent consolidation processes. Research thus far only examines the effect of sleep on information that is intentionally remembered for a test; there is no research on how sleep affects memory when information is not actively remembered.

Methods: In two experiments, we investigated the extent to which sleep consolidates memory for incidentally encoded information. Participants rated words in either a deep or shallow encoding task (i.e. abstractness rating or vowel counting) and completed a surprise recognition memory test 12 hours later. Some participants rated words in the morning and were tested later that evening after a period of wakefulness (Wake); others rated words in the evening and were tested the following morning after a night of sleep (Sleep). We took stimuli from lists of semantically-related words (e.g. door; glass, pane) that converge on an unpresented theme word (e.g. window), called a critical lure. Measuring memory for list words and critical lures allowed us to investigate the extent to which sleep consolidated veridical and gist-based memory. In Experiment 1, words were presented in order of descending associativity with the critical lure to encourage gist-based representations. In Experiment 2, the same words were randomly presented to reduce gist-based representations.

Results: In Experiment 1, Sleep participants showed higher recognition of list words and critical lures than Wake participants. Data collection for Experiment 2 is ongoing, but preliminary results suggest sleep consolidated memory for list words after deep encoding but not shallow encoding.

Conclusion: This work provides the first evidence that sleep consolidates incidentally encoded information. There is still some ambiguity regarding the extent to which sleep consolidated veridical memory or more robust gist-based memory. However, sleep seemed to consolidate memory when gist representations were stronger suggesting sleep may consolidate memories based on their strength. In a third experiment, we are testing the hypothesis that memory trace strength predicts the benefit of sleep on incidentally encoded information.

Support (If Any):
in part by sleep spindles, a hallmark feature of non-rapid eye movement (NREM) sleep. It is less clear how the brain selects and prioritizes which memories get consolidated during sleep. Here, we used EEG to identify neural activity during initial memory encoding that can be used to predict subsequent memory consolidation during sleep. We focused on oscillations in the theta (4-8Hz) frequency band, due to its role in memory encoding and retrieval processes.

Methods: Data from the 47 participants will be presented. All participants learnt pairs of words at a computer, followed immediately by a cued recall test. Six hours later, participants performed a second recall test. N = 17 participants stayed awake for the full six hour period, whilst N = 30 had a two-hour nap opportunity followed by four hours awake. High-density (57-channel) EEG was recorded throughout encoding, both recall sessions, and the nap.

Results: Participants in the nap group showed superior memory retention at the delayed test compared to the wake group. Theta activity during encoding was positively correlated with memory consolidation and spindle density during NREM sleep. In turn, spindle density was correlated with memory consolidation. A mediated regression model showed that the relationship between encoding theta and memory consolidation was mediated by spindle density. Additionally, successful memory recall after sleep was associated with significantly lower theta activity than successful recall following a period of wake. The magnitude of the theta decrease was significantly correlated with spindle density.

Conclusion: Our results show that the neural activity that occurs during initial memory encoding contains information that can be used to predict memory consolidation. Theta activity during encoding may act as a potential ‘tagging’ mechanism for subsequent consolidation. We also found that sleep reduces the amount of theta activity required to recall a consolidated memory. This may reflect a sleep-dependent transfer of information from medio-temporal to neocortical networks.

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0090 THE EVOLUTION OF MOTOR SEQUENCE MEMORY OVER TIME AND SLEEP
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Introduction: Sleep has been shown to facilitate the consolidation of explicit motor-sequence learning on the finger-tapping motor sequence task (MST). However, whether sleep’s contribution constitutes stabilization or enhancement is currently under debate. A transient boost in performance after a short break from practice on the MST has been reported, and its magnitude has been shown to predict post-sleep performance. This boost has been proposed to represent early consolidation mechanisms or recovery from reactivation. It must instead reflect active enhancement of the pre-sleep memory.

Methods: Data from the 47 participants will be presented. All participants learnt pairs of words at a computer, followed immediately by a cued recall test. Six hours later, participants performed a second recall test. N = 17 participants stayed awake for the full six hour period, whilst N = 30 had a two-hour nap opportunity followed by four hours awake. High-density (57-channel) EEG was recorded throughout encoding, both recall sessions, and the nap.

Results: Participants in the nap group showed superior memory retention at the delayed test compared to the wake group. Theta activity during encoding was positively correlated with memory consolidation and spindle density during NREM sleep. In turn, spindle density was correlated with memory consolidation. A mediated regression model showed that the relationship between encoding theta and memory consolidation was mediated by spindle density. Additionally, successful memory recall after sleep was associated with significantly lower theta activity than successful recall following a period of wake. The magnitude of the theta decrease was significantly correlated with spindle density.

Conclusion: Our results show that the neural activity that occurs during initial memory encoding contains information that can be used to predict memory consolidation. Theta activity during encoding may act as a potential ‘tagging’ mechanism for subsequent consolidation. We also found that sleep reduces the amount of theta activity required to recall a consolidated memory. This may reflect a sleep-dependent transfer of information from medio-temporal to neocortical networks.

Support (If Any): NIH grant MH048832.

0091 SPINDLE CHARACTERISTICS ARE ASSOCIATED WITH EXECUTIVE FUNCTION IN HEALTHY OLDER ADULTS FROM THE BRAIN IN MOTION STUDY
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Introduction: Sleep spindles are defining characteristics of NREM stage-2 sleep. Sleep spindle characteristics have been associated with memory consolidation and other cognitive functions, and have been used as marker of progressive cognitive decline in clinical populations. The objective of this study is to further explore the relationship between sleep spindle characteristics and cognitive functioning.

Methods: 63 participants (mean age ± SD = 68.02 ±3.67, 30 females) underwent one night of in-home polysomnography (PSG) and cognitive testing in separate sessions. A novel computerized algorithm was used to score PSG data and sleep spindle characteristics were obtained through EEG spectral analysis. A Principal Component Analysis (PCA) was conducted to reduce the number of analyzed cognitive variables and generate factors/domains based on the communalities between the original variables. Stepwise multiple regression analyses were employed to investigate the relationship between spindle characteristics and cognitive measures. All statistics were two-tailed and significance was set at p ≤ 0.05.

Results: The generated four factors which explained 76.2% of the total variance. Factor 1, which explained the largest amount of variance (34.1%), consisted of outcomes of primary executive functions (processing speed, inhibition and verbal fluency). After controlling for age, the primary executive functions factor was significantly associated with sleep spindle density (β = 0.002, tα2 = 2.388, p = 0.020, r2 = 0.266), duration (β = 0.002, tα2 = 2.374, p = 0.021, r2 = 0.266) and power (β = 0.002, tα2 = 2.410, p = 0.019, r2 = 0.268). No relationship was found between spindle characteristics and the other generated cognitive factors.

Conclusion: In our sample of healthy older adults, spindle density, duration and power are associated with executive functions after
controlling for the effect of age. This suggests that sleep spindle characteristics may be a potential biomarker of changes in cognitive function in this population.

Support (If Any): This work was supported in part by the Canadian Sleep and Circadian Network Multi-site Mentoring Program Award (to VG)

**0092**
SLEEP DEPRIVATION LEADS TO FRAGMENTED MEMORY LOSS
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Introduction: Forgetting is moderated by post-learning sleep, indicating that newly formed memories benefit from sleep-associated consolidation. Although rates of forgetting after a single day of wakefulness are well established, how prolonged periods of sleep deprivation impact on retrieval are unclear. Moreover, whether extended sleep restriction influences the qualitative nature of forgetting is yet to be established. In two experiments, we examined the effects of normal and protracted sleep loss on forgetting.

Methods: Experiment One: 27 healthy adults (17 females, 20.85 ± 3.29 years), entered a repeated-measures study with two conditions (sleep and wake). In the sleep condition, learning and baseline memory assessment for adjective-image pairs took place before a night of sleep. Retrieval for the adjectives (item memory) and image categories (associative memory) was tested the following morning. In the wake condition, learning and testing took place in the morning and evening, respectively. Experiment Two: 28 healthy adults (24 females, 19.43 ± 1.32 years) completed the same procedures, but the test phase occurred in the morning after a night of sleep or 24 hours sleep deprivation. In both experiments, a follow-up test was included 48 hours later to assess longer-term impacts of sleep loss on forgetting.

Results: Experiment One: item forgetting was higher after wakefulness than sleep ($F(1,26)=5.67, p=.025, \eta^2=.18$), but there was no additional deficit in associative memory ($F(1,26)=0.12, p=.73, \eta^2=.01$). No further differences were observed after 48 hours ($p>.05$). Experiment Two: item forgetting was amplified after sleep deprivation relative to sleep ($F(1,27)=20.53, p<.001, \eta^2=.43$). However, in contrast to normal wakefulness, extended overnight sleep loss led to a further impairment in associative memory ($F(1,27)=10.30, p=.003, \eta^2=.28$). Moreover, a marginal increase in item forgetting was observed in the sleep deprivation condition 48 hours later ($F(1,27)=3.57, p=.07, \eta^2=.12$).

Conclusion: Item memories and their associations are lost or retained as composite representations after a normal period of wakefulness. However, prolonged sleep deprivation not only amplifies forgetting, but also appears to result in memory fragmentation, such that retained item memories lose their associative links.

Support (If Any): Medical Research Council Career Development Award (MR/P020208/1) to S.A.C.

**0094**
LOSES SLEEP AND LOSING CONTROL: SLEEP DEPRIVATION IMPAIRS MEMORY CONTROL ABILITY
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Introduction: Reminders about unpleasant experiences can trigger the intrusion of unwanted memories into conscious thought. There are tremendous individual differences in the capacity for suppressing intrusive memories. However, the factors that govern intrusion control ability are elusive. Identifying these factors could inform our understanding of vulnerability markers for affective disorders that are characterised by intrusive thoughts. We tested the hypothesis that sleep might modulate our ability to prevent the past from intruding on the present.
A. Basic and Translational Sleep Science

Methods: After a night of sleep [n=30, 13 male, age = 19.90 ± 0.31 years; mean ± SEM] or total sleep deprivation [n=30, 12 male, age = 20.20 ± 0.32 years], participants attempted to suppress memories of emotionally negative and neutral scenes whilst reminder cues were presented in a think/no-think (TNT) task. Participants rated how successful they were at suppressing the 'no-think' scenes from memory after each trial. Indices of intrusion control were analysed using mixed ANOVAs including the factors group (sleep, sleep deprivation) and scene valence (negative, neutral).

Results: Intrusions (i.e. unsuccessful suppression attempts) were more prevalent in the sleep deprivation group than the sleep group [p = .022, η² = .089]. Moreover, intrusions became less frequent throughout the task in rested participants, but remained comparatively constant in sleep-deprived participants [p = .013, η² = .104]. The sleep deprivation group were also more susceptible to intrusions from memories that they had successfully suppressed in previous trials (relapses) than the sleep group [p = .010, η² = .111]. Finally, suppression reduced emotional reactivity to the negative scenes for rested participants according to subjective and physiological measures, but these effects were not observed in sleep-deprived participants.

Conclusion: Our findings suggest that sleep deprivation might diminish prefrontal executive control over medial temporal lobe structures that support memory retrieval and affect regulation. More broadly, our results offer new insights into the complex relationship between sleep disturbance and affective disorders, emphasizing the importance of sleep as a therapeutic target for mental illness.

Support (If Any): Medical Research Council (MRC) Career Development Award (MR/P020208/1) to S.A.C.

0095

CLASSICAL MUSIC DURING SLOW WAVE SLEEP FACILITATES EDUCATIONAL LEARNING: A TARGETED MEMORY REACTIVATION EXPERIMENT WITH IMMEDIATE AND 9-MONTH FOLLOW-UP TESTING

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Introduction: During slow-wave sleep, episodic memories are reactivated and consolidated. Using the targeted memory reactivation (TMR) technique, we can facilitate this memory consolidation process by presenting the sensory stimuli that were paired with the episodic memories during slow-wave sleep. Several studies have shown the effectiveness of TMR in learning word lists; however, the field has yet to develop ecologically-valid educational learning materials. This study involves application of learned principles to solve novel problems, which is key to academic success. However, because the effects of a single TMR session are short-lived, future research should test whether multiple sessions of TMR facilitate long-term learning outcomes in classroom settings.

Support (If Any): N/A
0097
PROSPECTIVE MEMORY IMPROVEMENT IS ASSOCIATED WITH CHANGES IN SLOW WAVE SLEEP, DELTA/THETA POWER, AND SPINDLE ACTIVITY
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Introduction: Prospective memory (PM)—the ability to plan and spontaneously remember to execute activities in the future—has been shown to improve across periods of sleep. While evidence indicates PM benefits most from SWS-rich sleep, the specific components of sleep that benefit PM performance remain undetermined.

Methods: Participants arrived at 9am (wake:n=30) or 9pm (sleep:n=30) and completed a battery of tests including three ongoing tasks: living/nonliving decision, lexical decision, and semantic categorization. After completion, a PM instruction for the next session was given (hit “q” whenever “table” or “horse” appears), followed by a 20-minute distractor task. Participants were then dismissed for a 12-hours of wakefulness or a night of polysomnograph-recorded sleep before completing a second round of the ongoing tasks that included a PM test for the critical words. For sleep participants, power spectral density analysis was conducted for all frequency bands, and canonical (13.5Hz), slow (11Hz) and fast spindles (15Hz) were detected using wavelet analysis with adaptive thresholds.

Results: Performance was similar across all three ongoing tasks. Sleep participants had significantly better PM compared to wake \( t(28)=2.0, p=0.05 \). Within the sleep group, there was a negative correlation between PM performance and SWS percentage \( r(30)=-0.39, p=0.03 \). Comparing sleep participants that successfully completed the PM task (n=17) to those unsuccessful (n=13), initial spectral analysis of SWS revealed decreased delta \( t(28)=2.1, p=0.05 \) and theta power \( t(28)=3.3, p=0.002 \) for successful participants. Successful sleep participants, however, had increases in slow spindle density across all channels \( t(28)=2.6, p=0.016 \).

Conclusion: These findings suggest that sleep protects the ability to successfully perform future actions across multiple contexts. Given recent evidence that SWS impairs gist memory, the generalizable, non-experienced based nature of PM may have overlapping sleep networks with gist memory, such that while sleep benefits it, the declarative memory focus of SWS reduces time spent consolidating prospection-based memory. Additionally, despite previous research suggesting that PM particularly benefits from SWS-rich sleep, our findings demonstrate that different components of sleep (i.e., slow spindles) are associated with successful PM execution, prompting further research for this unique memory type.

Support (If Any):

0098
LOCAL SPINDLE INCREASE IS CORRELATED WITH SLEEP-DEPENDENT MEMORY CONSOLIDATION OF MOTOR SEQUENCE TASK
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Introduction: The ability to quickly adapt to changes in the environment requires flexible thinking and updating of task-relevant information. However, both sleep loss and stress have been found to produce significant degradation in this type of cognitive performance. In this study, we investigated whether differences in total sleep time (TST) and wakefulness after sleep onset (WASO) were predictive of performance on a reversal-learning task. We
hypothesized that TST and WASO would predict weaker discriminability and greater response bias following a change in stimulus-response rules.

**Methods:** 63 adults (41 F; 21.7 ± 2.8 yrs) completed ~7 days (6.64 ± 0.96) of at-home actigraphy, followed by an in-laboratory session, which included a prolonged psychosocial stressor. Subjects performed a “Shoot/No Shoot” (SNS) task - a modified go/no-go paradigm. The SNS task required subjects to distinguish between enemies and allies using two pre-defined rules based on uniform color (tan vs. green) and environment (urban vs. rural). Subjects were required to shoot (go) or not shoot (no-go) based on the stable two-factor rule. Following instruction, the contingencies were reversed midway through the task, such that enemies became allies and allies became enemies, requiring subjects to learn the new stimulus-response rules. We quantified performance by decision criterion (response bias; c) and discriminability (d’). At-home TST and WASO were assessed for the night prior to the in-lab session.

**Results:** In the interest of reversal learning, all analyses were restricted to the first 40 trials post-reversal. Simple linear regressions showed that TST significantly predicted c: F(1,61)=7.94, p=0.006, R²=0.115. Subjects with shorter TSTs prior to the in-lab session displayed stronger response bias (larger c). There was no association between TST and d’. WASO was not found to be significantly related to c or d’.

**Conclusion:** These findings indicate that shorter sleep duration is associated with increasing tendency to “shoot” following a change in situational demands. Such findings emphasize the importance of regularly obtaining recommended sleep durations and managing fatigue, especially in safety critical operations that require flexible thinking.

**Support (If Any):** CDMRP grant W81XWH-17-C-0088

### 0100
**HUMAN SLEEP SPINDLES COUPLED TO HIPPOCAMPAL SHARP WAVE RIPPLES HAVE CHARACTERISTIC EEG FEATURES**

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**Introduction:** Sleep spindles mediate memory consolidation during sleep and are markedly reduced in schizophrenia. While spindle deficits correlate with impaired sleep-dependent memory, pharmacologically increasing spindle density in schizophrenia does not always improve memory. This may be because coupling with other NREM sleep oscillations like hippocampal sharp-wave ripples (SWRs) is required for spindles' optimal memory benefit and those spindles induced by these drugs are not coupled with SWRs. Identifying SWR-coupled spindles cannot currently be accomplished with scalp EEG alone since it cannot detect hippocampal activity. The EPILEPSIAE dataset of simultaneously recorded scalp EEG (to detect spindles) and intracranial EEG (to detect SWRs) presents an opportunity to identify an EEG signature of SWR-coupled spindles. This would allow SWR-spindle coupling to be evaluated noninvasively using scalp EEG alone.

**Methods:** To distinguish SWR-coupled from non-coupled spindles, we analyzed data from n=5 human subjects implanted with intracranial EEG (iEEG) electrodes in the hippocampus several days prior to invasive brain surgery. Polysomnography was acquired simultaneously. We identified sleep spindles in 17-21 EEG locations per subject and SWRs from 2-7 hippocampal channels per subject with automated algorithms. We then identified the subset of spindles coupled to SWRs and tested for significant differences in spindle features from non-coupled spindles.

**Results:** SWR-coupled spindles were significantly longer (669ms ± 33ms [S.D.] vs. 603ms ± 16ms; p = 0.028; two-tailed paired t-test across subjects) and significantly faster (12.3Hz ± 0.9Hz vs. 11.7Hz ± 0.7Hz; p = 0.02; two-tailed paired t-test across subjects) than non-coupled spindles.

**Conclusion:** Our findings suggest that a classifier could be trained to identify SWR-coupled spindles based on their EEG characteristics alone. This would allow a more refined characterization of spindle deficits in schizophrenia and testing of the effects of drugs on spindle-SWR coordination and memory. This, in turn, would substantially advance our ability to identify possible treatments for the cognitive deficits in schizophrenia, for which no remedies are available.

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### 0101
**EXPERIMENTAL SLEEP RESTRICTION, ANTICIPATORY STRESS, AND LEARNING ORGANIC CHEMISTRY**

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**Introduction:** Organic chemistry is an infamous course for many STEM and pre-health undergraduate students. Failure and dropout rates in organic chemistry range from 30-50%, with 75% of students who drop the pre-medical designation indicating struggling with organic chemistry as the primary reason. Some concerning research indicates that drop-out rates are disproportionately elevated in female students. There are currently no data on whether sleep impacts organic chemistry outcomes, but previous laboratory work suggests that mild sleep restriction can impair learning and increase stress reactivity.

**Methods:** Participants included 100 college undergraduate students who had not previously taken organic chemistry. We developed an interactive lecture and exam to simulate a prototypical organic chemistry class. Prior to taking the lecture, we randomly assigned participants to either normal time in bed (8 hours) or restricted time in bed (6 hours). Sleep/wake state was monitored using wristband actigraphy, and experimenters were masked to participant conditions using sealed envelopes. When participants returned to take the lecture, we applied blood pressure and electrocardiography monitors, and asked them to estimate how well they would learn the material and perform on a later test (meta-cognition).

**Results:** Prior to taking the lecture, female participants were significantly less confident in their ability to learn organic chemistry if they were sleep restricted (M=45.6%) than if they were well-rested (M=55.9%), p<.05. Females’ pre-lecture estimates were well-calibrated to their actual test performance in the normal sleep condition (M=62.6%), p>0.5, but very miscalibrated in the sleep restriction condition (M=66.9%), p<.001. Male participants were not significantly affected by the mild sleep restriction manipulation, p>0.5.
A Daytime Nap Does Not Increase Pattern Separation Ability

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Introduction: A large body of studies has showed that the ability to learn new information is impaired when we are sleep deprived. Pattern separation (PS), the ability to form distinct memories for events that are highly similar and share overlapping features, has also previously been found to be impaired by sleep deprivation. In the present study, we examined if a daytime nap would increase PS ability.

Methods: 108 young healthy participants came to the lab in the morning and completed the Mnemonic Similarity Task (MST). This task starts with an encoding phase where participants view images of common everyday objects and are asked to classify them as indoor or outdoor objects. During a subsequent memory test, participants view three different kinds of objects; ‘old’ objects that were also present during the encoding phase, ‘new’ objects that have not been seen before, and ‘true’ objects that are similar to, but not exactly the same as, objects viewed during encoding. The task of the participants during the re-test is to say if the objects presented are ‘old’, ‘new’ or ‘similar’. This test gives two different outcome measures: General Recognition (GR) - the ability to separate old objects from new ones, and PS - the ability to separate similar objects from old ones. After this task, participants were randomly allocated to either a sleep or a wake group. The sleep group had a two-hour nap opportunity and the wake group spent an equal amount of time resting. After this delay interval, participants completed the MST for a second time with a new set of images.

Results: Results revealed no support for sleep in increasing either GR or PS ability. Within the sleep group, there were no correlations between changes in PS ability and time spent in any sleep stage.

Conclusion: Previous studies that have found a role of sleep for PS ability have done so using larger manipulation of sleep. Based on the present study however, just a short daytime nap does not seem to have any effect on PS ability.

Support (If Any): N/A
EFFECT OF DINNER TIMING ON NOCTURNAL METABOLISM IN HEALTHY VOLUNTEERS

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Introduction: Consuming calories later in the day is associated with obesity and metabolic syndrome. We hypothesized that eating a late dinner alters metabolic function during sleep in a manner that promotes obesity.

Methods: We compared metabolic effects of routine dinnertime (RD, 18:00) versus late dinnertime (LD, 22:00) with a fixed sleep period (23:00-07:00) on the daily metabolic profile of healthy volunteers in a randomized crossover study. An isocaloric diet was administered at 8:00, 13:00, 18:00, or 22:00. For RD, dinner (35% daily kcal) was given at 18:00 and a snack (10% kcal) was given at 22:00; for LD, these meals were reversed. Peripheral venous blood samples were collected at 1-hour intervals from 17:00 to 12:00 the next day on both visits. We assessed plasma triglycerides (TG), free fatty acids (FFAs), glucose, insulin, cortisol, and sleep architecture. Participants ingested a lipid tracer, [2H3]palmitate with dinner to measure fatty acid oxidation. Time series data was analyzed using mixed effects regression models.

Results: To date, eight participants (5 male and 3 females) aged 26.4 ± 0.7 years old, with a BMI of 24.1 ± 1.2 kg/m² completed the study. During sleep, LD increased plasma glucose (β=16.8 mg/dl, P<0.001), insulin (β=15.4 µU/ml, P<0.001), cortisol (β=1.5 µg/dl, P=0.017), and decreased plasma FFA (β=-0.1 mmol/l, P<0.001). Morning glucose, insulin, cortisol and FFA levels were not significantly different between two visits. Morning TG were increased by RD (β=17.4 mg/dl, P<0.001). The evening postprandial period following LD was characterized by higher glucose and lower FFA as compared to RD (P<0.05). Fatty acid oxidation will be measured by serial enrichment of plasma [2H₃]palmitate with dinner to measure fatty acid oxidation. Time series data was analyzed using mixed effects regression models.

Support (If Any): R01HL135483, R03HL138068

SLEEP RESTRICTION SUPPRESSES THE LIPEMIC RESPONSE TO A STANDARDIZED HIGH FAT DINNER IN HEALTHY YOUNG MEN

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Introduction: Chronic sleep restriction increases cardiometabolic disease risk, including dyslipidemia. Experimental evidence suggests short-term sleep restriction decreases insulin sensitivity and alters non-esterified fatty acid (NEFA) metabolism. Studies examining the effects of sleep restriction on meal digestion and absorption have focused on changes in glucose and insulin, without assessing the digestion of meal lipids. We assessed the effects of four nights of sleep restriction on lipid transport following a high-fat meal.

Methods: Fifteen healthy men (mean±SD; age: 22±3 years; BMI: 24.7±3.0 kg/m²) participated in a controlled, 11-day, in-lab sleep restriction protocol. Participants consumed a standardized high-fat dinner (1041kcal; 48.9g fat, 110.5g carbohydrate, 46.6g protein) after two nights of baseline sleep (10h time-in-bed (TIB) opportunity), after four nights of sleep restriction (5h TIB), and after one night of recovery sleep (10h TIB). Frequent blood samples were drawn for five hours following the meal. NEFA and triglycerides (TG) were quantified in triplicate by colorimetric assay (Wako Diagnostics, Infinity, respectively).

Results: Sleep restriction suppressed TG area under the curve (AUC; minutes 60-300) during the high fat meal by 16.7%±5% (mean±SE; p=0.01). TG AUC fully recovered with one night of recovery sleep (p=0.96). Following sleep restriction, NEFA levels were suppressed throughout the high fat meal procedure (p=0.01), with no time by condition effect (p=0.95). Unlike TG, NEFA remained significantly suppressed after one night of recovery sleep (p=0.01) with an effect of time*condition compared to baseline (p=0.04). Glucose AUC was unaffected by sleep restriction. Compared to baseline, insulin AUC increased with restriction (p=0.004), but did not differ from baseline after recovery sleep (p=0.08).

Conclusion: Sleep restriction suppresses postprandial lipemia following a high-fat dinner; these shifts are not fully recovered by one night of sleep extension. The observed changes in the dynamic responses of TG and NEFA levels may be driven by clearance-mediated changes via lipoprotein lipase activation. Compensatory elevations in circulating insulin may be increasing the activation of lipoprotein lipase and enhancing TG and NEFA clearance from the plasma during sleep restriction.

Support (If Any): UL1TR000127, T32GM108563

SLEEP DURATION AND QUALITY AND DIVERSITY OF THE GUT MICROBIOME IN A GENERAL POPULATION SAMPLE OF ADULTS

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Introduction: Experimental studies in mice demonstrate disturbed sleep is associated with gut microbiota composition. A few small experimental studies in humans find associations between curtailed sleep and measures of gut microbiota richness and diversity. We examine associations of subjectively- and objectively-assessed sleep metrics with indices of gut microbiome richness and diversity in a random general population sample of adults.

Methods: Participants in the Survey of the Health of Wisconsin completed in-home study visits in 2016, and additionally provided fecal samples and participated in a week-long wrist actigraphy protocols to measure sleep (n=474, 56% female, mean age [range]=55[18-94] years). Participants completed questionnaires about sleep, diet, other health and sociodemographic factors, and an assessment of physical activity by wrist actigraphy. Metrics of
species richness and alpha diversity - the Chao1, ACE, Simpson, and Shannon indices - were regressed on self-reported sleep duration, extreme daytime sleepiness and the Epworth Sleepiness Scale (ESS), and actigraphy-measured sleep duration and wake after sleep onset (WASO). We estimated associations between each of the sleep and diversity measures separately, adjusting for age and sex and then additionally adjusting for BMI, moderate-vigorous physical activity, and dietary fat and fiber.

**Results:** Adjusting for gender and age, greater WASO was statistically significantly associated with lower richness and alpha diversity. These associations remained significant (Chao1) or borderline significant (ACE and Shannon) after further adjustment for BMI, physical activity, and dietary fiber and fat; e.g., 60 minutes greater WASO was associated with an approximate 26% (95% CI=1%-50%) population standard deviation reduction in microbial richness measured by Chao1. In fully-adjusted models, greater sleepiness was associated with lower richness and diversity on all indices (p=0.01-0.06). The ESS and sleep duration were not associated with microbiota richness or diversity.

**Conclusion:** Better sleep quality and less sleepiness are significantly associated with greater species richness and diversity of the gut microbiota in a general population sample of adults.

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**0107**

**ALTERED METABOLITES IN THE HUMAN PLASMA METABOLOME DURING INSUFFICIENT SLEEP ARE ASSOCIATED WITH REDUCED INSULIN SENSITIVITY**

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**Introduction:** Our previous findings show insufficient sleep reduces insulin sensitivity ($S_I$) and thereby increases diabetes risk. Yet, the mechanisms underlying reduced $S_I$ during insufficient sleep are not fully understood. To identify potential biochemical mechanisms underlying reduced $S_I$ associated with insufficient sleep, we investigated the human plasma metabolome during adequate and insufficient sleep using untargeted metabolomics.

**Methods:** Fourteen healthy adults (7M/7F; aged 25.2±4.7yr; BMI 22.5±2.0kg/m² [mean±SD]) completed an in-laboratory study consisting of three baseline days with 9h sleep opportunities/night followed by 10 days of insufficient sleep with 5h sleep opportunities/night. $S_I$ was assessed at baseline and on study day 12 (after 8 days insufficient sleep) using hyperinsulinenic/euglycemic clamps. Fasted plasma samples collected 1h after scheduled waketime on study days 3 (baseline) and 11 (insufficient sleep) were analyzed by untargeted LC/MS in aqueous and lipid fractions. Elastic net regularized regression identified associations between changes in plasma metabolites and $S_I$.

**Results:** After controlling for change in body-weight, $S_I$ decreased ($P<0.05$) ~13% during insufficient sleep versus baseline. After filtering, 3,592 metabolites were detected. The elastic net model identified 13 metabolites associated with $S_I$ during insufficient sleep with an R-squared of 0.93 ($P<0.001$) based on leave-one-out cross-validation. Five metabolites in the model are tentatively identified as: a monoglycosylceramide, phosphatidylcholine-42:8, malvidin3-glucoside-4-vinylphenol (an anthocyanidin), 1alpha,25-dihydroxy-2beta-5-hydroxypropionylditaminD3 (vitamin-D derivative), and PS(O-40:2) (a plasmalogen).

**Conclusion:** Using discovery metabolomics we identified 13 metabolites associated with reduced $S_I$ during insufficient sleep. Increases in monoglycosylceramides are known to decrease $S_I$, supporting our current findings. Decreases in overall phosphatidylcholine levels can disrupt cell-membrane integrity and are linked with metabolic disease. Links between the other identified metabolites and oxidant stress suggesting oxidative stress during insufficient sleep may link these metabolites with $S_I$. Collectively, our findings suggest altered lipid metabolism during insufficient sleep may contribute to reduced $S_I$. Further lipidomics studies are required to validate our current discovery-based metabolomics findings.

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analyzed using mixed model ANOVA with subject as a random factor, and condition and condition order as fixed factors.

**Results:** Subjects consumed more calories ($p=0.017$) as ad libitum after-dinner snacks in the 5h insufficient sleep condition. There was no difference in the choice of snacks selected between conditions ($p=0.24$), but the number of times subjects selected a high carbohydrate snack ($p<0.001$) and the total calories consumed from high-carbohydrate snacks ($p=0.004$) was higher during insufficient sleep. Conversely, the consumption of high-fat snacks, the number of times subjects selected a high-fat snack, and the total calories consumed from high-fat snacks were similar between conditions (all $p>0.23$).

**Conclusion:** Selection of high-carbohydrate after-dinner snacks promotes the positive energy imbalance observed during insufficient sleep.

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## 0109 SLOW WAVE SLEEP AND REM SLEEP DIFFERENTIALLY AFFECT NOCTURNAL GLUCOSE LEVELS

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**Introduction:** Disruptions in sleep quality impair daytime glucose metabolism. Normal sleep consists of non-REM sleep (stages N1, N2, and slow wave sleep [SWS]) and rapid-eye-movement (REM) sleep, which have distinct physiological characteristics. Here, we investigate how different sleep stages affect nocturnal glucose levels.

**Methods:** Sixteen healthy, young lean adults were studied under 2 controlled laboratory conditions (normal sleep and SWS suppression) with 8.5-hour bedtimes for four nights in a randomized order separated by at least one month. SWS suppression was achieved via acoustic stimuli. Sleep recordings were visually scored in 30-second epochs according to standard criteria. Glucose levels were assessed by a continuous glucose monitoring (CGM) device that measures interstitial glucose concentrations every 5 minutes. Additionally, on the 3rd night of each condition, frequent blood samples were collected to measure venous glucose concentrations. Concomitant venous and CGM glucose profiles from the 3rd night of each condition were treated using Kalman filtering techniques in order to correct artifacts and impute missing values in the CGM profiles. These CGM profiles were then interpolated to 30-second intervals to align with the scored sleep stages. One subject had missing sleep data for the of SWS suppression condition leaving a total of 31 nights used for this analysis. Multinomial logistic regression was performed over 10-min intervals to determine the relationships between sleep stages and nocturnal glucose levels.

**Results:** The time spent in SWS was associated ($p=0.050$) with a concomitant increase in glucose levels, whereas the time spent in REM sleep was associated ($p=0.004$) with a concomitant decrease in glucose levels. Additionally, the time spent in SWS predicted ($p=0.007$) an increase in glucose levels in the following 10-min period. Stages N1 and N2 did not show significant associations with glucose levels.

**Conclusion:** SWS and REM sleep differentially affect nocturnal glucose levels. These findings may have important clinical implications for the integration of novel sleep modules into artificial pancreas systems that are commonly used in the management of Type 1 diabetes.

**Support (If Any):**

## 0110 WITHIN-SUBJECT CONSISTENCY OF INCREASED INTERLEUKIN-6 LEVELS IN RESPONSE TO COMBINED SLEEP RESTRICTION AND CIRCADIAN MISALIGNMENT IN HUMANS

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**Introduction:** Interleukin (IL)-6 is a known mediator of inflammation and has been reported to increase after sleep restriction, in some but not all studies, and during circadian misalignment with 8h sleep opportunities. However, the effects of combined sleep restriction and circadian misalignment on IL-6 and the within-subject consistency of this response is unknown.

**Methods:** Twenty healthy adults (8 female), age 25.65±4.2, BMI 21.97±2.2 kg/m² (±SD), completed two 18-day protocols consisting of 2 weeks of self-selected 8h sleep schedules at home followed by a 4-day laboratory visit. During the 4-day visit, participants were given an 8h sleep opportunity on night 1, 3h opportunity on night 2, and 3h opportunities during mornings 3 and 4. Ten blood draws occurred during each visit: baseline after the first 8h sleep opportunity, a second draw after the first 3h sleep opportunity, and draws every 6h thereafter. IL-6 concentration was assessed using a multiplex immunoassay; raw concentration values were logged transformed. Change in IL-6 concentration over time was assessed using mixed model ANOVA and t-tests were used to determine differences from baseline at each time point. Intra-class correlation coefficients (ICC), derived from mixed model ANOVAs, were used to quantify the stability of individual differences in IL-6 levels at baseline and during combined sleep restriction and circadian misalignment.

**Results:** Average IL-6 concentration was increased during combined sleep restriction and circadian misalignment compared to baseline at all time points during visit 1 ($p<0.025$ adjusted for multiple comparisons) and time points 3-10 during visit 2 ($p<0.025$ adjusted for multiple comparisons). IL-6 concentration showed almost perfect trait-like stability (ICC 0.85) across visits at baseline and showed moderate consistency (ICC 0.44) across visits during combined sleep restriction and circadian misalignment (average of samples 2-10).

**Conclusion:** Combined sleep restriction and circadian misalignment produces a significant and moderately stable inflammatory
response. The implications and nature of this response remains unclear and further research is required.

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0111 LEPTIN RECEPTOR BLOCKADE DECREASED BLOOD PRESSURE AND HYPOXIC VENTILATORY RESPONSE IN AN ANIMAL MODEL OF METABOLIC SYNDROME

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Introduction: Human obesity leads to resistance to metabolic effects of leptin. Moreover, hyperleptinemia has been associated with hypertension and sleep disordered breathing. Leptin deficiency leads to hypventilation in ob/ob mice, but effects of leptin receptor blockade on breathing are unknown. Here we utilized NZO mice, a model of metabolic syndrome with obesity-induced hypertension and hyperleptinemia, and hypothesize that a leptin receptor blocker will abolish hypertension and decrease hypoxic ventilatory response (HVR).

Methods: Male NZO mice of 12-13 weeks-old housed in the 12:12-h light-dark cycle (lights on at 9AM) were treated with a leptin receptor antagonist Allo-aca for 9 consecutive days (0.2mg/kg, 2x/day, at 10AM and 6PM, subcutaneously). Blood pressure was measured by telemetry. Ventilation was assessed by whole-body barometric plethysmography. For HVR, the animals were exposed to 30 minutes of normoxia followed by 5 minutes of hypoxia (10% O2 + 5% CO2) (3x/day). Sleep studies were conducted by full-polysomnography (10AM-4PM). Glucose levels were measured after 5h fasting.

Results: Leptin receptor blocker induced a decrease in the mean arterial blood pressure during the light phase from 132.0±7.0 mmHg at baseline to 117.0±9.3 mmHg after treatment. Fasting glucose levels did not change after treatment. There was a significant decrease in the HVR from 2.3±0.1 mL/min/ΔSpO2 at baseline to 1.8±0.2 mL/min/ΔSpO2 after treatment. Allo-aca suppressed minute ventilation during NREM and REM sleep without a change in the oxygen desaturation index.

Conclusion: A leptin receptor blocker Allo-aca abolished hypertension and decreased HVR in NZO mice with polygenic obesity and metabolic syndrome. However, mice developed hypventilation, similar to that observed in leptin deficient ob/ob mice. Thus, leptin receptor blockers should be examined for treatment of hypventilation in obese patients, but more selective approach sparing respiratory effects of leptin may be required.

Support (If Any): NIH R01s HL128970 and HL133100 to VYP.

0112 FIRST NIGHT EFFECT ON SLEEP AND HEART RATE IN ADOLESCENT BOYS AND GIRLS: FINDINGS FROM THE NCANDA STUDY

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Introduction: Women are more vulnerable than men to the development of insomnia disorder, with the sex difference emerging during adolescence. Underlying physiological mechanisms are unknown, although upregulation of the autonomic nervous system (ANS) during sleep is strongly implicated in the pathophysiology of insomnia and may be critical in its development in adolescent girls. ANS flexibility is particularly important for adaptive stress responses. The first night in the laboratory is considered a stressful condition and participants who are more sensitive to this effect may be at greater risk for insomnia. Here, we examined possible sex differences in the first night effect on HR and sleep variables in healthy adolescents.

Methods: We compared polysomnographic (PSG) variables and nocturnal heart rate (HR) profiles between the first night in the laboratory (adaptation night) and a subsequent, non-consecutive overnight PSG (recording night) in 65 healthy adolescents (35 male). Participants were part of the National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) cohort at SRI International and were aged between 12 and 19 years (M=15.23, SD=2.04).

Results: Both male and female adolescents had a significantly higher HR at the beginning of the adaptation night than on the recording night (p<.05). HR showed the expected nocturnal decline during both overnights, however, in girls, the HR curve was shifted upwards across the adaptation night relative to the recording night. Differently, in boys, the differences in HR between the adaptation and recording nights diminished across the night (p<.05). Comparisons of sleep architecture showed that sleep efficiency tended to be lower during adaptation in all participants.

Conclusion: Both adolescent boys and girls showed evidence of a first night effect, particularly for nocturnal HR. However, in girls, the effect is prolonged across the night. Longitudinal data from NCANDA will be able to examine further whether sex differences in stress-related ANS functioning predict different trajectories in the development of insomnia.

Support (If Any): This study was supported by the National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA); AA021696 (IMC+FCB)

0113 THE GUT MICROBIAL CORRELATES OF STRAIN-SPECIFIC SLEEP FRAGMENTATION IN A SPACEFLIGHT ANALOG

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Introduction: The mammalian gastrointestinal microbiota interacts with the functions of the central nervous system, including sleep. Spaceflight is associated with disrupted sleep in astronauts, and our previous work has found altered gut microbiota during spaceflight in both humans and mice. To understand the role of the gut microbiota in disrupted sleep and the associated physiological changes under simulated spaceflight-like conditions, we studied mice in a spaceflight analog, hindlimb unloading (HLU), which
models a non-load-bearing status in the hindlimbs, cephalic fluid shifts, as well as situational and confinement stress. 

Methods: We developed a method and the required apparatus that allowed us to perform HLU while simultaneously recording sleep using EEG/EMG. Female C57BL/6J (B6) and C3H/HeJ (C3H) mice were subjected to HLU for 4 weeks. Fecal samples were collected at multiple time points prior to and during HLU. Microbial DNA was isolated from fecal materials and used to profile gut microbiota structure using 16S rRNA gene amplicon sequencing.

Results: B6 and C3H mice responded to HLU with striking differences. HLU led to ~3 times more fragmented sleep in B6 mice but not C3H mice. This strain difference in sleep responses to HLU was associated with a large strain difference in the gut microbiota composition between B6 and C3H mice, which persisted throughout the HLU period. Furthermore, in B6 mice, a difference in the microbial composition between HLU and control mice was observed at 1 week after the start of HLU but diminished after 3 weeks of HLU. The microbial composition in C3H mice remained unchanged.

Conclusion: These findings demonstrate a strong host genetic basis for responses to HLU, with a concordant disparate community structure of the gut microbiota, raising questions about the underlying mechanisms leading to previous observation on physiological changes associated with HLU, and perhaps spaceflight itself. Findings from this study indicate the possibility that countermeasures based on modulating the gut microbiota could lead to better sleep adaptation during spaceflight, a key area that requires further research.

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0114 THE ASSOCIATION BETWEEN BODY FAT PERCENTAGE AND THE FEELING OF SATIETY AFTER A MEAL FOLLOWING SLEEP LOSS IN YOUNG HEALTHY INDIVIDUALS

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Introduction: Recent studies in obese individuals have shown that the feeling of satiety after a meal varies according to their body fat percentage (BF%), but this association is not present when they are well rested. Other studies have shown that sleep restriction (SR) is associated with an increase in energy intake. The objective of this study was to verify whether the feeling of satiety after a meal following sleep loss is associated with BF% in healthy individuals.

Methods: Eighteen young healthy subjects (12 men and 6 women; 18-33y) completed an X-Ray scan measuring the BF% via biophotonic absorption. Participants completed a visual analog scale (VAS) measuring their desire to eat after having breakfast following three counterbalanced sleep conditions: a control condition (habitual bedtime and wake-time), a 50% SR with an advanced wake time, and a 50% SR with a delayed bedtime condition. Pearson correlations between the VAS score and the BF% were computed for all sleep conditions separately.

Results: The average BF% of the population was 18.8%, showing a relatively very healthy sample. In the control sleep condition, results showed no relationship between the desire to eat after breakfast and BF% (r=-.36, p=.14). However, the desire to eat after breakfast was significantly correlated with BF% in both the advanced wake time and the delayed bedtime conditions (r=.53, p<.05; r=-.64, p<.01, respectively).

Conclusion: These results suggest that even in a healthy population, the relative amount of body fat is associated with the feeling of satiety after a meal following sleep deprivation. This could be due to the hormonal changes after sleep loss. Indeed, it has been shown that ghrelin levels are associated with BF%, and that sleep restriction is associated with an increase in ghrelin levels. Further studies should focus on verifying the differences in ghrelin levels of individuals with different BF% in similar conditions.

Support (If Any): No
ASSOCIATION BETWEEN OBJECTIVE SLEEP DURATION AND INTAKE, BASAL METABOLIC RATE AND BODY COMPOSITION: A CROSS-SECTIONAL STUDY IN A COMMUNITY-BASED SAMPLE

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Introduction: The study aimed to examine the association between objective sleep duration and intake, basal metabolic rate (BMR) and body composition (BC) in the community adults.

Methods: Total 72 subjects were recruited from the staffs of one industry company through online advertising. The mean age was 33.2 ±/± 7.08% were men, and mean body mass index (BMI) was 22.4 kg/m2. The subjects filled in the standard questionnaire, 3-day food diary, and 7-day sleep log, and wore Actiwatch for 7 days before measurement of BMR and BC and serum biochemistry. The BMR was measured with indirect calorimetry at 8 AM after fasting for 12 hr while BC was measured with bioelectrical impedance analysis. The physical activity was assessed with activity count measured by Actiwatch. The association between sleep duration (short: <5hr, norm: 5-7 hr, long: >7 hr), and BMR and BC was tested with the linear regression with adjustment of age, gender, and BMI.

Results: The median duration of sleep in all participants was 5.9 hr (interquartile range (5.5-7.6) where it was 4.6 hr (4-4.9) in short sleeper (n=6), 5.8 hr (5.7-6.2) in norm (n=39), and 7.6 hr (7.5-7.8) in long sleeper (n=8). The median daily caloric intake, percentage of nutrient (fat, protein, and carbohydrate), BMR, respiratory quotient, fat mass, fat free mass and muscle mass, insulin, IGF-1, cortisol, and activity count were similar between 3 groups. The level of high-density lipoprotein (HDL) was higher in the long sleeper than short sleeper (69 mg/dl vs 48 mg/dl, P=0.01). The linear regression showed sleep hour or category of sleep duration was not associated with BMR, and BC.

Conclusion: The objective sleep duration was associated the level of HDL but not BMR and BC in the community adults.

Support (If Any): NIH grant HL117167

INCREASED CIRCULATING LEVELS AND PERIPHERAL TISSUE PROMOTER DNA METHYLATION OF THE HORMONE FGF-21 FOLLOWING ACUTE SLEEP LOSS IN HUMANS

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Introduction: Sleep loss and circadian misalignment alter energy metabolism in a tissue-specific manner. FGF-21 has tissue-specific and nutrient-dependent effects on metabolic substrate utilization, e.g. increasing insulin sensitivity of adipose tissue, yet its role has not been investigated in humans exposed to acute sleep loss. Increased levels of FGF-21 are also seen in metabolic disease such as type 2 diabetes and obesity.

Methods: In a randomized, 2-session, 2-condition, crossover clinical study involving 15 healthy young men, serum samples were obtained in the fasted state and after an oral glucose tolerance test (OGTT), following one night of sleep loss and following one night of sleep (8.5
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for analysis of serum FGF-21 levels by ELISA. Skeletal muscle and adipose tissue biopsies were collected in the morning fasting state in both conditions for DNA methylation and qPCR analyses.

**Results:** Even though the OGTT increased FGF-21 levels across conditions (P=0.0001), FGF-21 levels were significantly higher across timepoints after acute sleep loss compared with after sleep (p=0.022). A similar significant increase was seen in a separate cohort with cumulatively matching partial sleep loss (8.5 hrs). A sub-group analysis revealed that only participants with low but not high (P=0.031 vs P=0.41) insulin sensitivity, in response to the OGTT after sleep loss, exhibited a significant increase in serum FGF-21 levels after sleep loss compared with normal sleep. The promoter region of the FGF-21 gene exhibited increased DNA methylation after sleep loss compared with sleep (P<0.05), both in skeletal muscle and adipose tissue.

**Conclusion:** Increased circulating levels of FGF-21 may constitute a counter-regulatory mechanism by which the body tries to counteract adverse effects of disrupted sleep and circadian rhythms. Increased FGF-21 could have effects on peripheral metabolism that are in line with those previously observed after overnight wakefulness. It remains to be determined whether the altered DNA methylation of the promoter of FGF-21 in peripheral tissues after sleep loss results in long-term shifts in peripheral release of FGF-21 across the sleep/wake cycle.

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**0119**

**THE EFFECT OF SLEEP CONTINUITY DISRUPTION ON THREAT-RELATED ATTENTIONAL BIAS: RANDOMISED CONTROLLED EXPERIMENT IN GOOD SLEEPERS**

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**Introduction:** Previous research indicates that attentional bias towards emotional stimuli may contribute to the development and maintenance of psychopathology. Moreover, experimental studies show that sleep loss impairs functioning in neural circuitry underpinning emotion perception and regulation, resulting in increased reactivity to negative emotional stimuli. We sought to test the hypothesis that sleep continuity disruption causally induces emotion-related attentional bias, providing a mechanism through which sleep disturbance confers risk for psychopathology.

**Methods:** 51 healthy good sleepers (37 female; mean age = 24 years) were randomized to either one night (23:00-07:00) of undisturbed sleep (US) (n=24) or one night of sleep continuity disruption via forced awakenings (FA) (n=27). Participants in the Forced Awakening condition were awoken eight times, either for 20 mins (x6), 40 mins (x1) or 80 mins (x1) in a fixed pattern standardized across participants. A dot-probe task (Notebaert, Clarke & Macleod, 2016) was used to assess attention bias towards threat-related (versus neutral) words in the evening prior to and the morning following the sleep period. An attentional bias index score was computed for each participant, reflecting the extent to which participants showed preferential attention allocation towards threat versus neutral words. A positive attentional bias index reflects a greater attentional bias towards threat-related stimuli.

**Results:** Analyses of variance tested for a main effect of time (pre vs post sleep) and a group*time interaction. Results showed there was no effect of time [F = .068, p=.795; Mean pre = -.593 ms vs Mean post = -1.91 ms] or group*time interaction [F = .141, p=.709].

**Conclusion:** Sleep continuity disruption had no discernible effect on attention bias for threat-related words. Moreover, across both groups, there was no clear change in attention bias from pre-to-post sleep. Further work with different types of sleep manipulations is warranted.

**Support (If Any):** N/A
**0120**

**SUUVN-G3031, A NOVEL, POTENT AND SELECTIVE H3 RECEPTOR INVERSE AGONIST FOR THE TREATMENT OF NARCOLEPSY: PRECLINICAL CHARACTERIZATION**

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**Introduction:** Narcolepsy is a rare long-term brain disorder that causes a person to suddenly fall asleep at inappropriate times. H3R antagonists/inverse agonists increase histaminergic neurotransmission and offer a therapeutic option for the treatment of narcolepsy. SUUVN-G3031 is a potent H3R inverse agonist in the clinical development for the treatment of narcolepsy with or without cataplexy.

**Methods:** SUUVN-G3031 in-vitro binding, functional activity and phospholipidosis inducing liability was evaluated. Pharmacokinetic properties were evaluated after oral administration in mice, rat and dog. SUUVN-G3031 was evaluated in brain microdialysis for neurotransmitter modulation in rats. In vivo functionality was assessed using R-α-methylhistamine induced dipsogenia assay. Tele-methylhistamine modulation was evaluated as a possible clinical biomarker. Long term toxicity studies up to 6 months in rats and 9 months in dogs have been completed along with genotoxicity and fetal development toxicity studies in rats and rabbits.

**Results:** SUUVN-G3031 exhibited no inter-species difference in binding affinity at H3R and displayed inverse agonism in functional GTP;Y assay with >100 fold selectivity. SUUVN-G3031 has no phospholipidosis inducing liability. SUUVN-G3031 exhibited excellent pharmacokinetic properties and brain penetration. A single oral administration of SUUVN-G3031 produced significant increase in acetylcholine, histamine, dopamime and norepinephrine levels in the cortex. SUUVN-G3031 did not alter dopamine levels of striatum and nucleus accumbens indicating that it may not have addiction liability. SUUVN-G3031 blocked R-α-methylhistamine induced water intake and produced dose-dependent increase in tele-methylhistamine levels in rat and mice brain and cerebrospinal fluid. Preclinical safety evaluation warrants its clinical development.

**Conclusion:** SUUVN-G3031 is an inverse agonist at H3R and results from the preclinical studies provide a strong evidence for the potential utility of SUUVN-G3031 in treatment of narcolepsy and other sleep related disorders.

**Support (If Any):** None

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**0121**

**QUANTITATIVE ANISOTROPY WITHIN THE DEFAULT-MODE NETWORK PREDICTS MOOD DEGRADATION FOLLOWING SLEEP-DEPRIVATION**

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**Introduction:** Sleep deprivation (SD) adversely affects cognition and mood, but some individuals show a trait-like resistance to these effects. The default mode network (DMN), in particular, appears to play a key role in emotional regulation. We hypothesized that individuals with greater white-matter quantitative anisotropy (QA), i.e., greater compactness of white-matter paths, and thicker cortex for regions within the DMN, would demonstrate greater “resistance” to SD with regard to mood degradation across the overnight period without sleep.

**Methods:** Diffusion-weighted and T1-weighted data were collected from 45 healthy individuals prior to a SD protocol during which the Visual Analog Mood Scale (VAMS) was used every hour from 19:15 (time point1; TP1) to 11:15 (TP17) the following morning to measure two positive and three negative mood states. Four spherical regions of radius 12 mm within the DMN - the posterior cingulate cortex (PCC), middle prefrontal cortex (MPFC) and bilateral lateral parietal cortices (L.LPC/R.LPC) were used as regions of interest (ROIs). The index of mood resistance (IMR) was defined as the averaged differences between positive and negative mood states over 12 TPs (TP5 to TP16) relative to averaged differences at baseline (TP1 to TP4). Data from the last TP i.e., at TP17 was not included in the analysis. Age, sex, body-mass index and education were used as covariates.

**Results:** We found that there were significant positive associations between residualized IMR and QA within the MPFC (r = 0.33, p = 0.04), L.LPC (r = 0.46, p < 0.001) and R. LPC (r = 0.49, p < 0.001). We did not find significant association between IMR and thickness for any of the ROIs.

**Conclusion:** Greater compactness of white-matter bundles, but not the morphometry, within the DMN plays a significant role in the ability to resist mood degradation over the course of a night of SD. Future work focusing on effective brain connectivity will be necessary to confirm the role of DMN and individual differences in positive and negative mood states separately.

**Support (If Any):** D12AP00241 (WDK)

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**0122**

**INTERACTION BETWEEN STRESS LEVELS AND PREFRONTAL CORTICAL ACTIVATION DURING EMOTION REGULATION MODERATES SLEEP DISTURBANCE**

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**Introduction:** Emotion regulation difficulty has been known to be associated with both high levels of stress and sleep disturbance. This suggests that emotion regulation may have a significant role in the relationship between stress levels and sleep disturbance. In this study, we tested whether interactions between higher stress levels and neural underpinnings of emotion dysregulation amplify sleep disturbance.

**Methods:** Thirty one healthy adults (14 females, age = 36.65 ± 11.58) without sleep disorders based on nocturnal polysomnography participated in this study. They were viewing emotional and neutral pictures, and then suppressing their response to emotional pictures during fMRI scanning. Our participants also completed questionnaires assessing stress levels and sleep disturbance using Life Experience Survey and Pittsburgh Sleep Quality Index, respectively. Neural activity during emotion regulation (suppressing response to emotional pictures vs. viewing emotional pictures) was extracted from our regions-of-interest (ROIs), particularly the lateral prefrontal cortex (LPFC) and medial prefrontal cortex (MPFC), and entered into our moderation model to test whether interactions between stress levels and neural activity during
emotion regulation predicted sleep disturbance. We used the SPSS macro PROCESS (Hayes, 2013) to conduct moderation analyses.

**Results:** We found significant moderation effects of LPFC and MPFC responses during emotion regulation on the association between stress levels and sleep disturbance (LPFC: p=0.016, MPFC: p<0.015) Simple slope analyses showed that at lower LPFC and MPFC activity during emotion regulation, higher stress levels were associated with greater sleep, but at higher LPFC and MPFC activity, stress was not significantly associated with sleep disturbance.

**Conclusion:** These findings provide preliminary evidence that interactions between stress levels and neural substrates of emotion dysregulation (i.e., lower LPFC ad MPFC activity) may contribute to sleep disturbance. Effective emotion regulation in stressful situations may be an element factor for the prevention and treatment of sleep problems.

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**0123**
DIRECT PROJECTIONS OF GABAERGIC NEURONS IN THE NUCLEUS PONTIS ORALIS TO THE DORSAL RAPHE NUCLEUS
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**Introduction:** A large number of studies have indicated that GABAergic inhibitory processes in the nucleus pontis oralis (NPO) play an important role in the generation and maintenance of wakefulness as well as active (REM) sleep through the interaction with neurons in the dorsal raphe nucleus (DR). However, little is known regarding the morphological basis for such interaction. Accordingly, the present study was undertaken to investigate whether there is any direct connection between GABAergic neurons in the NPO and neurons of the DR.

**Methods:** Phaseolus vulgaris leucoagglutinin (PHA-L; an anterograde tracer) was injected into the NPO in anesthetized adult guinea pigs. The animals were euthanized after survival for one week. Subsequently, brainstem sections containing the DR were immunostained with antibodies against PHA-L and GABA following the procedure of double fluorescence immunohistochemistry, while the sections containing the NPO were treated with anti-PHA-L antibody for identifying the injection site.

**Results:** Under fluorescence microscopy, a large number of PHA-L labeled fibers/terminals were observed in the DR following the injection of PHA-L into the NPO. Some of these fibers/terminals also exhibited GABA immunoreactivity with double fluorescence immunohistochemistry techniques. In addition, some PHA-L-labeled terminals were found in close apposition to somata and dendrites of neurons in the DR.

**Conclusion:** The presence of GABAergic fibers/terminals that contain both PHA-L and GABA immunoreactivities in the DR following the injection of PHA-L into the NPO provides the anatomical evidence of direct projections of GABAergic neurons in the NPO to the DR. We therefore suggest that the pontine GABAergic control of wakefulness and active sleep is partly mediated via GABAergic projections from the NPO to the DR that modulate the activity of waking-on neurons in this nucleus.

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**0124**
BRAIN RESIDENT MAST CELLS REGULATE BRAIN HISTAMINE CONTENT AND PROMOTE WAKEFULNESS
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**Introduction:** Mast cells release various chemical mediators such as histamine and cytokines and play a central role in acute allergic reaction in peripheral organs. Recent studies showed some contributions of brain resident mast cells to brain histamine content and neurological functions. Our previous study demonstrated that wake-promoting effect by a histamine releaser was abolished in congenital mast cell deficient W/Wv mice (i.e., c-kit mutant mice). However, it is known that the mutant mice have multiple organ abnormalities beside mast cell deficiency. Here, we examined the roles of brain-resident mast cells in sleep/wake regulations using inducible mast cell and basophil deficient mice.

**Methods:** Mas-TRECK (MT) mice express diphtheria toxin receptor specifically in mast cells and basophils, while Bas-TRECK (BT) mice in only basophils. Toxin treatment systemically and exclusively deletes mast cells or basophils in these mice but not wild-type mice. Adult male mice underwent surgery for EEG/EMG electrodes and E-mitters. Sleep phenotype was characterized at 5 and 30 days after toxin injection. The amount of monoamines and histamine in the whole brain was measured sequentially. A battery of behavioral assays was performed to evaluate their neurobehaviors.

**Results:** In MT mice, whole brain histamine contents dramatically decreased to less than half at 1 week after toxin injection, followed by a gradual recovery to the original level by 45 days. There was no change in the monoamine contents. One the other hand, BT mice showed no change in the histamine level. MT mice exhibited the decreased amount of arousal during light period at 1 week, while no significant difference in sleep-wake cycle was observed compared to the wild-type mice at 30 days. BT mice did not show any sleep changes by the loss of basophils. There was no marked change in neurological functions in terms of anxiety, depression, motor coordination, and recognition memory.

**Conclusion:** Our findings demonstrate that brain resident mast cells serve as a major pool of brain histamine and contribute to the maintenance of sleep/wake regulation. It is warranted to determine how brain mast cells promote wakefulness.

**Support (If Any):**
similar to what occurs during non-rapid eye movement (NREM) sleep induction. Human, cat and rat electroencephalogram (EEG) studies have shown similarities between NREM sleep and dex-induced sedation in delta power and spindle activity. We tested the hypothesis that dex induces changes in the EEG that are similar to natural NREM sleep in young adult and old B6 mice.

Methods: Male B6 mice aged 4-5 months (young adult) and 10-18 months (old) were implanted for EEG/EMG recording from prefrontal cortex, parietal cortex and cerebellum. Seven days after the surgery mice received intraperitoneal saline (vehicle) or dex (50, 100, 200, 400 μg/kg) injections and electrophysiology was recorded for at least 4 hours. Wake, NREM, REM and sedation were visually scored. Spectral differences between dex sedation and NREM sleep were analyzed using Fourier based multitaper methods.

Results: Dex induced dose dependent sedation and suppression of REM sleep in both young adult and old mice. Dex sedation produced from higher doses contained increased delta power for the first ~90 minutes followed by attenuation of frequencies above 10 Hz compared to NREM sleep. Immediately following dex administration, high voltage spike waves were observed in the prefrontal cortex EEG for the first 10-15 minutes. High voltage spikes had a fundamental frequency of 3-3.5 Hz and were narrow with sharp peaks resembling epileptiform activity. Old mice had significantly more spikes than young adults.

Conclusion: These data support the idea that dex induces a sedated state that is distinct from NREM sleep. The elderly or people prone to seizures may have increased spike activity when given dex.

Support (If Any): none

A NOVEL NON-INVASIVE APPROACH FOR MEASURING UPPER AIRWAY COLLAPSBILITY IN MICE
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Introduction: Invasive procedures were previously developed for measuring pharyngeal collapsibility in rodents during expiration, when declining neuromuscular activity makes the airway unstable. We developed a non-invasive approach for streamlining collapsibility measurements by characterizing responses in physiologic markers of dynamic expiratory airflow obstruction to negative nasal pressure challenges.

Methods: Anesthetized mice were instrumented to monitor upper airway pressure-flow relationships with head-out plethysmography while nasal pressure was ramped down from ~ +5 to −20 cm H2O over several breaths. Inspiratory and expiratory flow, volume, and timing characteristics were assessed breath-wise. Critical pressure (Pcrit) was estimated at transitions in expiratory amplitude and timing parameters, and compared to gold standard Pcrit measurements when nasal and tracheal pressures diverged during expiration. Predictions equations were constructed in a development data set (n=8) and applied prospectively to a validation data set (n=16) to estimate gold standard Pcrit.

Results: The development data demonstrated that abrupt reversals in expiratory duration and tidal volume during nasal pressure ramps predicted gold standard Pcrit measurements. After applying regression equations from the development to a validation dataset, we found that a combination of expiratory amplitude and timing parameters proved to be robust predictors of gold standard Pcrit with minimal bias and narrow confidence intervals.

Conclusion: Markers of expiratory airflow obstruction can be used to model upper airway collapsibility, and can provide sensitive measures of changes in airway collapsibility in rodents. This approach streamlines repeated non-invasive Pcrit measurements, and facilitates studies examining the impact of genetic, environmental, and pharmacologic factors on upper airway control.

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SOCIODEMOGRAPHIC, SOCIOECONOMIC, AND BEHAVIORAL CORRELATES OF NIGHTMARE FREQUENCY IN A COMMUNITY SAMPLE
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Introduction: Nightmares are important sleep problems that are related to depression and suicide risk. This analyses examined whether sociodemographic, socioeconomic, and physical/mental health factors predict nightmare frequency, as well as beliefs/attitudes about sleep.

Methods: Data were from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study. N=986 adults age 22-60 provided complete data. Nightmare frequency was assessed as Never, Seldom (1/year), Sometimes (1/month), or Often (1/week or more). Sociodemographics included age (by decade), sex, and race/ethnicity. Socioeconomic included education, ability to afford the basics, and Subjective Social Status (SSS). Other variables included overall health, social support, control over sleep, whether work responsibilities, home/family responsibilities, mood, and feeling unsafe affects sleep, and depression score (PHQ-9). Ordinal logistic regressions were adjusted for age/sex/education.

Results: In adjusted models, nightmare frequency was associated with sociodemographics, including age in the 40s (OR=2.4, p<0.0005) or 50s (OR=2.2, p<0.0005), being female (OR=1.3, p=0.04), and having less education (some college OR=1.4, p=0.02; high school OR=1.6, p=0.04), and decreased frequency was seen in Blacks/African-Americans (OR=0.6, p=0.001). Regarding socioeconomic, increased nightmare frequency was seen among those who found it difficult (OR=1.6, p=0.01) or very difficult (OR=1.7, p=0.006) to afford the basics, or had lower subject social status (OR=1.2, p<0.0005). More nightmares were also seen among those whose health was rated fair (OR=1.9, p=0.002) or poor (OR=2.5, p<0.0005). Fewer nightmares were seen in those with more self-rated control over sleep (OR=0.9, p<0.0005) and greater social support (OR=97, p<0.0005) and more were seen in those who felt that their sleep environment was unsafe (OR=2.0, p<0.0005) or who believed that their sleep quality was adversely affected by work (OR=1.4, p=0.01) or mood (OR=2.1, p<0.0005), or who had higher depression scores (OR=1.1, p<0.0005).

Conclusion: Nightmares are clinically relevant and are related to a wide range of demographic, socioeconomic, health-related, and sleep-related factors.

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0128
PREVALENCE AND CHARACTERISTICS OF DREAMING ACROSS NINE COUNTRIES, AND ASSOCIATIONS WITH LIFE STRESS
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Introduction: Dreams are a hallmark of sleep and can be influenced by social, environmental, and cultural factors. Yet, few studies have examined international variability of dream-related factors. The present study examined dream-related content across nine countries, representing four continents.

Methods: Data were obtained from surveys administered to N=7,312 adults from: the USA(N=1911), France(N=511), Japan(N=750), China(N=1256), Brazil(N=760), South Korea(N=503), Germany(N=527), the United Kingdom(N=572), and the Netherlands (N=522). Participants were asked to evaluate how often they dream, experience recurrent dreams, remember dreams, and if their dreams impact waking activities (i.e., feelings upon awakening, daytime feelings, and sleep difficulties). Life stress over the previous three months was also assessed. All items were asked on a 5-point Likert scale. Multiple ordinal logistic regressions modeled the dream variables as outcomes, with country as a predictor (adjusted for age and sex). To examine if life stress moderated dream-related variables, separate models were also fit to examine the interaction between life stress and country.

Results: Compared to the USA, dream frequency was lower in Japan, China, Brazil, South Korea, Germany, UK, and The Netherlands. Recurrent dreams were less common in France, Japan, China, South Korea, Germany, UK, and The Netherlands. Dreams were less frequently remembered in France, Japan, China, South Korea, Germany, UK, and The Netherlands. Perceived impact of dreams was higher in France, China, South Korea, and UK. Impact following waking was less in Japan, Brazil, and The Netherlands, but greater in China. Links between dreams and sleep problems were considered more in China and less in Japan, Brazil, South Korea, Germany, and The Netherlands. Greater life stress was associated with higher levels of all dream variables, though this varied by country.

Conclusion: Dreams are experienced differently between countries. Further, the association of life stress and dreaming differs by country. Culturally-influenced perceptions of dreams could affect perceived relationships with stress.

Support (If Any):

0129
THE INTENSITY AND IMPACT OF CHRONIC PAIN, A STORY OF DIFFICULTY SLEEPING AND POST-TRAUMATIC STRESS DISORDER
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Introduction: Difficulty sleeping is one of the most prevalent symptoms in Post-traumatic stress disorder, occurring in over 90% of cases. High prevalence of sleep disturbance is also noted in populations suffering from chronic pain (71-78%). Increased alcohol use and negative consequences in individuals with depression, PTSD and chronic pain has been postulated to result from insomnia symptoms made worse by alcohol use. Given the hypothesis that self-medication and withdrawal symptoms perpetuate alcohol use disorder in PTSD, it is of interest to examine the relationship between difficulty sleeping, alcohol use, chronic pain and PTSD.

Methods: As part of a larger study, participants who met the CAPS symptom endorsement requirement for PTSD were compared with non-trauma exposed controls. Participants completed inventories of pain, smoking, alcohol use and brief medical history.

Results: Thirty-two participants were included in the study. Participant groups did not differ by age (37.97 ± 12.1), gender, ethnicity, or BMI. Difficulty sleeping and PTSD status were both significantly associated with 11 different inventories of pain, including ‘Average pain’ and ‘Pain interference with mood’. Furthermore, impact of pain on relationships with others was significantly higher in individuals with PTSD vs. non-trauma exposed controls (p=0.024) but was not related to sleep difficulties. PTSD participants also reported an increased number of alcoholic drinks per week compared to non-trauma exposed controls (p=0.03).

Conclusion: Similar perceptions of pain levels and the impact of pain on quality of life are endorsed by those with difficulties sleeping and those with PTSD. Additionally, increased alcohol use appears to play a role in sleep difficulties for those with PTSD and/or pain. Implications, limitation and future directions will be discussed.

Support (If Any): This research is funded as part of the Randox Laboratories and Ulster University PhD Academy.

0130
CANNABIS USE, SLEEP, AND SLEEPINESS: AN ONLINE SURVEY
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Introduction: Cannabis sativa is commonly used for sleep. Research suggests that acute and heavy cannabis usage have opposing effects on sleep. Recent legalization increased access to cannabis, and provides an opportunity to determine how varying cannabinoid concentrations or duration of use affects sleep and sleepiness.

Methods: A cross-sectional anonymous online survey was conducted (via REDCap). Eligible volunteers (≥18 years old, US resident, and used cannabis within 24-hours for sleep) described prior 24-hour cannabis use and cannabis use history. Validated sleep scales assessed sleep quality (Pittsburgh Sleep Quality Index [PSQI] and St Mary’s Hospital Questionnaire [SMHQ]) and daytime sleepiness (Karolinska sleepiness scale [KSS]).

Results: Of 571 participants (age 35±14 [SD] years; 65% female) 67% reported using cannabis for insomnia with the remaining reporting sleep disturbances related to pain (16%), anxiety (11%) or pain and anxiety (6%). 259 (45%) reported knowledge of tetrahydrocannabinol (THC) and/or cannabidiol (CBD) concentrations. Multiple regression analyses in these 259 participants suggest that sleepiness is negatively associated with age and with THC percentages in cannabis products used within the prior 24-hours, and positively associated with SMHQ score; but not associated with time of day, other medication use, or cannabis use dependency. Increased THC percentage and decreased time between consumption and bed were indicators of improved sleep quality. Percentage of CBD or ratios of THC:CBD run in separate models for prior night’s sleep quality and sleepiness did not reach significance.
0131 PLANES, TRAINS AND AUTOMOBILES: TRAFFIC NOISE AND ITS IMPACT ON SLEEP DEPTH MEASURED BY ODDS RATIO PRODUCT

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Introduction: Traffic noise events can lead to cortical and autonomic activation, disrupt sleep and impair physical and mental restoration. The odds ratio product (ORP) is a validated continuous measure of sleep depth and quality, based on automatic analysis of EEG data in 3s epochs. More so than traditional manual scoring of sleep in 30s epochs or the binary scoring of arousals, ORP allows tracking temporal changes of sleep in response to external stimuli. Here we examine event-related changes in ORP in response to nocturnal noise events.

Methods: Seventy two healthy participants (mean age 40 years, range 18-71; 40 women) slept for 11 nights in the laboratory, during which sleep was measured with polysomnography. In 8 nights they were exposed to 40, 80 or 120 road, rail and/or aircraft noise events at maximum sound pressure levels between 45-65 dBA. Event-related maximum change of ORP in a 90s window relative to pre-event baseline was analyzed with linear mixed models.

Results: Average whole night ORP increased with age ($β=0.008; p<0.001$), indicating decreasing sleep depth, but was not significantly affected by the average nighttime noise level or number of noise events. For events where participants were asleep at noise onset (n=29,663), ORP increased monotonically with sound pressure level ($F(4,27964)=88.4; p<0.001$) for all traffic modes. There was a main effect of traffic mode ($F(2,25809)=58.6; p<0.001$) on ORP, with a higher response to road ($p<0.001$) and rail ($p<0.001$) noise than to aircraft. The magnitude of ORP increase depended on sleep stage at noise onset, decreasing in the order of S2, SWS, REM ($F(3,20955)=133.9; p<0.001$), but recovery time to pre-event baseline ORP was in the reverse order. ORP change decreased as a function of age ($β=-0.002; p=0.004$). There were no significantly effects of noise duration, sex or sleep spindle density on event-related ORP change.

Conclusion: Traffic noise led to increased ORP in an exposure-dependent manner, reflecting decreased sleep depth and quality. The clinical relevance of event-related elevations of ORP is currently unknown, and warrants further investigation.

Support (If Any): None

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Conclusion: These findings support previous indications that THC can improve sleep in people using cannabis for that purpose, and suggest that increased THC results in decreased sleepiness the following day. The study limitations include no objective measure of sleep and no placebo condition. The significance of time of cannabis use in relation to sleep highlights the need to study the pharmacokinetics of smoked versus eaten cannabis products and their subsequent effects on sleep.

Support (If Any): Ford Foundation, UL1GM118964, UL1TR000128, Division of Consumer and Business Services of the State of Oregon (ORS 656.630).

0132 SELF-REPORTED SLEEP DISTURBANCE BY AIRCRAFT NOISE AROUND ATLANTA AIRPORT

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Introduction: Aircraft noise can disrupt sleep and impair recuperation. A recruitment survey for a field study on the effects of aircraft noise on sleep was sent to residents living in the vicinity of Atlanta International airport. To examine effects of aircraft noise on sleep, the survey included items on sleep quality, sleep disturbance by noise, strategies to cope with nocturnal noise and health conditions.

Methods: Questionnaires were mailed to randomly selected households around Atlanta airport. Questionnaires were completed by 290 respondents (mean age 53 years, range 21-97 years; 186 women, response rate 10.1%). Outdoor aircraft noise between 22:00-07:00 ($L_{Night}$), calculated in decibels (dB) for the dwelling of each respondent, was the main independent variable of interest. Logistic regression was performed for each dependent questionnaire response variable, adjusted for age, BMI, sex, race, marital status, income, education and employment.

Results: With increasing $L_{Night}$, there was significantly worse sleep quality ($OR=1.04/dB; p<0.05$), increased frequency of difficulty falling asleep within 30 minutes ($OR=1.06/dB; p<0.01$) and greater difficulty staying awake during daytime ($OR=1.06/dB; p<0.05$). An increase in $L_{Night}$ was also associated with increased noise-induced sleep disturbance ($OR=1.17/dB; p<0.0001$) and annoyance ($OR=1.19/dB; p<0.0001$), with respondents more likely to close windows to protect their sleep ($OR=1.05/dB; p<0.01$) and to report difficulties concentrating ($OR=0.95/dB; p<0.05$). There were no statistically significant effects on diagnosed sleep disorders, hearing impairment, hypertension, arrhythmia, chronic migraine or diabetes.

Conclusion: The physiologic mechanisms underlying the negative effects of aircraft noise on sleep may be of relevance for the development of disease. Future public health policy should be informed by evidence of noise-induced sleep disruption, of which the current study is but a first step.

Support (If Any): This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project 017 through FAA Award Number 13-C-AJE-UPENN-004 under the supervision of Sean Doyle. Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA.

0133 STUCK SONG SYNDROME: BEDTIME MUSIC AFFECTS NOCTURNAL POLYSOMNOGRAPHY OUTCOMES

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Introduction: Nearly all adolescents and young adults listen to music everyday, with music listening near its highest level in the evening. The National Institutes of Health have recommended listening to quiet music as part of the bedtime routine, and some researchers have claimed that listening to music before bedtime improves sleep efficiency to the level of hypnotic medications. These recommendations are based solely on studies in which participants self-reported their sleep quality.
Methods: Participants were 50 healthy young adults (M = 21.2 years, 70% female). Following visual analogue ratings, participants were told to relax and listen to quiet music for 10 minutes. We standardized the music playlist to include three songs with high familiarity. The songs were played at a quiet volume (42 dB) while participants sat upright in bed with the lights dimmed (40 lux) to simulate a bedtime routine. Participants were randomly assigned to listen to the lyrical or instrumental-only versions of the songs. They then repeated visual analogue ratings prior to lights out. Experimenters were masked to conditions at all time points.

Results: Participants self-reported greater relaxation after listening to music in both conditions (p < .05). In contrast to the popular notion that quiet instrumental music improves sleep quality, we observed significantly worse sleep efficiency in the instrumental condition than the lyrical condition, p < .05. Instrumental music impaired sleep quality because participants were nearly twice as likely to experience a nocturnal “earworm,” that is, a song stuck in their head. Nocturnal earworms were associated with longer sleep onset latency, lower sleep efficiency, greater time in N1, and less time in N3 (p < .05). By contrast, polysomnography outcomes were unrelated to daytime earworms (i.e., earworms experienced the next morning).

Conclusion: The perceived relaxing effects of music may reinforce bedtime listening behaviors, even when that music does not objectively improve sleep. In contrast to studies that measured sleep quality using self-report scales, the current work provides polysomnographic evidence that instrumental music can worsen sleep quality, particularly when instrumental music increases susceptibility to having a song stuck in one’s mind at night.

Support (If Any): N/A

0134 PROJECT TECH: THE IMPACT OF TECHNOLOGY USAGE ON SLEEP IN COLLEGE STUDENTS
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Introduction: More than 60% of college students are categorized as poor-quality sleepers, which negatively impacts not only physical and psychological health, but academic performance as well. Technology is increasingly becoming a necessity for college students in almost all aspects of life such as work, school, and social life. Based on recent correlational research, it has been suggested that technology use has a negative impact on sleep quality and quantity. Project Tech is a 4-week intervention designed to improve sleep quality and quantity through the use of sleep hygiene and stimulus control, and, more specifically, by eliminating technology use in bed and before bedtime.

Methods: Data are being collected from a sample of 60 students from a large Midwestern university. Participants are randomized into a control condition including sleep hygiene, and stimulus control protocol or and intervention condition including sleep hygiene, stimulus control, and technology stimulus control (do not use any technology while in bed throughout the day and do not use any technology within 30 minutes of going to bed). In person assessments of sleep quality, insomnia symptoms, stress, pre-sleep arousal, and technology use are assessed using validated self-report questionnaires pre- and post- intervention. Data collection is expected to be completed in February 2019.

Results: Repeated-measures ANOVAs will be conducted in Spring 2019 to examine the effectiveness of the intervention on sleep hygiene, sleep incompatible behaviors, sleep quality, sleep quantity, insomnia symptoms, stimultan control, technology use, and pre-sleep arousal.

Conclusion: If significant, the results would suggest that sleep hy- giene and stimulus control tips should incorporate technology use in bed and before bedtime to improve sleep, especially among college students.

Support (If Any): N/A

0135 STRESS, MINDFULNESS, PERSEVERATIVE COGNITIONS, AND SLEEP QUALITY: A MODERATED MEDIATION ANALYSIS
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Introduction: Psychological stress has previously been shown to be a predictor of poor sleep. Research indicates that pre-sleep cognitive arousal may mediate this relationship. Research has also suggested that mindfulness may improve sleep via its impact on perseverative cognitions. The purpose of the current study was to (1) examine the role of perseverative cognitions as a mediator in the stress-sleep relationship using both self-report and actigraphy measures of sleep and (2) determine whether the strength of this mediation is affected by one’s level of mindfulness.

Methods: Four weekday nights of concurrent actigraphy data were collected from 77 undergraduate students (86% female; 90% Hispanic; mean age 19.40 (2.07)). An online survey containing standardized measures of past-year stressful life events (ICSRLE), pre-sleep cognitive arousal (PSAS-Cognitive), sleep quality (PSQI) and trait mindfulness (MAAS) was also completed.

Results: Stress was correlated with poor sleep quality, both for self-report (r(77) = .36, p = .001) and actigraphy sleep fragmentation index (SFI; r(77) = .30, p = .004). Mediation/moderation analyses were conducted using Hayes’ PROCESS Macro V3.2 using 5,000 bootstrapped samples. Pre-sleep cognitive arousal did not significantly mediate this relationship for actigraphy-based SFI (fully standardized indirect effect = -.05, SE = .08, 95% CI [-.206, .105]), but fully mediated this relationship for self-reported sleep quality (fully standardized indirect effect = .24, SE = .09, 95% CI [.076, .418]). Additionally, a moderated mediation analysis indicated that mindfulness significantly moderated this mediation (index of moderated mediation = -.004, SE = .002, 95% CI [-.0081, -.0001]).

Conclusion: Pre-sleep cognitive arousal emerged as a significant mediator between stressful life events and sleep quality for subjective, but not objective, sleep quality. For subjective sleep quality, this mediating effect varied as a function of mindfulness: the indirect effect of stressful life events on sleep quality through cognitive arousal was greater for individuals scoring low in trait mindfulness than for those who scored high. Mindfulness may therefore act as a buffer, attenuating the impact of stressful events on pre-sleep cognitive arousal.

Support (If Any): N/A

0136 THE EFFECT OF SHIFT TYPE ON SLEEP BEFORE, DURING, AND AFTER WORK IN ROTATING SHIFT WORKERS
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Introduction: Atypical work schedules are associated with reduced sleep quantity and quality. Here, the objective was to determine the effect of shift type on total sleep time (TST) before, during, and after a series of consecutive shifts in rotating shift workers.

Methods: A total of 2,589 days (range: 21-36 days/participant) of actigraphy data was available from 76 police officers involved in rotating shift work (M: 56, F: 20; age: 32 ± 5.4 y). The effect of shift type (morning, evening, night) on TST in the 24 h before, during, and after a series of consecutive shifts was determined using linear mixed-effect modelling. Participant was used as random effect and shift type, sleep timing (categorized as before, during, or after a series of consecutive shifts), and their interaction as fixed effects. Post-hoc pairwise comparisons were performed using Tukey's test.

Results: Shift type and sleep timing as well as their interaction significantly affected 24-h TST (all p < 0.0001). Post-hoc analysis revealed a significant effect of shift type on TST in the 24 h prior to a first shift in a series (morning: 7.3 ± 0.15 h, evening: 7.8 ± 0.16 h, night: 8.8 ± 0.16 h) [means ± SEM]; all p < 0.05), while no effect was found during a series of shifts (morning: 6.6 ± 0.15 h, evening: 6.9 ± 0.16 h, night: 6.5 ± 0.15 h; all p > 0.05). In the 24 h after the last shift in a series, TST was significantly higher for night shifts (10.3 ± 0.16 h) than for evening (7.5 h ± 0.16 h) and morning shifts (7.9 ± 0.15 h) (both p < 0.0001).

Conclusion: A significant effect of shift type was found on 24-h TST in before and after, but not during, a series of consecutive work periods. Notably, we observed a significant sleep rebound after a series of night shifts in rotating shift workers.


0137 THE FALLING ASLEEP PROCESS IN ADOLESCENTS
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Introduction: Elevated bedtime psychophysiological activation interferes with the way people fall asleep and sleep. The falling asleep is an overlooked phenomenon, particularly relevant in the pathophysiology of insomnia. Insomnia disorder shows a profound sex difference in its prevalence, which emerges during adolescence. Greater vulnerability to insomnia in the female sex may be reflected in the manifestation of hyperarousal, particularly around sleep onset. Here, we compared the psychophysiology of the falling asleep process in adolescent boys and girls.

Methods: 102 healthy adolescents (12-20y, 54 female) from the National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) SRI cohort underwent in-lab polysomnography (PSG). Cognitive (pre-sleep arousal scale), cortical (electroencephalographic, EEG) and cardiac (heart rate) arousal measures were analyzed before and across the wake-to-sleep transition (5min before and after sleep onset).

Results: Approaching sleep onset was associated with a pronounced increase in EEG Delta and Theta power, while EEG Alpha, Sigma, and Beta power, as well as heart rate gradually dropped (p < 0.05). In the first 5min after sleep onset, EEG Delta and Beta power, and heart rate no longer changed, while Theta and Sigma power inverted their pattern and respectively, reduced and increased (p<.05). Girls tended to have higher heart rate and reduced EEG Alpha compared to boys, before sleep onset. Girls, compared to boys, had greater cognitive activation before bedtime (p < 0.05), and they took longer to fall asleep (21.3±17.4min vs. 14.8±14.5min; p<.05). Elevated pre-sleep cortical arousal (EEG-Beta power) was related to more PSG awakenings and %N2 sleep in girls, and to less %N3 sleep in girls and boys. Elevated cognitive activity was related to greater PSG wake after sleep onset and reduced %N3 sleep in boys.

Conclusion: The falling asleep process is characterized by a progressive cortical synchronization and reduction in cardiac activation, which is similar in adolescent boys and girls, despite greater bedtime cognitive activation and delayed sleep onset in girls. Longitudinal data and manipulation of the pre-sleep psychophysiological state on the falling asleep process and subsequent sleep.

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signals during REM sleep. This finding may suggest that respiratory events are less likely to elicit cortical neural activities during REM sleep than non-REM sleep.

Support (If Any): NSRR (http://sleepdata.org) for data.

0139
SUVN-G3031, A POTENT AND SELECTIVE HISTAMINE H3 RECEPTOR INVERSE AGONIST - PHASE-2 INVESTIGATIONAL NEW DRUG FOR THE TREATMENT OF NARCOLEPSY - DIFFERENTIATING FACTORS WITH COMPETITOR CLINICAL CANDIDATES
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Introduction: SUVN-G3031 is one of the potent H3 receptor (H3R) inverse agonist in the clinical development for the treatment of narcolepsy with or without cataplexy. Phase-1 evaluation for safety, tolerability and pharmacokinetics, and long term safety studies in animals has been successfully completed.

Methods: Extensive nonclinical profiling was carried out for SUVN-G3031 and H3R receptor antagonists/inverse agonists that are in active clinical development for the treatment of sleep related disorders. The nonclinical parameters like binding affinity at human and rat H3R, selectivity profiling, in-vivo and in-vitro ADME features, nonclinical efficacy, neurochemistry and safety were evaluated.

Results: SUVN-G3031 has no inter-species variation in binding affinity at H3R with >100 fold selectivity. Unlike competitor compound, SUVN-G3031 has no binding affinity at sigma 1 and 2 receptor up to the highest tested concentration of 10 µM. SUVN-G3031 has no inhibition and induction liability against major CYP isoforms and is neither an inhibitor nor a substrate of major uptake transporters. SUVN-G3031 has moderate plasma protein binding. SUVN-G3031 has superior oral pharmacokinetic and brain penetration properties in rat than the competitor compound. EEG study indicated wake promoting profile of SUVN-G3031 is superior than compounds of this class active in clinical development. SUVN-G3031 showed negligible affinity towards hERG channel (IC50 > 10 µM) and had no effects on any ECG parameters in dog telemetry study. SUVN-G3031 showed no convulsions or signs of other CNS safety. Unlike competitor compound, SUVN-G3031 has no adverse effects on fertility and embryo-fetal development up to highest tested doses. In long term toxicity studies, NOAEL exposures are several folds higher than competitor candidate.

Conclusion: Nonclinical studies demonstrated superior differentiating features of SUVN-G3031 over compounds of this class that are currently in active clinical development for the treatment of sleep related disorders. Phase-2 POC study for the treatment of narcolepsy is being planned in USA.

Support (If Any): None

0140
CHEMOGENETIC ACTIVATION OF GABAERGIC AND GLUTAMATERIC NEURONS IN THE MEDIAN PREOPTIC NUCLEUS DOES NOT ALTER ISOFLURANE ANESTHESIA
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Introduction: Ample correlative evidence suggests that anesthetics act on neural networks that control sleep and wakefulness. The preoptic area of the hypothalamus is important for sleep generation and the regulation of sleep homeostasis, and a subset of GABAergic neurons in this area express cFos during the loss of consciousness caused by inhaled anesthetics. However, no studies to date have investigated a causal role for preoptic neurons in the regulation of the anesthetic state. This study tests the hypothesis that chemogenetic activation of GABAergic or glutamatergic neurons in the median preoptic nucleus (MnPO) influences anesthetic state transitions.

Methods: Male and female Vgat-Cre (n=17) and Vglut-Cre (n=18) mice were injected with an adeno-associated virus for expression of the excitatory designer receptor hM3Dq in MnPO GABAergic (Vgat+) and glutamatergic (Vglut+) neurons, respectively. Mice received randomized intraperitoneal injections of vehicle or the agonist for the designer receptors clozapine-N-oxide (CNO; 0.5 and 1.0 mg/kg). Sixty minutes post-injection, mice were anesthetized in a chamber pre-filled with 1.5% isoflurane in oxygen, and anesthesia was maintained for 30 minutes. Induction and recovery time were quantified, respectively, as time to loss and resumption of righting response. Data analysis was conducted by two investigators, one of whom was blinded to the treatment condition. In separate experiments, rectal temperature was assessed before and after CNO administration.

Results: Relative to vehicle, chemogenetic activation of MnPO GABAergic neurons did not alter anesthetic induction and recovery time. Activation of glutamatergic neurons did not change induction time, but increased (P=0.0071) recovery time after injection of 0.5 mg/kg CNO only (P value for 1.0 mg/kg >0.9999). CNO administration to Vglut-Cre mice induced a sustained (min 20 to 90) decrease in body temperature (P<0.0001); there was no change in Vgat-Cre mice.

Conclusion: This is the first investigation of a causal role for preoptic neurons in anesthetic state transitions. These data suggest that activation of GABAergic and glutamatergic neurons in the MnPO does not substantially alter anesthetic state transitions.

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0141
ASCENDING PROJECTIONS FROM PARAFACIAL ZONE TO THE MEDIAL PARABRACHIAL NEURONS
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Introduction: The parafacial zone (PZ) is an important region for the generation of non-REM (NREM) sleep. We previously found that optogenetic-stimulation of PZ GABA projections inhibits lateral parabrachial neurons (IPB) that project to basal forebrain (BF) and we thought that through this circuit PZ neurons promoted NREM sleep. However some studies reported that glutamatergic neurons in mPB are necessary for spontaneous waking compared to those in IPB which promote arousal mainly in response to
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hypercapnia or pain. We found that the PZ heavily innervates the mPB, suggesting that PZ might promote NREM sleep by inhibiting mPB. We used *in vitro* Channelrhodopsin2 (ChR2)-assisted circuit mapping (CRACM) to investigate the functional synaptic connectivity between the PZ and mPB neurons. We also studied in whole animal experiments the effects of activation of PZ GABAergic neurons using a chemogenetic approach.

**Methods:*** We recorded mPB neurons in brain slices from Vgat-IRES-cre mice. To induce the expression of ChR2-mCherry in PZ GABA (PZVGAT) neurons, we injected an AAV-DIO-ChR2-mCherry unilaterally into the PZ of Vgat-IRES-cre mice. We then recorded mPB neurons while photo-stimulating the PZVGAT neurons axons and terminals in the PB. To induce the expression of hM3Dq-mCherry in PZVGAT neurons, we injected bilaterally an AAV-DIO-hM3Dq-mCherry into the PZ of Vgat-IRES-cre mice. We recorded EEG and EMG after intraperitoneal injections of saline (controls) or clozapine-N-oxide (CNO).

**Results:** Optogenetic-stimulation of PZVGAT ->mPB input evoked inhibitory postsynaptic currents (iIPSCs) in 21 out of 29 mPB neurons. We have previously found that activation of PZVGAT ->IPB input evoked iIPSCs that were solely mediated by GABA_A signaling. In mPB neurons, iIPSCs were abolished only when GABA_A and glycine receptors antagonists were co-applied. In addition, we confirmed that injections of CNO were able to increase NREM sleep after activation of PZVGAT neurons that expressed hM3Dq.

**Conclusion:** Our results suggest that PZ neurons project to both lPB and mPB. They inhibit lPB neurons by GABA release and inhibit mPB neurons through GABA and glycine. We hypothesize that activation of PZ promotes NREM sleep by inhibiting mPB neurons.

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0142

THE CUMULATIVE EFFECT OF PARTIAL CHRONIC SLEEP RESTRICTION ON THE NEURAL PROCESSING STREAM IN NEUROLOGICALLY NORMAL INDIVIDUALS

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**Introduction:** Event-related potentials (ERP) are averaged electroencephalogram (EEG) responses to stimuli enabling precise temporal characterization of neural processing. We analyzed the temporal evolution and course of cognitive processing impairments during a 16 day randomized, cross-over sleep restriction experiment, by analyzing visual attention (N2pc), stimulus classification (P3), and decision making (error-related negativity (ERN) and positivity (Pe)) ERPs.

**Methods:** Eighteen healthy subjects (8 women, 10 men; age 22.8±4.88, range 18-36 years underwent sleep restriction (3 acclimation nights of 9 hours of time in bed, then 9 experimental 4 hours nights, then 3 recovery sleep nights), and control sleep (3 nights of 9 hours of time in bed) sequences in random order. EEG recordings during a visual attention task were completed once (day 3) during the acclimation period, 3 times during the experimental period (days 5, 6, 9), and once in the recovery period (day 15). Post-hoc off-line ERP data processing yielded N2pc, P3, and ERN/Pe waveforms with comparison of primary amplitude and latency measures across experimental timepoints utilizing mixed linear regression modeling.

**Results:** ERN and Pe amplitudes were significantly reduced during sleep restricted days 6 and 9 (both p<0.05, for Pe p<0.02), and P3 amplitude was significantly lower during sleep restricted days 9 and 15 (both p<0.02), compared to corresponding control sequence days. Pe (day 6) and P3 (days 5, 6, 9) fractional area latencies were also significantly delayed during sleep restriction compared to the corresponding control sequence days (both p<0.03). There were no significant N2pc amplitude or latency differences between conditions.

**Conclusion:** These data suggest that stimulus classification and error-monitoring, reflecting mesial temporal and frontal neuronal network processing, are selectively impaired during chronic sleep restriction. Covert attentional shifting remained intact, implying greater allocation of top-down executive resources toward preserving attentional capacity at the cost of degraded error monitoring capacities during sleep restriction. Further research analyzing sleep homeostatic drive and vigilance is planned to determine whether these brain functions influence visual processing efficiency.

**Support (If Any):** NIH/NHLBI R01 HL 114676, Mayo Clinic CCMATS I UL1 RR024150-01
**0143**

**SOCIAL JETLAG IS ASSOCIATED WITH UNHEALTHY EATING BEHAVIORS AND HIGHER BMI IN ADOLESCENTS**

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**Introduction:** Social jetlag, the misalignment between the sleep schedule imposed by social obligations (i.e., work, school) versus free days, is associated with increased adolescent body mass index (BMI). The goals of the current study were to (1) investigate the association between social jetlag and eating behaviors in adolescents, and (2) determine whether social jetlag is associated with BMI while adjusting for unhealthy eating behaviors and lack of physical activity.

**Methods:** Survey data were collected from the age 15 wave of the Fragile Families and Child Wellbeing Study (n = 2,985), a cohort of children born in 20 U.S. cities. Social jetlag (in hours) was calculated as the difference between midpoint of self-reported sleep on the weekend and school nights. Eating behaviors (4 total) included number of days youth eats breakfast, green vegetables or fruit, and fast food during the week, and the number of sweetened drinks consumed daily. Regression models were conducted to test associations of social jetlag with eating behaviors (Poisson) and with BMI (linear), adjusting for school night sleep duration and demographic and household characteristics (e.g., sex, race/ethnicity, family structure, use of electronics near bedtime). A second linear regression with BMI as the outcome also adjusted for physical activity and eating behaviors.

**Results:** Greater social jetlag was associated with lower consumption of breakfast and green vegetables/fruit and greater consumption of fast food and sweetened drinks (all p < 0.01) after adjusting for school night sleep duration, demographics, and household characteristics. Greater social jetlag also predicted higher BMI (b = .15, p = .042), and this association remained (b = .17, p = .023) after further adjustment for physical activity and eating behaviors.

**Conclusion:** In this large sample of adolescents, social jetlag was associated with BMI, even after controlling for school night sleep duration, physical activity, eating behaviors, demographic, and household characteristics. These findings suggest that short sleep duration, lack of physical activity, and unhealthy eating behaviors do not fully explain the association between social jetlag and higher BMI in adolescents.

**Support (If Any):** N/A

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**0144**

**EXERCISE TIMING AND SLEEP IN YOUNG ADULTS**

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**Introduction:** Sufficient sleep and regular exercise are important for optimal health. Although exercise is associated with enhanced sleep quality; there is evidence that exercise performed in the evening can have an adverse impact on subsequent sleep. Unfortunately, many individuals with busy schedules are only able to make time to exercise in the evening. Therefore, it is important to understand the relationship between exercise timing and sleep. In addition, an individual’s chronotype (preference for activity in the morning or evening) may play an important role in this relationship. We examined exercise timing, chronotype and sleep in a diverse population of young adults.

**Methods:** Data were analyzed from N=867 enrolled in a cross-sectional study of undergraduates (19.5±1.4y, 38% female, 38% white). Participants were recruited after completing a workout at on-campus fitness facilities during operational hours (7 AM to 11 PM, approximately 55 participants were recruited per hour) and completed the Reduced Chronotype and Pittsburgh Sleep Quality Index (PSQI) questionnaires. Multiple regression and analysis of variance were used to examine the relationship between exercise timing, chronotype and sleep.

**Results:** In this sample of undergraduates, average self-reported sleep duration=6.9±1.2 h/night, bedtime=12:45 AM ± 77 min, and global PSQI score=6.0 ± 2.8. Approximately 58% were neither morning/evening type, 13% were moderately/definitely morning type and 29% were moderately/definitely evening type. Timing of exercise was not associated with sleep duration or global PSQI score but was associated with bedtime, and the PSQI perceived sleep quality and sleep efficiency subscales (p<0.05). Participants who exercised in the evening (6-11 PM) went to bed later and reported poorer sleep quality and lower sleep efficiency than those who exercised in the morning (7 AM-noon) or afternoon (noon-6 PM) (p<0.05). Participants with an evening preference exhibited a poorer global PSQI score than those with a morning preference and this was consistent among morning and evening exercisers (p<0.05).

**Conclusion:** Findings suggest that exercise timing and chronotype are important predictors of sleep timing and quality in undergraduates and support current sleep hygiene recommendations to not perform intensive exercise within 3 hours of bedtime.

**Support (If Any):** N/A

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**0145**

**HOW DID MAMMALIAN SLEEP PATTERNS Evolve? TEMPORAL NICHE Pursuit in an Evolutionary Model of Sleep**

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**Introduction:** Early mammalian ancestors are thought to have been primarily or exclusively nocturnal to avoid antagonistic interactions with terrestrial dinosaurs. However, fossil evidence indicates that many terrestrial dinosaur predators had invaded the nocturnal niche by the late Mesozoic. Moreover, there is evidence that nocturnality evolved multiple times independently in the early mammalian lineage. These findings suggest a dynamic co-evolution of temporal niche among dinosaurs and early mammals. To investigate this scenario, we used a neurophysiological model of sleep-regulatory circuits to simulate the evolution of sleep patterns in an agent-based predator-prey system.

**Methods:** We defined an artificial genome for the model, with alleles corresponding to values of model parameters that have previously been shown to govern the model’s sleep/wake patterns, including its sleep duration, timing, and cycleicity. Evolution was simulated with fixed population sizes, with the fittest individuals passing parameters to the next generation, including random genetic mutations. An evolutionary fitness function was defined, based on time spent asleep, time spent foraging (for prey), and interactions with other individuals, both within and across species.
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Results: The predator-prey model generated persistent oscillations in allele frequencies across generations, which were phase-coupled between predator and prey species. These oscillations were driven by switching between diurnal (day-active) and nocturnal (night-active) modes. Specifically, predators successively invaded the prey's primary temporal niche, while the prey successively evaded the predators' primary temporal niche, by means of genetic mutations that supported each temporal niche. The rate of oscillations was determined by gene mutation rate and strength of predator-prey interactions. A two-dimensional toy model was derived to explain the key dynamics.

Conclusion: These findings indicate that co-evolution may be a driver of evolutionary cycles in sleep patterns, including 'temporal niche pursuit' of prey by a predator. The evolutionary model provides a means of testing ecologically based hypotheses regarding the role of environmental factors in shaping sleep-regulatory circuits.

Support (If Any): -

0146 MODEL-BASED PREDICTIONS OF NEUROBEHAVIORAL PERFORMANCE OF RESIDENT PHYSICIANS IN A RANDOMIZED ORDER SAFETY TRIAL EVALUATING RESIDENT-PHYSICIAN SCHEDULES (ROSTERS)

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Introduction: Mathematical models of neurobehavioral performance are a key tool in work schedule assessment, allowing quantitative predictions of performance, especially in cases where empirical assessment would be impractical. Models have recently been extended to predict accurately the effects of chronic sleep restriction on vigilant performance, increasing their operational relevance.

Methods: Using a validated mathematical model of neurobehavioral performance, we tested the hypothesis that resident physicians working an extended duration work roster (EDWR), including 24-28 hours of continuous duty and up to 88 hours per week averaged over 4 weeks, would have worse predicted performance than resident physicians working a rapidly cycling work roster (RCWR) intervention designed to reduce duration of extended-duration shifts. Model predictions of attentional failures were generated using 298 actual ROSTERS work and sleep schedules (n=148 for EDWR, n=150 for RCWR). Predicted outcomes were hours per week during work hours spent at moderate (equivalent to 16-20 hours of continuous wakefulness) or high (equivalent to ≥20 hours) impairment.

Results: Compared to RCWR, resident physicians working EDWR were predicted to spend significantly more time at moderate impairment (p<0.05), with this difference being most pronounced during the circadian night (p<0.001). On both schedules, performance was predicted to decline from weeks 1 + 2 to weeks 3 + 4 (p=0.001), but rate of predicted decline was significantly greater on EDWR (p<0.01). Predicted impairment was inversely related to sleep duration (p<0.001).

Conclusion: The findings reveal the utility of a model that incorporates effects of circadian rhythms and acute and chronic sleep loss on performance to evaluate the safety profile of schedules for resident physicians and others. Model predictions identify potential approaches to improving schedules.

Support (If Any): Randomized Order Safety Trial Evaluating Resident Schedules (ROSTERS) is supported by National Heart, Lung, and Blood Institute, which provided a Certificate of Confidentiality for data protection (U01-HL-111478 and U01-HL-111691). Dr. Klerman's support includes NIH K24-HL-105664, R01-HL-128538, R01-HL-14088, R01-GM-105018, R21-HD-086392, P01-AG-009975 and NSBRI HFP-02802, HFP-0006, and HFP-04201. Drs. Barger, Lockley, and Czeisler's support includes the National Institute of Occupational Safety and Health R01-OH-010300.

IX. Sleep and Circadian Interactions

0147 THE EFFECT OF EVENING USE OF ORGANIC LIGHT EMITTING DIODE LIGHT ON CIRCADIAN RHYTHM AND SLEEP

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Introduction: Light exposure during night suppresses the release of melatonin and shifts the circadian clock to a later time, and these effects are affected by light intensity and wavelength of light. Organic light emitting diode (OLED) is a human-friendly type of lighting because it is blue-hazard-free, but the effect of OLED light on circadian rhythm has not been evaluated. This study is aimed to evaluate the effect of OLED light on melatonin secretion and sleep compared to light emitting diode (LED) light.

Methods: 24 healthy subjects (18 females, age 26.9±5.7) with intermediate sleep-wake cycle were recruited. Exposure to three conditions of light, consisted of OLED, LED, and control (dim light, 10lux) were performed at three different night (from 6pm to midnight) in a random order at 7-day intervals. The light intensity of OLED and LED was 150 lux and color temperature was 4,000K. During the 6 hours of light exposure, saliva samples for melatonin were taken every hour, and subjects were under polysomnography after each condition of light exposure. Psychomotor vigilance test (PVT) was performed after waking to assess vigilance after sleep.

Results: Mean dim light melatonin onset (DLMO) was 9:11PM in dim light condition, 9:20PM in OLED, and 9:36 PM in LED. DLMO was significantly delayed after LED exposure compared to dim light (p=0.003). In contrast, there was no significant delay of DLMO after OLED exposure compared to dim light (p=0.245).
Introduction: Chronic, lifestyle-driven sleep restriction is common in many modern 24-hour societies. In these instances, people will compensate for their weekly sleep deprivation by sleeping more on weekends. Many cohort studies revealed that weekend sleep extension compensates for short weekday sleep in relation to mortality, obesity, and hypertension. However, these studies used self-reported sleep durations, and did not focus on objective sleep quality. The aim of this study is to evaluate differences in sleep duration and quality between weekdays and weekends using a portable EEG monitoring device.

Methods: Twenty-onetwo Japanese volunteers, aged 20-67 years (4 female and 17 male), enrolled in this study. They underwent seven days of monitoring using a portable EEG device that recorded their sleep activity. These recordings were used to evaluate sleep parameters, such as total sleep time (TST), sleep efficiency (% of time in bed (TIB)), sleep latency, wake time (% TIB), wake after sleep onset (WASO), REM sleep, light sleep (stages N1 and N2), and deep sleep (stage N3).

Results: TIBs on Friday and Saturday night were significantly longer than other nights of the week, leading to longer TST on Friday and Saturday night. Sleep efficiency (% TIB) was better on weekdays than weekends, and wake time (% TIB) was greater on Friday, Saturday and Sunday nights as compared to other days of the week. WASO and light sleep were longer on weekend nights than weekday nights, meanwhile, REM sleep and deep sleep were unaffected by the day of the week.

Conclusion: TIB and TST increased on weekend nights, but sleep efficiency tended to decrease. REM sleep and deep sleep were stable throughout the week, while light sleep increased as TST was longer. Extended TIB may increase WASO and light sleep.

Support (If Any): None.

0149 STRESS, SLEEP, AND CIRCADIAN ACTIVITY RHYTHMS AMONG COLLEGE STUDENTS: A PRELIMINARY REPORT

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Introduction: Decreased spindle amplitude and intensity has been found to be related with circadian preference for morningness in adolescents. However, it is unknown whether this is the case in adults. Thus, this analysis aims to look at the relationship between adult Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ) scores and polysomnography data to determine whether the same is true in adult populations.

Methods: Participants (N=15, M=41.07 years) completed the MEQ to determine their personal circadian preference. Polysomnography was recorded in participants’ homes using the Aura PSG ambulatory system (Grass Technologies) during the exam week (week I), students perceived moderate stress (M=15.1, SD= 8.2) and reported about 2-3 nights of sleep disturbances. In average they need 459 minutes of sleep to feel refreshed; however, they only slept 426.2 (SD=59.5) and 433.2 (SD=50.6) min/day in week I and II, respectively. The average TST was less during weekdays than weekend. The WASO were > 10% for both weeks indicating fragmented sleep, and CARs were 0.74 (SEM=0.04) and 0.77 (SEM=0.04) for week I and II, respectively. The acrophase was around 4 pm indicating an evening-typed person. During the exam week, stress level was positively associated with sleep disturbances, poor daytime functioning, and poor activity correlation; self-reported sleep disturbance was associated with more WASO and higher morning fatigue level; better CAR was associated with better TST (all p< .02).

Conclusion: In this preliminary report, findings revealed college students experienced stress, fragmented sleep, fatigue, and desynchronized CAR. Stress coping strategies and sleep hygiene should be mandatorily included in the college education.

Support (If Any): This project was funded to S.F. Chou by a Presidential Interdisciplinary Grant at the University of Texas at Tyler.

0150 EXPLORING ASSOCIATIONS BETWEEN SLEEP SPINDLE CHARACTERISTICS AND CIRCADIAN PREFERENCE IN ADULTS

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Introduction: Decreased spindle amplitude and intensity has been found to be related with circadian preference for morningness in adolescents. However, it is unknown whether this is the case in adults. Thus, this analysis aims to look at the relationship between adult Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ) scores and polysomnography data to determine whether the same is true in adult populations.

Methods: Participants (N=15, M=41.07 years) completed the MEQ to determine their personal circadian preference. Polysomnography was recorded in participants’ homes using the Aura PSG ambulatory system (Grass Technologies) during the midterm exam to assess their stress, sleep, and fatigue. 14-days consecutive wrist actigraphy data, including total sleep time (TST) and wake after sleep onset (WASO) were collected. Cosiner analysis was used for computing the CAR, including amplitude, mesor, and acrophase.
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STRAIN COMPARISON OF THE EFFECTS OF A SPACEFLIGHT ANALOG ON SLEEP DISRUPTION
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Introduction: Hindlimb unloading (HLU) is the most prevalent simulation of microgravity on earth. It captures several effects of spaceflight including: cephalic fluid shift, partial unloading of the hind limbs and spine, as well as sleep and immunologic impairments. Future analysis will include more participants to further explore the possible association between MEQ and spindle density. Spindle characteristics such as amplitude and intensity will also be included.

Support (If Any): This work was funded by NIH R01 AG040133 (PI: Spencer)

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SLEEP RELATED CHARACTERISTICS IN WORKERS WITH IRREGULAR WORK
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Introduction: Now a day, more and more workers choose to work without a fixed time schedule and/or work space. It is of interest to examine whether workers with this modernized work pattern have specific sleep-related characteristics. Therefore, the current study addressed this issue by comparing sleep-related characteristics between workers with and without a regular work schedules.

Methods: his study recruited 446 healthy adults through internet. Participants were divided into two groups by their answers on a single question “Do you work on a regular schedule?”. Those who answer “no” were assigned to the RW group (n=199), and “yes” were assigned to the RW group (n=247). They were asked to complete a survey that included: a questionnaires for demographic information, the Morningness-Eveningness Questionnaire (MEQ; Horne & Östberg, 1976), the Circadian Type Inventory (CTI; Folkard, 1987), the Munich ChronoType Questionnaire (MCTQ; Roeppenberg et al., 2006), the Epworth Sleepiness Scale (ESS; Johns, 1997), the Insomnia Severity Index (ISI; Morin, 2001), the Perceived Stress Scale (PSS; Cohen, Kamarack & Mermelstein, 1983), the Centre for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977), and the Situational Fatigue Scale (SFS; Yang & Wu, 2005). Independent t-tests were conducted to compare the ratings on the questionnaires between two groups.

Results: Significant differences between two groups were found on the score of MEQ, Flexibility/Rigidity (FR) factor of CTI, ISI, ESS, PSS, and CESD. RW group have found to have higher score on MEQ, FR factor of CTI and ESS scores. On the other hand, RW group have found to have lower score of MEQ, ISI, ESS, PSS, and CESD. RW group have found to have lower score than RW group. There were no significant difference on Languid/Vigorous (LV) factor of CTI and SFS.

Conclusion: We found several differences between the individuals with regular or irregular work schedules. The results indicated that while those workers with irregular work schedule tend to be more flexible in their circadian rhythm, they sleep worse and are sleepier and more depressed. As there are increased number of workers having irregular work schedule, their sleep quality as well as related daytime functioning need further investigation.

Support (If Any): NASA grant NNX15AL05G

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ESTIMATED PREVALENCE OF FAMILIAL ADVANCED SLEEP PHASE (FASP) IN A SLEEPS CLINIC POPULATION
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ESTIMATED PREVALENCE OF FAMILIAL ADVANCED SLEEP PHASE (FASP) IN A SLEEPS CLINIC POPULATION
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overnight sleep. Sleep architecture, was analyzed using a combination of EEGlab and Matlab.

Results: Sigma density means in NREM2 did not significantly correlate with MEQ scores in adults (p = 0.31). However, sigma density means in NREM3 were negatively associated with circadian preference scores (R = -0.592, p = 0.055).

Conclusion: These results suggest a trending negative association between sleep-related characteristics such as amplitude and intensity will also be included.

Support (If Any): This work was funded by NIH R01 AG040133 (PI: Spencer)

SLEEP, Volume 42, Abstract Supplement, 2019
Introduction: Advanced Sleep Phase (ASP) describes individuals with an extreme phase advance, and Familial Advanced Sleep Phase (FASP) describes individuals for whom this pattern is present in multiple biologically related family members. Identifying probands with FASP has proven a powerful tool to find new clock genes. We report here the first prevalence estimate of ASP and FASP from a sleep clinic population. This can improve recruitment and enrollment for research on circadian genetics. Further, this can inform clinicians on the likelihood of ASP in patients noting early evening sleepiness and early morning awakening.

Methods: 1,748 patients presenting for symptoms of OSA to a North American sleep center were asked about preferred sleep schedule over a 9.8-year period. Those with extreme chronotypes were further assessed using criteria that has previously identified autosomal dominant FASP genetic variants. All patients were personally evaluated by one of the authors (CRJ).

Results: In a population of patients presenting for OSA, there is an ASP prevalence of 0.46% and a FASP prevalence of at least 0.29%. Most patients with stringently defined ASP had FASP.

Conclusion: Conservatively, one out of every 220 patients presenting to a sleep clinic for symptom of OSA will have ASP, and one out of every 350 will have FASP. We recommend sleep clinics implement a two-question screen: on a long weekend or vacation with no obligations, when would you) 1) first go to bed? and 2) have your final awakening? Improved screening can yield better identification of FASP individuals and additional genes that influence the circadian clock. Given the pleiotropic effects of “circadian genes,” we hope these findings will lead to improved treatment options for a wide range of sleep and medical disorders in the future.

Support (If Any): The work was supported by NIH grants NS099333 (LJP, CRJ) and NS072360 (Y-HF), and by the William Bowes Neurogenetics Fund.

0154 SLEEP INERTIA NEGATIVELY AND CONSISTENTLY AFFECTS COGNITIVE SPEED AND WORKING MEMORY DURING SLEEP RESTRICTION AND CIRCADIAN MISALIGNMENT

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Introduction: Sleep inertia is influenced by sleep deprivation and circadian phase. The consistency of individual differences in performance upon awakening from sleep during combined sleep restriction and circadian misalignment has not been investigated.

Methods: Twenty adults (8 female) aged 25.6±2.4 years (mean±SD) repeated an 18-day protocol, separated by three days of ad libitum sleep at home. Participants kept habitual, self-selected 8h sleep schedules for two weeks, then stayed in the laboratory for four days. Laboratory visits included one sleep opportunity each day: 8h night one (S1), 3h night two (S2), 3h mornings three (S3) and four (S4). Sleep in the 10 and 30 minutes prior to scheduled waketime were determined by polysomnography. Cognitive function was assessed at 1, 16, and 31 minutes after scheduled waketime after S3 and S4. Cognitive speed and working memory were tested with a 2-minute addition task (number attempted; number correct). Sleepiness was tested using the Karolinska Sleepiness Scale (KSS). Stability of individual differences in cognitive function were quantified by intra-class correlation coefficients (ICC) derived from mixed-model ANOVAs.

Results: Average amount of wake in the last 10 and 30 minutes of sleep opportunities was 0.4±0.07 and 1.5±0.20 minutes (mean±SE), respectively. Cognitive speed and working memory were significantly impaired upon awakening and improved thereafter (p < .05; main effect of time since awakening). There was an interaction between time since awakening and sleep opportunity for the KSS, such that sleepiness scores were similar upon awakening from S3 and S4, but decreased over time to a greater extent after S3 versus S4 (p < .001). Within an individual, performance was highly consistent (ICC = 0.71-0.90), whereas sleepiness scores were more variable (ICC = 0.28-0.67).

Conclusion: Consistent performance upon awakening from sleep during combined sleep restriction and circadian misalignment has implications for development of targeted countermeasures for workers performing safety-critical tasks under sleep inertia (e.g., military, healthcare and emergency workers).

Support (If Any): Office of Naval Research MURI N00014-15-1-2809; NIH TR001082; Undergraduate Research Opportunities Grant, University of Colorado Boulder.

0155 CIRCADIAN AND HOMEOSTATIC INFLUENCES ON CALORIC INTAKE: FORCED DESYNCHRONY IN HEALTHY WEIGHT, OVERWEIGHT, AND OBESE ADOLESCENTS

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Introduction: Earlier (circadian) meal timing is associated with more favorable weight outcomes. Whether control of caloric intake across the endogenous circadian cycle and/or time from awakening to bedtime differs depending on body weight is unknown. We addressed these questions in adolescents with a 28-h forced desynchrony (FD), hypothesizing that overweight (OW) and obese (O) adolescents had a higher proportion of daily energy consumed later in the wake episode and at a later circadian phase compared to healthy weight (HW) adolescents.

Methods: 51 (29m) adolescents (12-15yr) completed 7 FD cycles. Six meals occurred at fixed times each cycle: Meal1 was 1.7h after scheduled awaking, Meal2 was 2h after Meal1, and Meals3-6 followed at 3-h intervals. Foods were selected about 1h before each meal and weighed before and after each meal. Proportion of energy intake for each meal across each wake episode was computed relative to total energy consumed in that cycle. Weight categorization used body mass index (BMI) percentiles (CDC): HW (>5th and <85th; n=24), OW (≥85th and <95th; n=13), or O (≥95th; n=14). Endogenous circadian period was determined using salivary melatonin onsets (Mean: HW=24.19h; OW=24.23h; O=24.22h). Effect of circadian phase and time since scheduled awakening was assessed by Repeated Measures ANOVAs using 6 circadian and 6 time-awake bins.

Results: There was a significant time awake effect (F(3,2076)=113.5, p<0.01) that differed by weight category (F(10,2076)=4.9, p<0.01), with more consumption earlier and less
later in OW and HW; O group showed more consistent consumption across the wake episode. There was also a significant circadian influence ($F(5,2086)=38.08, p<.01$) that differed by weight category ($F(10,2076)=2.75, p<.01$), with O group showing a lower amplitude and later acrophase. We also examined circadian alignment using 1st (aligned) vs. 4th (misaligned) FD cycles. A significant misalignment effect ($F(5,550)=14.32, p<.01$) was seen and differed by weight category ($F(10,528)=2.21, p=.02$).

**Conclusion:** Consistent with our hypotheses, O showed higher consumption late in the wake episode and at a later circadian phase than other weight groups. Circadian and misalignment influences were weaker for O group compared to OW and HW groups.

**Support (If Any):** DK101046

0156

**BOTH CIRCADIAN CLOCK AND SLEEP CONTROL PLASMA LEVELS OF PCSK9, THE MAIN REGULATOR OF PLASMA LDL CHOLESTEROL**

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**Introduction:** Shift work is a risk factor for elevated plasma levels of low-density lipoprotein cholesterol (LDL-C); yet the underlying mechanisms remain unclear. Proprotein convertase subtilisin/kexin type 9 (PCSK9) is a circulatory protein synthesized mainly by the liver; PCSK9 causes the degradation of the hepatic LDL receptor and thus, increases plasma LDL-C levels. Under normal physiologic conditions PCSK9 concentration in humans peaks in mid-morning. To determine the mechanisms involved in the dynamic regulation of PCSK9 in humans, we separately tested how the circadian clock and sleep affect circulating PCSK9.

**Methods:** To reveal any endogenous circadian rhythm in PCSK9, 10 healthy participants completed a week-long forced desynchrony (FD) protocol consisting of recurring 20-h “days.” Core body temperature was used as the circadian phase marker. To further determine the contribution of sleep versus that of the inactivity that accompanies sleep on PCSK9, 10 additional healthy participants were studied across two nights: one with sleep and one with maintained wakefulness (randomized order). Plasma PCSK9 was measured every ~1.5 h in both protocols. Data were analyzed using mixed model analyses.

**Results:** In the FD, PCSK9 levels follow a strong circadian rhythm, with a peak at ~10:30 AM (~20% change trough to peak, $p<0.001$). Additionally, PCSK9 levels increased during recurring sleep opportunities (~10% increase), independently of circadian phase ($p<0.001$). In the second protocol, we further discovered that PCSK9 increased significantly only during sleep (~10% increase, $p=0.006$) but not during maintained wakefulness and inactivity ($p = 0.37$).

**Conclusion:** Both the endogenous circadian system and nocturnal sleep contribute to high levels of circulating PCSK9 in the morning. This regulation ties sleep and the circadian clock to the physiological regulation of PCSK9, and will have relevance for LDL-C regulation in shift workers or other conditions of circadian disruption or disrupted sleep. These findings increase our understanding of the physiological regulation of cholesterol homeostasis in healthy individuals and may also have relevance to patients with hypercholesterolemia.

**Support (If Any):** NASA-NNX10AR10G, NIH R01-132985, and Oregon Institute of Occupational Health Sciences, and Knight Cardiovascular Institute.
ETHNORACIAL SLEEP DISPARITIES AMONG COLLEGE STUDENTS IN THE UNITED STATES: A NATIONALLY REPRESENTATIVE STUDY
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Introduction: Racial/Ethnic disparities of sleep health in the United States may underlie other disparities in health and well-being. College students may be particularly vulnerable to suboptimal sleep health due to time constraints, social stressors, and environmental circumstances related to living in dormitories, which likely differ by race/ethnicity. However, few studies have investigated sleep disparities among college students.

Methods: We used data from the National Health Interview Survey (2004-2017) to test the hypothesis that racial/ethnic sleep disparities exist among college students residing in dormitories in the United States. Habitual short sleep duration (<7 hours/day), difficulty falling asleep and/or staying asleep (≥3 days/week), and perceived non-restorativeness of sleep (on most days) were self-reported. Adjusting for sociodemographic characteristics, Poisson regression with robust variance was used to determine the prevalence of poor sleep dimensions among racial/ethnic minority students compared to Whites.

Results: Among 1,202 college students (64% White; 19% Black; 10% Hispanic/Latino; 7% Asian), the prevalence of short sleep duration among Black students (46%, 95% CI: 38-53) was significantly higher than Whites (33%, 95%CI: 32-35), but not among Hispanics/Latinos (33%, 95% CI: 24-42) and Asians (36%, 95% CI: 26-47). In adjusted models, Black students were more likely to report short sleep duration than their White counterparts (adjusted prevalence ratio (aPR) = 1.30, 95% CI:1.01-1.67), but there was no significant difference in short sleep duration among Asians (aPR=1.21, 95%CI: 0.86-1.70) and Hispanics/Latinos (aPR=1.02, 95%CI: 0.79-1.37). The proportion of separate insomnia symptoms ranged from 7% to 46% (combined symptoms: 7-27%) across ethnoracial groups (p<0.05). The prevalence of perceived non-restorativeness of sleep ranged from 15% to 46% across ethnoracial groups, but also did not differ by ethnoracial group.

Conclusion: In the US, Black college students, but not Hispanics/Latinos nor Asians, were more likely to experience short sleep duration compared to Whites. Insomnia symptoms and perceived restorativeness of sleep did not differ between ethnoracial groups. Future research identifying the social and environmental causes of these disparities using longitudinal designs, larger sample sizes, and objective sleep measures is warranted.

Support (If Any): PSU Bunton-Waller Fellowship
relapse. We have previously demonstrated that acute sleep deprivation (SD) enhances the rewarding properties of cocaine using the conditioned place preference (CPP) task. Furthermore, SD induces preference to low, subthreshold dose of cocaine. However, the mechanism(s) by which SD influences reward-related behavior are still unknown. Here, we investigated a possible role of adenosine, a neuromodulator which mediates sleep homeostasis and is directly or indirectly influenced by drugs of abuse, including cocaine.

**Methods:** Adult male mice with a conditional knockout of adenosine A1 receptors on forebrain glutamatergic neurons (fAdora1;CamKII:Cre+) underwent unbiased CPP training using a three chambered box. CPP expression and acquisition was tested using a protocol consisting of a pre-test (doors open) to ensure a lack of side bias, followed by alternating daily cocaine and saline conditioning trials (doors closed), and a 20 min post-test (doors open). Mice were sleep deprived via a slowly moving treadmill belt for 4 hours immediately prior to the post-test (experimental group, CPP expression), cocaine conditioning trials (experimental group, CPP acquisition), saline conditioning trials (control group, CPP acquisition) or allowed to sleep undisturbed (control group, CPP expression). A moderate cocaine dose (8 mg/kg) was used which is typically reinforcing and supports CPP in mice.

**Results:** Unlike in wildtype mice, SD did not increase either CPP expression or acquisition to a moderate dose of cocaine in fAdora1;CamKII:Cre+ mice. Furthermore, sleep deprived fAdora1;CamKII:Cre+ mice only reached a trend towards preference for CPP expression. Interestingly, the relative amount of time spent in the cocaine-paired context in control fAdora1;CamKII:Cre+ mice was similar to that previously found in sleep deprived wildtype mice. Since SD of fAdora1;CamKII:Cre+ mice had far less effect, CPP was similar to that of sleep deprived wildtype mice.

**Conclusion:** These results suggest that loss of A1 receptors may occlude the ability of sleep disturbance to influence reward seeking possibly due to a shift in dose response.

**Support (If Any):** VA BLR&D CDA2 award IK2BX002531.

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**0160 NEGUDEMO MOOD AND POOR SLEEP ARE ASSOCIATED WITH ALTERED MORAL REASONING UNDER STRESS**

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**Introduction:** The ability to utilize principled reasoning when judging moral problems is paramount to decision-making. Complex reasoning is centered around mutual benefit and universal principles, whereas simple reasoning is built upon self-interest and punishment/reward. Sleep is critical for making principled judgments. However, the effects of both sleep quality and mood during acute stress have not been investigated. Here, we assessed the effect of mood and sleep onset latency (SOL) on moral judgements under stress, hypothesizing that longer SOLs and negative mood would predict greater acceptance of simpler moral arguments.

**Methods:** 60 adults (41 F; 22±2.9 yrs) completed ~7 nights (6±1.0) of at-home actigraphy followed by an in-lab session, which include a prolonged psychosocial stressor. Subjects underwent either a positive/neutral or negative mood induction, with regular mood boosts throughout. On the Moral Competence Test (MCT), subjects rated the acceptability of six arguments in favor of and against the agent’s decision for each scenario on a 9-point Likert scale. We quantified principled moral orientation (p-score) as the coefficient of correlation between acceptance of MCT items (arguments) and item complexity. SOL for the night prior to the in-lab session was used to assess sleep quality.

**Results:** Subjects in the negative mood group made more principled judgments than those in the positive mood condition (t(62)=2.5, p=0.01). SOL did not differ between groups. However, a Pearson’s correlation showed a significant relationship between SOL and p-score for the negative mood group (r=-0.5, p=0.02), but not the positive mood group (r=-0.1, p=0.62). Longer SOLs were associated with simpler reasoning.

**Conclusion:** These findings suggest that those in a negative mood tend to utilize more principled reasoning compared to those in a positive mood. However, the previous night’s sleep quality had significant implications for the complexity of moral reasoning used. Subjects in the negative mood group tended to regress to simpler reasoning when the previous night’s sleep was poor, suggesting that there is an important interplay between mood state and sleep efficiency when making morally-driven decisions in a stressful environment.

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**0161 INSOMNIA SEVERITY IS ASSOCIATED WITH POSITIVE AND NEGATIVE AFFECT: NHST AND BAYESIAN MULTILEVEL APPROACHES**

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**Introduction:** Sleep is implicated in the experience of various mood disorders and poor psychological functioning. Observational studies of sleep and affect identify associations between insomnia status and both positive and negative mood. One potential moderating pathway is through the effect of social isolation. Though these relationships have been explored cross-sectionally and experimentally, fewer studies have examined these relationships over time using ecological momentary assessment (EMA) methodology. The current study addresses this gap in the literature in a community cohort with contemporary measurement and analysis strategies.

**Methods:** Participants were a community sample of 300 healthy adults (150 men, 150 women) ages 21 to 70 years enrolled in the North Texas Heart Study. The sample was stratified by age within gender and race/ethnicity, and the mean age at enrollment was 42.44 years (SD=12.76). At baseline, participants completed the Insomnia Severity Index-Modified (ISI-M), a 7-item validated scale that assesses perceived severity of insomnia. EMA surveys were used to assess daily experiences acutely using cellular devices. Questions about positive affect, negative affect, and social exposure were collected over a 48-hour time period at random during 45-minute intervals. Multilevel modeling using both Null Hypothesis Significance Testing (NHST) and Bayesian approaches was used to assess the relationship between insomnia severity and both positive and negative affect.

**Results:** Higher ISI-M predicted lower positive affect (b=-.21) and higher negative affect (b=.08), respectively, and there was a trend
for the interaction of ISI-M and time predicting positive affect (p=0.053). Those who reported being around people (i.e., social exposure) were likely to have concurrently higher positive affect throughout the study (β=0.2). However, there was no interaction of social exposure and ISI-M predicting either positive or negative affect. Bayesian and NHST results were consistent.

Conclusion: The current study demonstrates the association between insomnia severity and daily affect. This relationship does not appear to depend on social exposure. Implications for these relationships on future research and interventions will be discussed.

Support (If Any): The North Texas Heart Study was supported by the National Heart, Lung, and Blood Institute.

Introduction: Stressful situations are common in the military, and understanding how stress impacts subjective ratings is important for mission success. Subjective sleepiness, fatigue, and negative mood have been linked to performance impairments. Performance has also been linked to unit-level subjective ratings of perceived state. However, little is known about how stressful operational conditions and military group assignment impact perceptions of sleepiness, fatigue, and mood. This analysis aims to examine the influences of a live-fire exercise and platoon membership on subjective ratings of sleepiness, fatigue, and mood.

Methods: Forty-six participants [42 males (mean age 24.5±4.2 SD)] were recruited from a sample of active-duty Soldiers belonging to three platoons. The study was planned around a 72-hour simulated mission culminating in a live-fire exercise (LFX), consisting of physical and cognitive stressors and marksmanship. Visual Analog Scales (VAS) capturing subjective tiredness (extremely tired-not at all), fatigue (least fatigue-most fatigue), sleepiness (sleepy-alert), hostility (hostile-friendly), and happiness (happy-sad) were assessed before and after the LFX. Data was analyzed with repeated measures ANOVA to assess the effects of Time (Pre-LFX, Post-LFX) and Platoon (A, B, C).

Results: Significant main effects of Time and Platoon were observed on subjective ratings of tiredness, fatigue, and hostility (p<0.05), while only significant main effects of Time (Pre, Post) were observed for ratings of sleepiness and happiness (p<0.05). All subjective ratings were worse following the LFX. No significant interaction effects were observed.

Conclusion: The live-fire exercise increased subjective ratings of tiredness, fatigue, and sleepiness, and had a negative impact on subjective mood states. Platoon membership also influenced select measures associated with fatigue and mood. As increases in tiredness, fatigue, and sleepiness and decreased mood may negatively impact performance, understanding how a stressful event during a mission influences subjective ratings may lead to insight on sustaining performance in the operational context. Further analysis is needed to explore the direct relationship of these variables on performance in the live-fire exercise.


0163 INTRAINDIVIDUAL VARIABILITY IN OBJECTIVE AND SUBJECTIVE SLEEP LONGITUDINALLY PREDICTS SOCIAL ACCEPTANCE
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Introduction: Healthy sleep is linked to positive social interactions and decreased social isolation. However, it remains unclear whether individual sleep fluctuations predict social acceptance (i.e., favorable attitudes toward others’ kindness and sincerity) in the long term. The present study investigated whether average and intrindividual variability in objectively and subjectively assessed sleep predicted social acceptance longitudinally.

Methods: Archival data from the Midlife in the United States Study (MIDUS II and MIDUS III) were utilized for the current investigation. Participants were 292 adults (51% female, M age=57 yrs., SD=11.5 yrs.) who completed 7 days of actigraphy and sleep diary measures in MIDUS II, as well as a measure of social acceptance (SA) across both MIDUS II and III. Age and gender were utilized as covariates in multiple hierarchical regression analyses predicting social acceptance from objective and subjective sleep.

Results: Greater fluctuation in SOLact (β=-.04, p<.05), SEact (β=-.19, p<.05), TSTact (β=-.04, p<.05), and WASOact (β=-.05, p<.05) at T1 contributed to higher T2 SA. Greater mean SQdiary (β=-.65, p<.05) and TIBdiary (β=.04, p<.05) at T1 predicted higher T2 SA. Lastly, intrindividual variability in TIBdiary (β=-.01, p<.05) and mean SQdiary (β=.75, p<.05) predicted increases in SA from T1 to T2.

Conclusion: These findings support the importance of considering intrindividual sleep variability alongside mean scores when predicting social outcomes. Both greater mean and greater intrindividual variability in sleep patterns at an earlier time point predicted higher social acceptance 10 years later. Individuals who perceived their sleep as better were more likely to expect and accept genuinity in social interactions. Furthermore, contrary to expectation, higher sleep variability predicted increased social acceptance. These incongruous results indicate a need for further investigation. Future research should attend to (1) the association between past sleep and social well-being and (2) mechanisms by which self-report, alongside objective, sleep indices contribute to interpersonal acceptance over time.

Support (If Any):
A. Basic and Translational Sleep Science

overall lifestyle regularity) may protect against anxiety remains unclear. Greater social rhythmicity may lead to healthier sleep habits, which, in turn, could protect against anxiety. Although previous research has examined the association between poor sleep and anxiety, sleep health has yet to be examined as a potential pathway by which social rhythmicity may predict fewer anxiety symptoms. The current study explored whether (1) higher social rhythmicity predicted fewer symptoms of anxiety and (2) sleep health acted as a mechanism underlying this association.

**Methods:** An archival analysis was performed using data from an online study, Investigating Sleep Across Normal Development (ISLAND Study). The sample consisted of 4,388 adults aged 18+. Measures of social rhythmicity (SRM-10), sleep health (RUSATED), and anxiety symptoms (GAD-2) were utilized. Age and gender were covariates in mediation analyses.

**Results:** Mediation analyses were performed to assess sleep health as a potential mediator between social rhythmicity and anxiety. The overall model was significant, p < .0001 and 18.7% of the total variance was accounted for by social rhythmicity. Controlling for covariates, higher social rhythmicity was directly associated with fewer anxiety symptoms (95% CI [.0428, .0577]). Additionally, sleep health significantly mediated the association between social rhythmicity and anxiety symptoms (95% CI [.0163, .0221]).

**Conclusion:** Individuals who have higher levels of daily routine regularity experienced less anxiety symptoms than those who are more irregular in their daily routines. Furthermore, sleep health was found to be an explanatory mechanism in this association. Potentially, individuals who have more regular lifestyle habits are also more likely to engage in healthy sleep behaviors. Additionally, regular lifestyle habits could help to organize the day to promote healthier sleep behaviors. Future research should continue to examine the link between social rhythmicity and sleep quality on various health outcomes.

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0165

**DYADIC SLEEP**

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**Introduction:** Family caregivers of adult cancer patients are at risk for elevated psychological distress and poorer sleep quality, compared with non-caregivers. While psychological distress is known to be a predictor of poor sleep, unknown is the specificity of the distress/mood to which poor sleep is most attributable. This study aimed to investigate the associations of various moods with sleep efficiency among spousal caregivers of cancer patients across 14 consecutive days accounting for weekday-vs-weekend variance in sleep behaviors.

**Methods:** Spouses (n=26, 51 years old, 53% female) of newly diagnosed colorectal cancer patients completed daily mood and sleep logs for two weeks. Overall positive and negative moods as well as eight specific moods were measured using the Affect Balance Scale. Sleep efficiency was assessed using the Consensus Sleep Diary. Friday through Sunday were considered as weekend.

**Results:** Caregivers overall reported moderate levels of feeling affectionate, calm, and happy, and reported mild levels of other moods. Caregivers also reported good sleep efficiency in general (M=88.8%; ranged 71% to 99%). Multilevel modeling predicting sleep efficiency from the general positive and negative mood of the same day and of the previous day revealed that negative affect of the same day, but not the previous day, predicted poorer sleep efficiency (B=-0.027, p<0.02). Further investigation with specific negative moods revealed that depressive mood (B=-0.012, p<0.054) and feeling guilty (B=-0.033, p<0.057) during the day, but not the previous day, tended to predict poorer sleep efficiency that night. Anger did not significantly predict sleep efficiency on the same night or the subsequent night.

**Conclusion:** These preliminary findings suggest negative mood during the day has an extended effect to night sleep. Unlike the cliché for a sound marriage, however, our findings suggest caregivers’ sleep is affected by self-evaluative mood (feeling oneself short of what is expected, such as feeling of depression and guilt), rather than anger (evaluating other not meeting their expectation). Future studies must replicate these findings and expand the investigation to the nuanced role of self-evaluative moods in caregivers’ sleep health and its clinical implications.

**Support (If Any):** R01NR016838

0166

**DIFFERENCES IN SELF-REPORTED SLEEP DURATION, SLEEP QUALITY, ALERTNESS, FATIGUE, AND MOOD ACROSS A 72-HOUR MISSION TRAINING EXERCISE**

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**Introduction:** Military operations often necessitate extended group-level performance under stressful and high-fatigue situations with few opportunities to rest and recover. Performance impairment has previously been associated with sleep restriction, decreased alertness, and increased fatigue. Less well documented, however, is how these differences extend to mood and how one’s group association influences these outcomes in an operational context. The current study sought to investigate the influence of group on self-reported sleep duration, alertness, fatigue and mood during a 72-hour mission training exercise.

**Methods:** Forty-six healthy volunteers (42M (24.5 ± 4.2; mean±SD)) across three platoons of active duty Soldiers participated during a company-wide, 72-hour mission training exercise. Each morning, upon awakening, volunteers reported the prior night’s subjective sleep duration as well as Visual Analog Scales (VAS) assessing perceived quality of sleep and previous day’s fatigue.VAS also asked volunteers to report mood metrics of calmness, tiredness, hostility, and alertness upon awakening.

**Results:** Significant main effects of day (1, 2, 3) were observed for sleep duration, sleep quality, fatigue, and tiredness, while significant main effects of platoon (A, B, C) were observed for sleep quality, tiredness, and alertness. Significant interaction effects between day and platoon were observed for fatigue only (all p < 0.05). The subjective sleep duration reported on the morning of Day 2 (4.20±0.30h, mean±SEM) was significantly longer than Days 1 or 3 (2.38±0.27h and 2.41±0.25h, respectively). Scores of reduced sleep quality, fatigue, and tiredness increased across the 72-h mission. Platoon A reported the lowest levels of sleep quality and alertness as well as the greatest level of tiredness. No effects were found for calmness and hostility.
Conclusion: Time within a mission and group differentially modulated sleep duration, alertness, fatigue and mood during a 72-hour mission training exercise. Follow-up studies are needed to determine the relationship of these variables to performance outcomes. These findings have important implications for identifying targets of intervention for sustained performance in the military context.


0167 SLEEP QUALITY IS BOTH A PREDICTOR AND A CONSEQUENCE OF NEUROTICISM LONGITUDINALLY Cheng Li, Esther Yuet Ying Lau, C. Harry Hui, Jasmine Lam, Shu E. Cheung, Sing H. Cheung

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Introduction: Poor sleep quality is a significant health issue which may be affected by individual characteristics like personality and can bring changes to personality over time as well. As found in a longitudinal study using secondary samples (Stephan et al., 2018), neuroticism (i.e. low emotional stability) at baseline is associated with poor sleep quality at follow up, and higher sleep difficulties at baseline is associated with less of a decrease in neuroticism over time in middle aged and older adults. However, sleep quality was not measured by a validated sleep measure and the follow-up was conducted only once, either four or ten years later. The present study aims to investigate the association between neuroticism and sleep quality using a validated sleep measure administered three times in a younger generation.

Methods: 7186 individuals (mean age=24.86, SD=7.75, Range=18-77; 64.06% women) completed an online survey at three time points: The Pittsburgh Sleep Quality Index (PSQI) and the International Personality Inventory Pool (IPIP) at baseline (Wave 1), four years later (Wave 5), and five years later (Wave 6).

Results: Cross-lagged analyses revealed that emotional stability prospectively predicts sleep quality both one year (βstand = -.168, p < 0.001) and four years later (βstand = -.128, p < 0.001); sleep quality predicts emotional stability prospectively four years later (βstand = -.070, p < 0.05) but not one year later (βstand = -.031, p > 0.05).

Conclusion: Low emotional stability predicts poor sleep quality in the short run (one year) and the long run (four years), while poor sleep’s effect on neuroticism is evident only in the long run in Chinese young adults. Our findings provide novel information on the long-term effects of sleep quality (which is a more transient variable) on neuroticism (which is a more enduring trait). The pervasiveness of prolonged poor sleep quality is underlined, and further investigations into the neuropsychosocial mechanisms of the bidirectional relationships are warranted.

Support (If Any): NA

0168 SLEEP AND ACADEMIC PERFORMANCE IN KOREAN HIGH SCHOOL STUDENTS

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Introduction: The objective of this study was to investigate Korean high school students’ sleep and its relationship with academic performance.

Methods: The sleep surveys were conducted by high school students in Daegu, South Korea. The questionnaires provided details for factors such as sleep quality, sleep and wake schedules, nighttime smartphone use, and a five-level grading scale pertaining to academic performance (A: 1-20%, B: 21-40%, C: 41-60%, D: 61-80%, E: 81-100%). Chi-squared test, independent t-test, analysis of variance and regression analysis were used to analyze the results.

Results: A total of 691 high school students consisting of 279 (40.4%) boys and 412 (59.6%) girls completed the questionnaires. Those with poor sleep quality (Pittsburgh sleep quality index, PSQI ≥8.5) resulted in 111 (16.1%) and depressed mood (Hospital depression scale, HDS ≥8) resulted in 254 (36.8%). All students with high levels of academic performance tended to have lower PSQI scores (A: 5.29±2.58, B: 5.41±2.98, C: 6.00±2.65, D & E: 6.15±2.97), and the A-level students had significantly higher Morningness-eveningness questionnaire scores than those at D & E-levels students. Regression analysis shows that earlier departure time from school and higher nighttime smartphone use was significantly associated with worse academic performance in high school students.

Conclusion: This study showed a close relationship between students’ sleep quality and academic performance. The students with better sleep quality, morningness, and less nighttime smartphone use had a tendency to perform better academically. To improve academic performance, lifestyle modification should be considered as an important factor.

Support (If Any): NA

0169 MISALIGNED CORE BODY TEMPERATURE RHYTHMS IMPACT COGNITIVE PERFORMANCE OF HOSPITAL SHIFT WORK NURSES

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Introduction: Circadian rhythms greatly influence 24-h variation in cognition in nearly all organisms, including humans. Circadian clock impairment and sleep disruption are detrimental to cognition and negatively influence the acquisition and recall of learned behaviors. The circadian clock can become out of sync with the environment during circadian misalignment. Shift work represents a real-world model of circadian misalignment that can be studied for its physiological implications. The present study aimed to test the hypothesis that circadian misalignment disrupts vigilance and cognitive performance on occupationally relevant tasks using shift work as a model. As such, we sought to 1) explore the general effects of night- and day-shift worker schedules on sleep-wake parameters and core body temperature (CBT) phase, and 2) determine whether shift-type and CBT phase impact cognitive performance and vigilance at the end of a 12-hour shift.

Methods: We observed a sample of day-shift and night-shift hospital nurses over a 10-day period. At the end of three, consecutive, 12-hour shifts (7pm-7am or 7am-7pm), participants completed a...
cognitive battery assessing vigilance, cognitive throughput, and medication calculation fluency (via an investigator developed and tested metric).

**Results:** Night-shift nurses exhibited significantly greater sleep fragmentation as well as a greater disparity between their wake-time and time of CBT minimum compared to day-shift nurses. Night-shift nurses exhibited significantly slower cognitive proficiency at the end of their shifts, even after adjustment for CBT phase.

**Conclusion:** These results suggest that circadian disruption and reduced sleep quality both contribute to cognitive functioning and reduced alertness. Multiple regression was used to determine whether mean or trial-to-trial variability in PVT reaction time was associated with sleepiness and impaired simple attention processes. In this study, we aimed to determine whether performance on an attention task influences self-reported sleepiness of individuals across the sleep disturbance spectrum.

**Methods:** Participants (N=50) included individuals across the insomnia spectrum from good sleepers to patients with insomnia disorder. Insomnia severity was assessed using the Insomnia Severity Index. Simple attention was assessed using a computerized Psychomotor Vigilance Test (PC-PVT) administered in the morning. Participants' rated their sleepiness on a scale from 1 (not sleepy) to 10 (extremely sleepy) before and after they completed the PVT. Spearman's correlation coefficient was used to assess associations between insomnia severity, sleepiness, and PVT performance. Multiple regression was used to determine whether mean or trial-to-trial variability in reaction time predicted post-PVT sleepiness, adjusting for pre-PVT sleepiness and Insomnia Severity Index score.

**Results:** Greater trial-to-trial variability in PVT reaction time predicted greater post-PVT sleepiness after adjusting for pre-PVT sleepiness and insomnia severity, r=2.9, p=0.005. Insomnia symptom severity was associated with greater sleepiness at pre- and post-PVT, r(50)=0.41, p=0.003 for both. After adjusting for pre-PVT sleepiness, insomnia severity was not a significant predictor of post-PVT sleepiness. Average PVT reaction time was not associated with sleepiness.

**Conclusion:** Participants with greater inconsistency in simple attention performance reported greater sleepiness than they had reported 10 minutes previously. Trial-to-trial variability in reaction time performance may have raised participants' awareness of their sleepiness. Alternatively, participants with inconsistent performance may have altered their self-report to match their performance. Although insomnia symptom severity was associated with sleepiness it did not make participants more prone to biased sleepiness reports based on performance on the PVT.

**Support (If Any):** N/A

**0171**

**OBJECTIVE EFFORT AND MATH PERFORMANCE PREDICTED BY NIGHT-TIME AWAKENINGS AND TOTAL SLEEP TIME**

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**Introduction:** How do awakenings affect objective behavioral effort and performance? Participants with sleep problems characterized by frequent awakenings reported more severely impaired productivity (Zammit et al., 2010), greater absenteeism and presenteeism (Bolge et al., 2010), and those in a construction work-force who had more frequent attention and memory errors (cognitive failure) self-reported less safety compliance and more minor workplace injuries (Brossoit et al., 2018). The relationship between nighttime awakenings, total sleep time, and next-day objective effort and math performance was assessed.

**Methods:** 60 undergraduate students were measured twice over three days. Sleep was determined by subjective next-day sleep diary. Time persisting on a Mirror-Tracing task (Calin-Jageman et al., 2015) measured effort exertion. Percent correct and time spent adding three numbers on an addition task assessed performance.

**Results:** For participants who reported nighttime awakenings (n = 34), those with more frequent awakenings spent less time completing the mirror-tracing trials (r = -.529, p = .001) and less accurately traced the shapes (r = -.449, p = .008). Math percent correct was not significantly correlated with hours of previous night's sleep, however we found a weak negative correlation between average hours slept and average time spent working on the addition problems (r = -.304, p = .018).

**Conclusion:** Our findings suggest that night-time sleep interruptions, especially those experienced by people with sleep disorders like insomnia or apnea, negatively impact next-day exerted objective effort. This is particularly concerning in high-risk or mentally demanding fields, like medicine, long-haul driving, aviation, and child-care. Our findings suggest that methods assessing objective effort in those with awakenings will be productive, particularly in treatment studies.

**Support (If Any):** N/A

**0172**

**EFFECTS OF DAYTIME SLEEPINESS ON WORKING MEMORY PERFORMANCE IN VETERANS WITH AND WITHOUT PTSD**

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**Introduction:** Working memory (WM) is a cognitive system responsible for temporarily storing and manipulating newly-acquired...
information. WM may be impacted by daytime sleepiness resulting from chronic sleep disturbances that characterize posttraumatic stress disorder (PTSD). We evaluated whether WM performance varied as a function of daytime sleepiness in Veterans with and without PTSD on the 2-Back task. We hypothesized that daytime sleepiness, measured by the multiple sleep latency test (MSLT) would predict accuracy and mean reaction time (RT), and that PTSD status would interact with sleep latency to influence WM performance.

Methods: Thirty-seven Veterans with PTSD and 48 Veterans without PTSD completed a 48-hour laboratory stay. Daytime sleepiness was measured by average sleep latency on the MSLTs on day 2. Following each MSLT, a n-Back WM task was administered. The 2-Back WM parameters of interest included accuracy and mean RT. Independent t-tests and non-parametric Mann-Whitney U tests were used to compare daytime sleepiness effects on WM performance between groups. Sleep latency was split into high (SL>5) and low (SL≤5) groups. Linear regressions were used to test the interaction between diagnostic group, sleep latency, and accuracy on WM.

Results: Daytime sleepiness did not differ between Veterans with and without PTSD (t(83)=−.10, p=.92). However, the PTSD group showed reduced accuracy (U=622, p=.02) and increased mean RT (U=625, p=.02) compared to the non-PTSD group on the 2-Back WM task. Overall, sleep latency did not independently predict WM performance for accuracy (β=.06, p=.60) or mean RT (β=-.08, p=.45). There was no significant interaction between diagnostic group and sleep latency group for either accuracy or RT.

Conclusion: Working memory performance is a key cognitive process for problem-solving and reasoning ability. The results suggest that even if Veterans with PTSD do not exhibit heightened daytime sleepiness, they show detectable WM impairments. The extent to which overnight sleep and daytime vigilance may interfere with higher executive functions, such as WM, in PTSD remain to be evaluated.

Support (If Any): USAMRMC MOMRP PT 130572(PI: Reifman).

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0174
NINETY-MINUTE RECOVERY NAP FOLLOWING AEROBIC EXERCISE IMPROVES EXECUTIVE FUNCTION IN MALE COLLEGIATE STUDENTS
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Introduction: The purpose of the present study was to examine the effects of a recovery nap following aerobic exercise on executive function. We further evaluated nap structure after aerobic exercise by using electroencephalography (EEG).

Methods: In the first study, eight healthy, trained male volunteers (mean age, 21.9±0.4 years) performed a 90-min treadmill run at 60-65% of their heart rate reserve (HRR), starting at 8:45 am; they then participated in a counterbalanced measures design study under the following three conditions: 90-min of seated rest, and a 20-, and 90-min nap. A modified flanker (mFl) task consisting of congruent (i.e., →←→←←) and incongruent tasks (i.e., ←←→←←) was used for assessing executive function. Changes in oxymoglobin in the prefrontal cortex during the mFl task were monitored with near-infrared spectroscopy. Performance tests began at 15:00. In the second study, seven healthy, trained male volunteers (mean age, 21.9±0.4 years) participated in two experimental conditions (a crossover design study): 90 min seated rest and 90-min run on the treadmill at 60-65% of their HRR from 8:45 am. After that, participants took a nap between 12:30 and 14:00. During sleep, brain waves were measured using EEG.

Results: The 20-min nap group had shorter reaction times in the congruent task in a flanker task than the seated rest group. The 90-min nap group had shorter reaction times in the congruent and incongruent task of the flanker task. Increased oxymoglobin levels during the mFl task were observed in the left prefrontal cortex in the 20-min nap group and in the left and right prefrontal cortex in the 90-min nap group. We found that aerobic exercise decreased stage 1 sleep and increased slow-wave sleep in the 90-min nap group.

Conclusion: The 90-min recovery nap shortened reaction times and increased activation of the prefrontal cortex in a flanker task. The increase in slow-wave sleep might, at least in part, play a role.

Support (If Any): This work was supported by an academic grant from the graduate school of Nippon Sport Science University.
0175

BED AND BREAKFAST: THE ASSOCIATION BETWEEN SLEEP TIMING AND BREAKFAST INTAKE FREQUENCY

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Introduction: Breakfast intake is associated with many positive health outcomes, including lower risk of obesity. Furthermore, poorly timed sleep has been identified as a potential risk factor for both obesity and less healthy dietary choices. As breakfast is a component of a healthy lifestyle, it is necessary to further investigate how sleep timing influences breakfast intake. The current study examined mean and intraindividual variability (IIV) of sleep timing as predictors of breakfast intake frequency in adults.

Methods: An archival analysis was performed using data from the Pittsburgh Cold Study 3. The sample consisted of 196 participants (ages 18-55; M = 30.175, SD = 10.856; 58% males). Ecological momentary assessments (EMA) of daily sleep timing (bed and wake) and daily self-reported breakfast intake were utilized over 14 days. Both mean and variability of sleep timing (IIV) were calculated.

Results: Hierarchical regression analyses were used to examine the association between mean bedtime, variability in bedtime, and breakfast intake frequency. Income, education, employment, and wake time (mean and IIV) were entered into the model as covariates. The overall model significantly predict breakfast intake, F(7, 189) = 12.511, p < .001. Although mean bedtime was not a significant individual predictor of breakfast intake (β = -.002, t(189) = 1.014, p = .312), variability in bedtime did emerge as a significant individual predictor of breakfast intake (β = -.011, t(189) = -2.356, p = .019). Specifically, more variability in bedtime was associated with less frequent breakfast intake.

Conclusion: More regular bedtimes predicted higher frequency of breakfast intake, over and above wake times. This study highlights the importance of understanding the role of sleep in dietary habits. Future research should explore the importance of sleep timing as a modifiable risk factor, as well as its association with dietary habits. Findings can inform prevention and intervention approaches targeting healthy diet and weight management.

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0176

LONGER SLEEP DURATION PRECEDES GREATER WATER INTAKE AT BREAKFAST

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Introduction: Few studies have examined the relationship between sleep duration and breakfast eating patterns, although studies suggest that each of these variables is associated with weight gain. This analysis evaluated the relationship between sleep duration and next-day breakfast composition in adults who recently experienced involuntary job loss — a group at high risk for weight gain.

Methods: At the baseline visit of the ongoing prospective Assessing Daily Activity Patterns through occupational Transitions (ADAPT) study, 97 fasting participants completed a sleep diary describing the prior night’s sleep at home and then self-selected unrestricted breakfast food of their choice at a hospital cafeteria. Breakfast intake was documented by pre-post meal food photography. Breakfast nutrient intake was assessed by trained dietary assessors using the Nutrition Data System for Research. Associations between prior night total sleep time and food composition were examined in regression models controlling for sex and body mass index.

Results: Mean total sleep time was 428 minutes (SD = 106 minutes) with 58% of participants receiving at least 7 hours of sleep. Total sleep time was positively associated with more total grams of food and beverage at breakfast (β = .57, SE = .28, p = .05) characterized by high water weight (β = .57, SE = .25, p < .05). There was no association between total sleep time and energy, total fat, total protein, or total carbohydrate consumption at the breakfast meal. These findings remained consistent with post-hoc control for fast duration.

Conclusion: Compared to individuals with shorter sleep duration, individuals with longer sleep duration had heavier next-day breakfasts characterized by more grams of water but no difference in total or macronutrient-specific energy. Because water intake is associated with the intake of fewer daily calories, these findings call for further investigation into the mechanistic underpinnings of factors common to both fluid and sleep homeostasis, such as thermoregulation. Controlled, laboratory-based investigation, into the relationship between sleep and breakfast intake is also warranted.

Support (If Any): #1R01HL117995-01A1

0177

TYPES OF HABITUAL PHYSICAL ACTIVITY ASSOCIATED WITH HABITUAL SLEEP DURATION, SLEEP QUALITY, AND DAYTIME SLEEPINESS

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Introduction: Sleep is related to physical activity, but previous population-level studies have not been able to explore specific types of activities associated with better sleep.

Methods: Data from the 2017 Behavioral Risk Factor Surveillance System were used, with N=38,964 adults age>18 providing complete physical activity and sleep data. Participants were asked whether they engaged in any physical activity in the past 30 days and if so, what was the main form of activity. The most common activities were walking, biking, running, gardening/yardwork, weights/aerobics/calisthenics, golf, swimming, jogging, yoga/pilates, and household/chores/childcare. Sleep variables assessed included duration (very short[<5h], short[5-6h], normal[7-8h] and long[9+ h]), sleep difficulties (nights/week), and daytime sleepiness (days/week). Weighted regressions were adjusted for age, sex, race/
Results: RESULTS: Compared to no activity, walking, running, weights/aerobics/calisthenics, and biking were associated with a decreased likelihood of very short (all p<0.0005), short (all p<0.0005), and long sleep (all p<0.001), fewer sleep difficulties (all p<0.0005), and less sleepiness (all p<0.0005). Also, less very short and short sleep, and less sleepiness were seen with yoga/pilates (p<0.0005, p=0.004, and p=0.0005, respectively), and less very short sleep and fewer sleep difficulties were also seen with swimming (p=0.008 and p=0.01, respectively) and golf (p=0.001 and p=0.02, respectively). Less sleepiness was also seen in those who reported jogging (p<0.0005) and gardening/yardwork (p<0.0005). Compared to walking, very short sleep was still inversely related to biking, golf, and yoga/pilates (p=0.04, p=0.01, and p<0.0005, respectively), and was positively related to childcare/housework (p=0.02). Long sleep was inversely related to running (p=0.02). Sleep disturbance was inversely related to running, weights/aerobics/calisthenics, and biking (p<0.0005, p=0.008, and p=0.02, respectively). Sleepiness was inversely related to biking (p=0.004).

Conclusion: In the population, physical activity was associated with better sleep, but this may depend on the type of activity that an individual engages in.

Support (If Any): R01MD011600
0180
FEELINGS OF EMOTIONAL EXHAUSTION AND DEPERSONALIZATION PREDICT SELF-REPORT OF TROUBLE SLEEPING FOR NURSES WORKING IN HOSPITAL ENVIRONMENTS
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Introduction: American nurses report sleeping an average of 6.8 hours per night on workdays, which is less than the recommended 7-9 hours. Burnout, which is comprised of emotional exhaustion (EE), depersonalization (DP) and personal accomplishment (PA), is common among nurses and may contribute to insufficient sleep quantity and sleep disruption. We aimed to investigate if burnout, measured using the Maslach Burnout Inventory (MBI), predicted self-report of trouble sleeping for nurses working in the hospital.

Methods: This is a secondary report of a prospective crossover trial of nurses assigned to either 6 weeks of daily work-breaks in an outdoor hospital garden or 6 weeks of indoor-only breaks. After a 1-week washout period, break assignments were switched for an additional 6 weeks. Nurses completed the MBI at the beginning and end of each 6-week period. Each workday, nurses completed a visual analog scale reporting no trouble sleeping to much trouble sleeping immediately following a break. For this analysis, we used initial MBI subscale score (EE, DP, PA) as a predictor of mean trouble sleeping over the subsequent 6-week period regardless of break location using generalized estimating equations.

Results: A total of 29 nurses (27 females, mean age 42.8 years) participated. Most (n=20) worked dayshift, and 9 worked night shift. Initial MBI subscale score, regardless of break location, was predictive of mean self-report of trouble sleeping over the subsequent 6-week period for EE (p<0.001) and DP (p=0.004), but not for PA (p=0.48). When divided by break assignment (indoor-only vs garden), results were similar for EE (indoor p<0.001; garden p=0.001), DP (indoor p=0.001; garden p=0.001), and PA (indoor p=0.20; garden p=0.49).

Conclusion: The MBI subscales of EE and DP were predictive of self-report of trouble sleeping for nurses in this study. Further research using objective measures of sleep are needed to confirm and extend these preliminary observations.

Support (If Any): Funding for this research was provided by the TKF Foundation as part of the National Open Spaces Sacred Places Initiative.

0181
ASSOCIATION BETWEEN INDOOR AIR QUALITY AND SLEEP QUALITY
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Introduction: Sleep quality is quite important for health and daily performance. Indoor air quality (IAQ) is related to sleep quality. Although some people have a relaxed mood, and sleep in the bedrooms with low noise, moderate light and appropriate temperature, they cannot sleep well because of poor air quality. The aim of this study is to figure out the association between indoor air quality and sleep quality.

Methods: A total of 25 19-25-year-olds divided into two groups were recruited in the university dormitory and two cases (high and low ventilation rates) were conducted in both the fall of 2010 (the first group) and the spring of 2011 (the second group). High and low ventilation rates were achieved by opening and closing window, respectively. CO2 levels, temperature and relative humidity were monitored during the whole experiment. Mann-Whitney U test was used for statistical analyses.

Results: CO2 levels of high and low ventilation rates were respectively 1251.7±579.1 and 1867.6±1794.5 ppm (p-value < 0.01). Sleep latency, sleep efficiency and wake after sleep onset were 6.4±10.1 min (window open), 6.4±9.1 min (window closed); 83.9±7.9 %, 83.4±7.8 % and 70.3±41.2 min, 72.5±41.3 min, respectively. However, these results were not significant (p-value > 0.05).

Conclusion: Strom-Tejsen et al. (2016) found sleep quality improved significantly when the CO2 level was lower, but there is still a lack of studies showing direct effects of IAQ on sleep. Therefore, we plan to have another more comprehensive study to confirm this association.

Support (If Any):
This effect was reversed after total sleep deprivation that followed extension (p=0.008).

**Conclusion:** One week of sleep extension significantly reduced bias toward expected threat, while subsequent sleep deprivation restored this bias. While adaptive to respond to a potentially threatening situation, it is also adaptive for fearful faces to lose salience under high repetition with no actual threat present. Sleep extension may increase cognitive control in the prefrontal cortex to allow this modulation of behavior.

**Support (If Any):** Department of Defense Military Operational Medicine Research Program

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**0183**

**SLEEPINESS IMPACTS COGNITIVE PERFORMANCE IN A NATURALISTIC POPULATION**

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**Introduction:** Laboratory sleep deprivation experiments have clearly demonstrated that inadequate sleep negatively impacts a person’s cognitive function, which negatively impact worker productivity, training and relationships. Yet the variability and the relationship between sleepiness and cognitive performance in a naturalistic experiment remains poorly defined. We have conducted a naturalistic experiment to examine whether there is sufficiently varying cognitive performance to be of scientific interest and if perceived sleepiness is related to performance variation.

**Methods:** Thirty-nine undergraduate participants (Mean age:21±3; F=27, M=10, Not Available=2) completed circadian-matched lab sessions four times a week for 10-15 weeks, in which they answered survey questions and performed cognitive tasks, including the Digit Symbol Substitution Task (DSST) and the Psychomotor Vigilance Task (PVT). Each participant wore an accelerometer for the duration of the experiment to objectively estimate sleep and wakefulness. Generalized mixed model analysis was used to determine relationships and the Kolmogrov-Smirnoff test was used to evaluate reaction time distribution.

**Results:** Participants displayed approximately 20% variance in cognitive performance. While learning effects were observed, “good” and “bad” performances were distributed throughout the protocol period. We used DSST number correct to initially define “good” and “bad” performance in morning or afternoon sessions. We then determined there were significant differences in reaction time distributions in 73 out of 78 morning/afternoon sessions, supporting differences in cognitive function between those sessions. We then evaluated PVT performance from those same sessions and found that a majority of PVT distributions between those trials were different as well. To determine explanatory factors, we determined that subjective sleepiness, as determined by the ESS and KSS, was negatively associated with DSST number correct and significantly positive association with DSST median reaction time, PVT median reaction time, and lapses in a 5-min PVT. In contrast, subjective total sleep time was not significantly associated with any performance metric.

**Conclusion:** Participants in a 10-15 week naturalistic study exhibited 20% variability in their cognitive performance. Over that time period, subjective sleepiness was a strong predictor of cognitive function whereas declared total sleep time was not associated.

**Support (If Any):**

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**0184**

**PREDICTING DAILY SLEEPINESS FROM NIGHTTIME SLEEP IN VETERANS WITH AND WITHOUT PTSD**

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**Introduction:** Disturbed sleep characterizes posttraumatic stress disorder (PTSD), and may cause daytime sleepiness and compromise readiness and performance. The extent to which nocturnal sleep predicts daytime sleepiness (DS) in military personnel with and without PTSD is unknown. Here, we investigated nighttime sleep predictors of objective and subjective DS in Veterans with and without PTSD.

**Methods:** 37 post-9/11 Veterans with PTSD (PTSD) and 47 without PTSD (Control) completed a 48-hour lab stay. Subjective and objective DS were assessed five times daily with a mood questionnaire that measured global vigor (Vigor) and Multiple Sleep Latency Tests (MSLT) to assess sleep latency (SL). Nighttime polysomnography was conducted using high-density (64-channels) electroencephalography. Sleep parameters included natural log-transformed sleep efficiency (SE), percent time in non-REM and REM sleep, and the average global log-transformed absolute power for non-REM and REM in slow oscillation (0.5-1Hz), delta (1-4Hz), theta (4-8Hz), alpha (8-12Hz), sigma (12-16Hz) and beta (16-32Hz) activity bands. To limit adaptation effects, analyses were limited to day 2. Independent samples t-tests were used to identify group differences in DS and nighttime sleep. Linear regressions were performed to identify nighttime sleep predictors of DS. Significant predictors were mean centered and entered into regressions with group and corresponding interaction effects to explore whether nighttime sleep moderated relationships between group and DS.

**Results:** The PTSD group reported lower Vigor (mean±sd, 72.17±16.33) than the Control group (85.49±8.90; t=4.47, p < .001). Objective SL did not differ between groups. Only SE differed between groups (t=2.18, p = .03) and was slightly lower in PTSD. REM beta activity predicted Vigor, independent of group (β = -0.36, p = .02). No significant interaction between SE and REM beta was observed for Vigor or SL.

**Conclusion:** Subjective sleepiness was higher in PTSD than Control subjects, but this was not reflected in objective sleepiness. REM beta activity predicted subjective, but not objective sleepiness in both groups of Veterans. How objective and subjective DS and REM sleep measures relate to cognitive performance remains to be investigated.

**Support (If Any):** USAMRMC MOMRP PT-130572(P: Reifman).

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**0185**

**THE IOWA REGULATORY RESILIENCE TO SLEEPINESS TESTING (IRREST)**

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**Introduction:** Despite considerable individual differences in vulnerability to sleep disruption, there is currently no practical tool to
capture these individual differences in resilience and there is only limited evidence about whether they are general or domain-specific. To address this need, we developed and validated the Iowa Regulatory Resilience to Sleeplessness Test (iRREST).

**Methods:** A construct-validation approach to scale development was employed. First, during the substantive phase self-report items that capture vulnerability vs. resilience to sleep loss across various domains were generated. Participants rated them in response to a memory prompt about experiences with a fixed dose of isolated sleep loss (2 hours) with items revised for representativeness and relevance. Second, during the structural phase, factor-analyses were conducted to identify and replicate the factor structure and reliability of scales. Convergent and discriminant analyses evaluated the scale in light of related sleep and personality measures. Third, the external phase examined criterion validity of the scales in predicting neurocognitive and affective responses to experimental sleep restriction, alongside ecological relevance of the measure by examining daily diary responses (four studies, total N = 1,018).

**Results:** First, the substantive phase yielded items capturing resilience to sleep loss distinct across cognitive, affective, and somatic domains. Second, the structural phase yielded discriminant and reliable scales that captured cognitive, affective, and somatic resilience, while also marking a general resilience factor. Convergent and discriminant analyses showed (expected) moderate associations with daytime sleepiness and dysfunctional beliefs about sleep, but small to negligible associations with other measures of sleep behavior, perceptions, or personality. Third, the external phase yielded validity evidence in predicting both cognitive performance and affect in response to sleep loss, as well as self-reported dysregulation as a function of natural sleep variation.

**Conclusion:** Evidence offers initial support for the validity of the iRREST as a measure of individual differences in sensitivity to moderate sleep loss, while suggesting the presence of a general factor of resilience to sleep loss.

**Support (If Any):** This research was supported by the National Science Foundation Award #1525390 to the first author.
0188
WHAT MAKES PEOPLE WANT TO MAKE CHANGES TO THEIR SLEEP? ASSESSMENT OF PERCEIVED RISKS OF INSUFFICIENT SLEEP AS A PREDICTOR OF INTENT TO IMPROVE SLEEP
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Introduction: Sleep health is associated with many domains of functioning. Yet, changing behaviors linked to improved sleep health is difficult. Beliefs about the health impact of sleep may motivate behavior change. This analysis examined which beliefs about sleep might motivate sleep behavior change.

Methods: Data were from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study, consisting of N=1007 community-dwelling adults age 22-60. Participants were asked, regarding the “single most important thing you personally could do to improve your sleep,” whether participants were in the stage of precontemplation (not considered change), contemplation (considered but not decided), preparation (decided but not acting), and action stages of change from the transtheoretical model. They were also asked items from the Sleep Practices and Attitudes Questionnaire (SPAQ) regarding the degree to which they agree with whether “not getting enough sleep” can cause sleepiness, drowsy driving, weight gain, heart disease, high cholesterol, hypertension, moodiness, lower energy, decreased sex drive, missed days at work, decreased performance, memory/concentration problems, diabetes, and/or tiredness. Ordinal logistic regressions evaluated increased likelihood of stage of change, based on degree of agreement with those statements, adjusted for age, sex, race/ethnicity, and education. Post-hoc analyses also examined sleep duration as an additional covariate.

Results: In adjusted analyses, stage of change was associated with degree of agreement that insufficient sleep can cause sleepiness (OR=1.17, p=0.035), weight gain (OR=1.20, p=0.0005), heart disease (OR=1.21,p=0.001), cholesterol (OR=1.13, p=0.047), hypertension (OR=1.16, p=0.014), moodiness (OR=1.42, p=0.0005), decreased energy (OR=1.30, p=0.002), absenteeism (OR=1.13, p=0.007), decreased performance (OR=1.20, p=0.003), concentration/memory problems (OR=1.23, p=0.004), diabetes (OR=1.14, p=0.042), and feeling tired (OR=1.39, p=0.0005). When sleep duration was added to the model, significant relationships remained for weight, heart, hypertension, moodiness, energy, absenteeism, performance, memory, diabetes, and tiredness.

Conclusion: Degree of belief that insufficient sleep can cause outcomes such as moodiness, occupational problems, and health problems may impact whether an individual is contemplating/attempting to improve their sleep. This may guide education/outreach efforts.

Support (If Any): R21ES022931

0189
INTEGRATING HEALTHY SLEEP INTO A SELF-COMPASSION AND CARE TOOLKIT FOR CAREGIVERS WITH INTEGRAL FEEDBACK FROM PEER NAVIGATORS
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Introduction: One in ten grandparents live with their grandchildren (GRG). Our previous work demonstrated GRG suffer higher rates of sleep problems and sleep aid use than those not providing care to children. The recent passage of the Family First Prevention Services Act (2018) made kinship navigator programs a new federally reimbursable program for GRGs. To improve the evidence-base for this new health program, we worked with peer navigators, those who were also caregiving for their own grandchildren, to design a sleep and self-compassion and care toolkit called Time for Me (TFM).

Methods: Using a Community Based Participatory Research (CBPR) approach, researchers, program administrators, and peer navigators met biweekly over the course of twelve months to co-develop a sleep health and self-compassion and self-care toolkit (TFM). Adding sleep to other well established self-care pillars, the CBPR team used qualitative content analysis and quantitative surveys to pilot test each pillar to determine which were especially important for 25 GRGs. ANOVA was used to determine how different sleep prioritization in self-care and self-efficacy were compared to other self care strategies for GRGs.

Results: Qualitative content analysis revealed that including peer in the development of intervention is critical to understanding how to incorporate sleep into the self-care model. Additionally, self-compassion was identified as an essential component, because it allowed caregivers an opportunity to give themselves permission to focus on sleep. Descriptive baseline results from 25 middle-aged (m=48 years), single (68.6%), African-American (52%), low income (m=$21,000) grandparents (92% female) participants reported that although sleep was the most important pillar of self-care, caregivers reported that they were the least self-efficacious at healthy sleep [F(1, 24) = 4.96, p =<.01].

Conclusion: Results suggest that using CBPR with peers can provide important insight to inform intentional strategies on sleep promotion. Although sleep is important to caregivers, they note that it is an area of focus and concern for improved self-care. Future studies could further test TFM to determine its impact and cost efficiency for these vulnerable families.

Support (If Any): N/A
A. Basic and Translational Sleep Science

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Introduction: Sleep disruption is prevalent in military populations. Sleep education programs show promise in civilians and have been recommended for service members to mitigate negative effects of chronic sleep restriction, circadian disruption, and other unique barriers to healthy sleep.

Methods: A sleep education program for US Naval Personnel was developed based on a module created for college students, by the authors (Circadian, Light, and Sleep Skills (CLASS)). Content included the importance of sleep, sleep hygiene, and several components specifically tailored to military members: acute alerting and phase-shifting by light for fatigue mitigation and schedule adjustment; optimization of sleep quality given sleep restriction in high operational-tempo settings; and physical performance (e.g., circadian rhythms in performance; phase-shifting and alerting effects of exercise). Feedback from service members, veterans, scientists, and educators was incorporated prior to implementation. This pilot study used a pretest-posttest design. The 30-minute program was presented aboard a Littoral Combat Ship in two sessions (n=55; 6 females). Pre-program questionnaire items queried knowledge of circadian rhythms and habits, sleep-related behaviors, and motivation to change (1-5, 5=high motivation). Immediate post-program questionnaires included knowledge, motivation, and program satisfaction overall and with the content, format, length, and relevance of the program were also high (all significantly greater).

Results: Knowledge increased significantly post-program (from 51% to 66% correct; p<0.001). All individuals reported they would use newly-learned strategies, and most (84%) would share learned information with others. Sleep was rated as highly important for performance and health post-program (mean±SD=4.9±0.4; p<0.001). Mean motivation values were high both pre- and post-program (4.0±0.6 and 3.8±0.7, respectively; both significantly greater than 3, p<0.001). Satisfaction overall and with the content, format, length, and relevance of the program were also high (all significantly greater). Post-program, 84% would share learned information with others. Sleep was rated as highly important for performance and health post-program (mean±SD=4.9±0.4; p<0.001). Mean motivation values were high both pre- and post-program (4.0±0.6 and 3.8±0.7, respectively; both significantly greater than 3, p<0.001). Satisfaction overall and with the content, format, length, and relevance of the program were also high (all significantly greater).

Conclusion: Preliminary results suggest that motivation to engage in healthy sleep behaviors is high among Sailors, and the program is informative and well-received. Long-term follow-up will determine effects on sleep, sleep-related behaviors, and psychological health. This work will inform future efforts including larger samples, a control comparison group, and a period of deployment post-program.

Support (If Any): Congressionally Directed Medical Research Programs, JPC-5 Early Assessment and Intervention (N1702).

0191

COMBINING CAFFEINE AND A NAP TO IMPROVE ALERTNESS DURING A SIMULATED NIGHTSHIFT

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Introduction: Shiftwork is common in a 24/7 society. Shiftworkers experience circadian misalignment and disrupted daytime sleep and are more prone to errors and accidents than non-shiftworkers. Countermeasures such as caffeine and naps have been used to mitigate the attentional deficits associated with shiftwork, with inconsistent results. The aim of this study was to investigate the combined effects of 200mg of caffeine prior to a 30-minute nap opportunity during the circadian nadir on vigilant attention.

Methods: Six healthy non-shiftworkers (aged 21-36y; 4 females) were recruited for a within-subjects counter-balanced double-blind crossover design study at the University of South Australia's Sleep and Chronobiology Laboratory. Participants completed two 36-hour laboratory visits, separated by one week, consisting of a simulated nightshift (1930-0900h); a 30-minute nap opportunity at 0330h; and, a 7-hour daytime recovery sleep opportunity (1000-1700h). Participants were randomised to a "cafnap" or placebo condition: Cafnap=200mg of caffeine powder added to a 200ml decaffeinated coffee; or placebo=200ml of decaffeinated coffee. The drink was consumed 5-minutes prior to the nap. Participants undertook a 3-minute psychomotor vigilance task (PVT) at 1930, 2015, 0100, 0315, 0400, 0445, 0645, 0745 and 0845h. Linear mixed model ANOVAs with fixed effects of condition, time and condition*time interactions and random effect of participant ID were conducted for PVT lapses and mean reciprocal reaction time (MRRT).

Results: The cafnap produced a significant reduction in the number of lapses F(1,105)=12.45, p<.001 and significant increase in MRRT F(1,105)=39.42, p<.001 compared to placebo. PVT performance was maintained at or above 96% of baseline across the entire simulated nightshift post-cafnap.

Conclusion: This combined countermeasure may be useful for improving shiftworker safety by limiting the physiological and behavioural decrements experienced by shiftworkers. Further investigation is needed to examine the cafnap's impact upon daytime recovery sleep, habitual caffeine users, actual shiftworkers and various chronotypes.

Support (If Any): The University of South Australia, Division of Education, Arts and Social Sciences (EASS) University Research Investment - Performance Allocation (URIPA) grant.

0192

A RE-APPRAISAL OF THE LINK BETWEEN DAYLIGHT SAVING TIME AND TRAFFIC ACCIDENTS IN THE US

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Introduction: To date, evidence addressing the effects of Daylight Saving Time (DST) on traffic accidents is inconsistent and often limited by geographical heterogeneity in accident occurrence and follow-up duration. The DST spring transition is thought to acutely increase traffic accident rates by inducing modest levels of circadian disruption and ~1h of sleep deprivation. Our goal was to re-examine the link between spring DST and traffic accident rates, considering changes in DST timing, potential differences in fatal/total accident rates, both nation-wide and within two urban settings with distinct meteorological profiles.

Methods: We analyzed three US traffic accident data sources: (i) the Fatality Analysis Reporting System (FARS) database of the National Highway Traffic Safety Administration (fatal accidents since 1975); (ii) all police-recorded fatal and nonfatal accidents in Denver (2012-2018); (iii) all police-recorded fatal and nonfatal accidents in Seattle (2007-2018). We compared the number of accidents on Saturday, Sunday and Monday of the DST change weekend with corresponding Saturdays, Sundays and Mondays in the week before and after the DST spring transition, using two-tailed paired
t-tests and mixed models accounting for potential accident rate changes over time. Additional analyses considered time-of-day of accident occurrence.

**Results:** Data on 1,874,672 accidents were available. We did not observe differences in fatal/non-fatal accident rates associated with the DST spring transition in neither of the datasets (p>0.10). Changes in timing of DST did not result in shifts of accident rates (p>0.10). Accident fatality, time-of-day, or geographical location did not influence the association between DST and accident rates. We replicated prior findings restricting FARS analyses to 1975-1995 (Varghuese & Allen, 2001), showing higher accident rates associated with the DST spring transition.

**Conclusion:** In this large study of traffic accidents, we did not observe evidence for an association between the spring DST transition and accident rates, despite being able to replicate prior positive findings in a smaller dataset. To better appreciate the potential burden of DST on human health, further, large-scale studies are necessary to detect this presumably small effect.

**Support (If Any):** N/A

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**SLEEPINESS AND SLOW ROLLING EYE MOVEMENTS ARE INCREASED DURING AUTONOMOUS VERSUS MANUAL DRIVING**

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**Introduction:** Driving automation systems (DAS) purport to reduce the number of motor vehicle collisions and enhance driving safety by reducing driver workload, providing stable lane-keeping and automated braking when a hazard is detected. Current regulations require drivers to maintain situation awareness when supervising an autonomous vehicle in order to take over driving when necessary. As DAS become standard for motor vehicles, the driver’s role will shift from one of active engagement to passive monitoring. Prior studies have demonstrated that performance on monitoring tasks is reduced following sleep loss. Given the high prevalence of sleep deficiency in the US, we hypothesized that supervision of an autonomous vehicle would unmask underlying sleepiness compared to manual driving among individuals following their typical sleep schedules.

**Methods:** During one laboratory visit, participants completed a simulated 42-minute manual and autonomous drive in randomized order. Electroencephalography and electrooculography were recorded continuously during both drives (BrainVision Recorder version 1.21). Slow rolling eye movements (SREMs) were marked by a blinded scorer and were defined as rolling eye movements lasting at least two seconds. The Karolinska Sleepiness Scale (KSS) was collected following each drive. Sleep diaries and actigraphy were collected for two weeks prior to the laboratory visit to measure self-selected sleep habits. SREMs and KSS scores were analyzed using mixed-effects models adjusted for drive order (SAS version 9.4).

**Results:** Seventeen participants (8 females, age mean: 33.7 ± 10.6 years) completed the study. Participants rated themselves sleepier (KSS manual mean: 5.4 ± 2.4; autonomous mean: 6.9 ± 2.1; p = 0.03) and had more SREMs during the autonomous (mean: 19.9 ± 19.5) versus the manual drive (mean: 9.7 ± 11.3; p = 0.04).

**Conclusion:** Our findings demonstrate that people feel sleepier and experience more SREMs during autonomous versus manual driving. This suggests that DAS may reduce driver situation awareness. Further research is needed to determine whether these attentional failures reduce an individual’s ability to take control of a vehicle when necessary. Further analysis is needed to evaluate how sleep history may mediate these findings.

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**SLEEP QUANTITY AND QUALITY, PVT-B PERFORMANCE, AND SUBJECTIVE SLEEPINESS, FATIGUE, AND STRESS IN COMMERCIAL MOTOR VEHICLE (CMV) DRIVERS: ON-DUTY DAYS VS. RESTART (OFF-DUTY) DAYS**

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**Introduction:** An observational study of CMV drivers was undertaken to assess the operational, safety, health, and fatigue impacts of the restart provisions in Sections 395.3(c) and 395.3(d) of Title 49, Code of Federal Regulations.

**Methods:** N=235 drivers (224 males, 20-69y) participated in an observational study for up to 5 months duration. All drivers held a valid CMV driver’s license, worked >60 hours/week, completed drives during the day and night, and made use of the restart provisions. They were recruited to reflect diverse types of vehicles and operational distances. They reported either driving mostly during the day (10.2%), mostly during the night (14.9%), or a combination of day and night (74.9%). They were monitored via electronic devices to track driving (including safety critical events) and work hours. Smartphone apps were used to track their behavioral alertness on the Brief Psychomotor Vigilance Test (PVT-B), and their ratings of fatigue, sleepiness, stress, and sleep quality. Statistical comparisons were performed using linear and non-linear mixed-effects modeling.

**Results:** A total of 26,964 days of data were acquired, including >79,000 PVT-B tests. During on-duty days, drivers slept an average of 6.6h/day, compared to 7.7h/day during restart (off-duty) days (p<0.0001). During restart periods drivers rated their sleepiness higher (p<0.0001), their sleep quality higher (p<0.0001), and their stress lower (p<0.0001), compared to on-duty days. Drivers’ fatigue ratings were higher, and sleep quality ratings were lower, during 1-night vs. 2-night restarts. They had more PVT-B lapses during restart periods than during on-duty periods (p<0.0001),
0196
SLEEP QUANTITY AND QUALITY IN US ARMY INFANTRY SOLDIERS BEFORE, DURING, AND FOLLOWING A 72-HOUR SUSTAINED TRAINING EXERCISE
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Introduction: Getting the proper amount of sleep is not a prioritized during military operations. While the Army recognizes that 7-9hrs of sleep is optimal for soldiers to achieve peak performance on the battlefield, the Army considers 4hrs of sleep within a 24hr period to be the minimum requirement. The current study investigated sleep during a simulated combat operation and assessed whether six armored companies were able to meet the Army minimum standard of sleep each day.

Methods: One hundred and fifty (150) U.S. Army, active duty Soldiers organized into fifty-four (54) tank crews participated during a simulated combat operation. Objective sleep was measured using Phillips Actiwatches during Phase 2 (OPS) for 13 days. Daily TST of each participant and tank crew were organized into time-series and analyzed using a Boolean-type algorithm.

Results: Daily TST showed an average of 5.9±0.88hrs of sleep per day. However, time-series analysis revealed that 90% (n=135) of all tankers failed to meet the standard consistently. Tank Commanders (n=48) failed to meet the standard 28% of the time. Further, 33% (n=50) of tankers went two days or more and 14% (n=21) went three consecutive days or more under 4hrs TST. Each day 1/3 of all tank crews were affected by not receiving 4hrs TST. Refit days on Day 6 and Day 10 revealed nearly 90% compliance with the standard and an average TST of 7±2hrs.

Conclusion: Initial daily TST calculations showed tankers receiving sufficient sleep on average per day. However, using a time-series analysis we were able to investigate sleep on a day-to-day basis. This revealed that tankers failed to meet the standard frequently. Further investigation into how group performance and cohesion were affected during these periods of minimal sleep need to be completed to help leaders understand the impact sleep has on mission outcomes and assist in creating strategies for maintaining sleep health on the battlefield.

Support (If Any): Department of Defense Military Operational Medicine Research Program (MOMRP).

0195
MEETING THE MINIMUM ARMY STANDARD FOR SLEEP IN A SIMULATED COMBAT OPERATION
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Introduction: Infantry Soldiers are expected to participate in extended tactical missions that can be cognitively and physically demanding. Soldiers are expected to be self-sufficient without re-supply for up to 72 hours. During this time, opportunities for sleep are sporadic and limited, but have not been directly documented. It is therefore important to identify patterns of sleep before, during and following operations in order to pinpoint how sleep loss affects the mission and in what ways fatigue can be minimized.

Methods: Active-duty, medically-fit Soldiers (N=46) who were already scheduled to participate in the training exercise were recruited for participation. The study occurred across three phases: Baseline occurred within the month leading up to the training exercise; Mission was the 72 hour training, and Recovery, the 5 days following the end of the training exercise. Participants wore Actiwatch Spectrum Pros or Pluses for the duration of the study. Sleep duration and efficiency were analyzed using Philips Actiware 6.0 and compared between phases using a one-way ANOVA in SPSS 24. Sleep differences across phases were confirmed by Tukey HSD post-hoc analysis.

Results: Soldiers slept less during Mission (3:08±2:38hrs;p<0.001) compared to Baseline (4:56±2:21;P<0.001) or Recovery (4:39±2:16;p<0.001). Soldiers also had worse sleep efficiency during Mission (72.65±20.52;p<0.001) compared to Baseline (81.26±11.23;p<0.001) or Recovery (84.25±10.99;p<0.001).

Conclusion: During Mission, Soldiers averaged 3 hours of sleep. Soldiers only slept on average 5 hours before and during recovery from this exercise. Sleep efficiency also suffered during Mission. These findings indicate that Soldiers are chronically sleep deprived. While sleep loss during sustained operations may be unavoidable, pre-existing fatigue may handicap performance from the onset and accumulate over time. This risk could be mediated by sleep banking prior to mission or recouping sleep loss during the recovery period.

tested using correlations. Poorer sleep quality was predicted to be related to poorer occupational outcomes.

**Results:** As predicted, the ISI was significantly correlated with the FSS (r=0.89; p<0.001) and the PSQI (r=0.75; p<0.05), such that poorer sleep quality was linked with higher fatigue and emotional exhaustion. Interestingly, fatigue and emotional exhaustion were strongly correlated with the functional constructs within the ISI, which describe impairments due to sleep loss (FSS [r=0.57; p<0.01]; Emotional Exhaustion Scale [r=0.662; p<0.002]), but not the sleep quality-related items, which query specific sleep difficulties (p-values>0.73). Although the global score of PSQI was not correlated with the FSS or Emotional Exhaustion scale (p-values>0.21), Component 7 (PSQI functional constructs) was significantly correlated with the FSS and Emotional Exhaustion Scale (FSS [r=0.75; p<0.01]; Emotional Exhaustion Scale [r=0.561; p<0.013]) such that poorer sleep was related to poorer outcomes.

**Conclusion:** The current study established the important relationship between subjective sleep quality and occupational outcomes. Furthermore, the diverging links between constructs in the ISI/PSQI and occupational outcomes indicate that this population may not have “typical” sleep difficulties (e.g., insomnia) but still feel poor sleep quality is impacting their daily functioning. This is relevant for research methodology within HROs since assessing sleep using traditional measures may fail to parse apart nuances within these unique occupational environments.

**Support (If Any):** Department of Defense Military Operational Medicine Research Program (MOMRP).

**0199 CHRONIC SLEEP DEBT IN SOLDIERS IS EXACERBATED BY MISSION TRAINING: AN ASSESSMENT OF SUBJECTIVE SLEEP CHARACTERISTICS**

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**Introduction:** Military operations require vigilance and performance under stressful conditions while functioning with little sleep. Performance impairments (i.e., marksmanship, vigilance, executive function) have been linked with reduced sleep duration and sleep quality, as well as perceived sleepiness and fatigue. This research assessed changes in the Soldier subjective sleep profile when conducting a 72-hour military exercise during a state-side period between deployments.

**Methods:** Performance of forty-six Soldier volunteers [42 males (mean age 24.5±4.2)] was assessed during a company-wide mission exercise. Subjective sleep duration, quality, and sleepiness were collected two weeks prior to mission and immediately post-mission, utilizing a modified Pittsburg Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS).

**Results:** Sleep duration post-mission (M=7.77 hours, SD=1.45) was significantly higher than post-mission (M=3.94 hours, SD=1.34) (p<0.0001), and significantly different across platoon-group (p=0.027). However, mean sleep duration pre-mission was lower than the Army-recommended 7-8 hours, indicating chronic sleep debt across platoons prior to mission commencement. Additionally, there were no differences in PSQI scores across pre- and post-mission, with 83% categorized as “poor sleepers” (PSQI > 5) pre-mission (M=7.85, SD=3.83) and ending with 98% “poor sleepers” post-mission (M=8.71, SD=2.45). Perceived sleepiness also significantly increased across the mission (p<0.0001); however, ESS scores for both pre- and post-mission indicated clinically relevant levels of excessive daytime sleepiness (ESS > 10) (pre: M=10.61, SD=5.76; post: M=17.57, SD=7.48).

**Conclusion:** The time between deployments is intended as a recovery period, where Soldiers can reorganize, reconnect, and train. However, even when state-side, Soldiers may be at risk for chronic sleep restriction and poor sleep quality leading to excessive daytime sleepiness even before participating in mission training and future deployment. Further investigation of potential influences factors is warranted (i.e., Unit type, command climate, training regimes, work-life balance). Furthermore, platoon characteristics may influence factors leading to sleepiness.
A. Basic and Translational Sleep Science

during mission activities. Further analysis will explore performance degradations associated with daytime sleepiness and individual platoon differences, such as leadership, qualifications, and group cohesion.


0200
THE PREVALENCE OF CONTROLLED REST AS A COUNTERMEASURE TO SLEEPINESS ON THE FLIGHT DECK
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Introduction: Despite the introduction of flight, duty, and rest time regulations to reduce the risk of sleepiness, airline pilots often encounter elevated sleepiness during flight. To combat this sleepiness, in some instances, pilots can take a short nap on the flight deck (controlled rest) to improve their alertness. Little is known, however, as to when and how often this countermeasure is used operationally.

Methods: Forty pilots from a long-haul airline wore actiwatches and filled in an electronic sleep and work diary for approximately 2 weeks resulting in data from 238 flights. Self-reported in-flight rest periods were used to set rest intervals and sleep was estimated within these intervals using Philips Actiware 6.0.9 (Bend, OR). Wake threshold selection was set to medium; sleep threshold detection algorithm was set to 10 immobile minutes at sleep onset and sleep end. Timing of sleep periods was analyzed relative to home base time.

Results: Preliminary analyses showed that controlled rest was taken on 41.6% (n=99) of flights. On 8.8% of these flights (n=21), pilots reported taking two controlled rest periods. Sleep, as estimated by actigraphy, was achieved during 79.2% (n=95) of controlled rest periods. The mean ± SD duration of controlled rest periods was 42.4 ± 9.7 minutes with a mean of 24.6 ± 16.1 minutes of sleep estimated within these rest periods. Approximately two-thirds (67.5%, n=81) of all rest periods were initiated during home base time night (0000h-0800h). On 23.2% (n=23) of flights with controlled rest, pilots also reported taking bunk rest (longer rest period in a designated onboard sleeping facility).

Conclusion: The data from this airline show that controlled rest is commonly used as a countermeasure to sleepiness on the flight deck. Further analysis is required to determine what other factors contribute to the decision to take controlled rest, and how effective it is in reducing sleepiness on the flight deck.

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X. Behavior and Performance

0202
FATIGUE MANAGEMENT TO REDUCE PERFORMANCE RISK FOR SPACE EXPLORATION
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Introduction: The Fatigue Management Services team, located at the Johnson Space Center (JSC), is responsible for supporting the International Space Station (ISS) Crew Surgeons and other operational clinicians with the management of sleep loss and circadian desynchrony, including assisting astronauts and other mission support personnel with jet lag effects that are incurred from pre-flight training, in-flight operations, and post-flight recovery. Protocols that manage one’s fatigue can increase safety and efficiency, improve sense of well-being, improve performance, improve productivity, and improve attention. An operational proof of concept of the Fatigue Mitigation Protocols (FMP) was conducted by the team and questionnaires were distributed to clients to evaluate the acceptability in order to standardize the Fatigue Management process.

Methods: The FMP consists of protocols for collecting baseline data and testing hypnotic medications. The protocols for the
hypnotics were adapted from the JSC study, _Operational Ground Testing Protocol to Optimize Astronaut Sleep Medication Efficacy and Individual Effects_. The proof of concept consisted of five days of a sleep and cognitive baseline using both subjective and objective measures, followed by a minimum of 2 days of clients simulating taking a hypnotic medication, no medications actually consumed. Subjective measures consisted of questionnaires for sleep issues, self-report of sleep, baseline, efficacy, emergent awakening, and morning awakening. The objective measures consisted of both qualitative and quantitative sleep and a cognition measure. A reliable and validated measure identified the acceptability of FMP.

**Results:** The results of the FMP had an above average score of acceptability, compared with published averages. The overall acceptability, based on feedback capture during debriefings, was very positive, as well as providing insight to increase user friendliness further and to make the language both unambiguous and appropriate for at home use.

**Conclusion:** The Fatigue Management Protocols are a standardized and systematic approach to fatigue management that can be followed at any NASA center. The FMP provides both cost effective and convenient guidance for an individualized fatigue management strategy.

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**0203**

**GREATER CHANGE IN FECAL METABOLOME ASSOCIATED WITH LOWER ABILITY TO MAINTAIN WAKEFULNESS DURING SLEEP RESTRICTION AND CIRCADIAN MISALIGNMENT.**

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**Introduction:** This study combined sleep restriction and circadian misalignment, and tested the association of fecal metabolome with the ability to maintain wakefulness and sleepiness/alertness.

**Methods:** 15 healthy adults (5 female), mean (±SD) age 24.3 (±3.6), BMI 22.2 (±2.3) kg/m² completed an 18-day protocol twice, separated by 3 recovery days of unscheduled sleep at home. For each 18-day protocol, participants maintained habitual self-selected 8h sleep schedules for two weeks at home prior to completing a four-day laboratory visit with one sleep opportunity per day: 8h on night one, 3h on night two and 3h on mornings three and four. Sleepiness/alertness was tested every 3h during scheduled wakefulness. Ability to maintain wakefulness was tested with the Maintenance of Wakefulness Test (MWT). Self-reported sleepiness/alertness was tested with the Karolinska Sleepiness Scale (KSS) and a visual analog scale. Fecal samples were collected following the first and third sleep opportunities. Fecal metabolome was analyzed using ultra high-performance liquid chromatography coupled to a quadrupole-Orbitrap mass spectrometer. Fecal metabolome changes during sleep restriction and circadian misalignment were quantified by Canberra-Adkins distance. Association of within-subject fecal metabolome changes with sleepiness/alertness was tested with linear mixed effects models. Stability of individual differences in metabolome changes were quantified by intra-class correlation coefficient (ICC).

**Results:** During combined sleep restriction and circadian misalignment, greater change in fecal metabolome was associated with significantly shorter MWT sleep onset latency (p=0.028, SE=4.94), and lower self-reported alertness (p=0.045, SE=15.51), but not with KSS. Fecal metabolome changes showed substantial trait-like stability (ICC 0.66).

**Conclusion:** Greater within-subject change in the fecal metabolome was associated with lower ability to maintain wakefulness and alertness during sleep restriction and circadian misalignment. The gut microbiome may support the ability to maintain wakefulness during insufficient sleep and circadian misalignment, and could be a countermeasure target for safety-critical professions experiencing such conditions (e.g. military, health care).

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**0204**

**FOOD INSECURITY IS ASSOCIATED WITH OBJECTIVELY AND SUBJECTIVELY MEASURED SLEEP.**

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**Introduction:** Food insecurity (FI), defined as uncertainly about one’s ability to access safe and nutritious foods due to financial constraints, is a profound source of stress and is associated with cardiometabolic risk. A few studies have shown that FI is associated with self-reported sleep. This is the first study to examine the association between FI and multiple dimensions of sleep, assessed objectively and subjectively.

**Methods:** We examined data from predominantly African American adults (n= 785, mean age 56 (16.0) years; 77% female) living in low-income neighborhoods. FI was measured using a 10-item validated survey that assesses conditions and behaviors that characterize households lacking financial resources to meet basic food needs (over past 12 months). Sleep duration, efficiency, WASO, and variability in sleep duration were measured via...
wrist-worn actigraphy. Sleep quality was assessed via sleep diary. Analyses estimated each of the sleep outcomes as a function of FL, adjusting for individuals’ sociodemographics and body mass index. We also tested psychological distress as potential mediator of observed associations.

Results: Greater FL was associated with shorter actigraphy-assessed sleep duration ($B=-2.44; \text{SE}=1.24$, per 1-unit increase; i.e., 24 minutes shorter sleep for the most as compared to least insecure group) and poorer sleep efficiency ($B=-27; \text{SE}=13$; $p's<.05$), and poorer subjective sleep quality ($B=-0.3; \text{SE}=0.1$; $p<.01$). Greater FL was also associated with greater likelihood of short (< 7 hours; OR = 1.11; CI: 1.02-1.21) and long sleep (> 9 hours; OR = 1.19; CI: 1.01-1.39), compared to the recommended sleep duration of 7-9 hours. There were no associations between FI and WASO or sleep variability. Psychological distress partially mediated the association between FI and subjective sleep quality.

Conclusion: FI is an independent correlate of actigraphy-assessed sleep duration and efficiency and subjective sleep quality. These findings demonstrate the importance of considering novel social determinants that may underlie disparities in sleep health and considering policies to mitigate the root causes of sleep and other health disparities.

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0205
HABITUAL DIETARY QUALITY ASSOCIATED WITH HABITUAL SLEEP DURATION, INSOMNIA, DAYTIME SLEEPINESS, AND FATIGUE IN A COMMUNITY SAMPLE
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Introduction: Previous studies have shown a relation between sleep duration/quality and dietary intakes, but relatively few have examined characteristics of habitual diet associated with sleep, using validated measures. The present study examined relationships between overall diet quality and a range of sleep-related factors.

Methods: Data were taken from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study, which examined a diverse sample of 998 adults, age 22-60y, in the Philadelphia area. Diet quality was assessed with the Dietary History Questionnaire, a diet history tool for adults. Depression was assessed with the Center for Epidemiological Studies-Depression Scale. Sleep quality was assessed by sleep diary. Psychological distress was assessed using the General Health Questionnaire.

Results: Overall better diet quality score was associated with greater sleep duration (B=0.08%, CI: 0.02-0.03, $p=0.009$), better sleep quality (B=0.02, CI: 0.04-0.0093, $p=0.021$), and less insomnia (B=-0.04, CI: -0.07-0.01, $p=0.015$), sleepiness (B=-0.04, CI: -0.06-0.01, $p=0.002$), and fatigue (B=-0.07, CI: -0.13-0.01, $p=0.03$). When specific components were evaluated in post-hoc analyses, items that assessed fruits, vegetables, and whole grains were associated with better sleep outcomes and dairy, snacks, and coffee sweeteners were most consistently associated with worse sleep-related outcomes.

Conclusion: Overall healthy diet is cross-sectionally associated with several domains of sleep including greater duration and quality and decreased sleepiness/fatigue. Interestingly, specific elements of the habitual diet were related to different sleep-related outcomes, suggesting novel avenues for interventions/pathways for future study.

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0206
PERSONALIZED CAFFEINE RECOMMENDATIONS TO MAINTAIN ALERTNESS: YOU AND I NEED DIFFERENT DOSES
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Introduction: By optimizing caffeine consumption, we could maximize its recuperative benefits during sleep deprivation and reduce its use. However, to date, there are no algorithms to determine how much and when one should consume caffeine to safely maximize alertness, while considering between-individual variability.

Methods: To provide individualized caffeine recommendations, we combined two recently developed algorithms: 1) an artificial intelligence algorithm that uses psychomotor vigilance task (PVT) measurements to customize the parameters of a validated alertness-prediction model to an individual’s response to sleep deprivation and caffeine, and 2) an optimization algorithm that provides optimal caffeine recommendations to maximize alertness at the desired time, while minimizing caffeine use. We used the resulting algorithm to calculate personalized caffeine recommendations for 21 subjects challenged with 62 h of total sleep deprivation. The algorithm used the first 38 h (12 PVT measurements) to learn how each subject responds to sleep deprivation, and then obtained caffeine recommendations to keep each subject to an alertness level no lower than that achieved by a blood alcohol concentration of 0.08%. To place the advantages of personalizing the recommendations in perspective, we compared them to recommendations obtained for an “average” individual (i.e., a group average prediction).

Results: We obtained a wide range of personalized doses: whereas the seven subjects most vulnerable to sleep deprivation required between 500 and 1000 mg of caffeine, the seven most resilient subjects required none. For the vulnerable subjects, following the group-average recommendation instead would have worsened their alertness impairment (by 49 ms, on average, in a 5-min PVT). In contrast, for the seven most resilient subjects, following the same recommendation would have led them to consume caffeine (300 mg on average) not needed to maintain their desired alertness level.

Conclusion: We present the first caffeine optimization algorithm that provides personalized guidance for safe and effective use of caffeine to maximize alertness at the most needed times.

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IMPACT OF CHANGING SCHOOL START TIMES ON TEACHERS/STAFF
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Introduction: Delaying middle and high school start times is important for increasing sleep in students. However, no known studies have examined the impact of changing school start times on the personal sleep and well-being of K-12 teachers/staff in a district having made such a change.

Methods: In Fall 2017, the Cherry Creek School District changed school start times at all levels: elementary school [ES]: from 9:00 to 8:00 a.m.; middle school [MS]: from 8:00 to 8:50 a.m.; high school [HS] from 7:10 to 8:20 a.m. Teachers and school-based staff completed online surveys in Spring 2017 (pre-change n=2287) and Spring 2018 (post-change n=2702). Questions included weekday bedtime [BT] and wake time [WT], with total sleep time [TST] calculated as the difference between WT and BT; engagement with family/friends (dinner, talking about day); and PROMIS Sleep Related Impairment (SRI).

Results: Post-start time change, ES teachers/staff reported significantly earlier BT and WT (9m and 10m, ps<0.001), with no change in TST; MS teachers/staff reported no change in BT, with significantly later WT and longer TST (15m and 12m, ps<0.001); HS teachers/staff reported minimal change in BT, with significantly later WT and longer TST (28m and 21m, ps<0.001). No significant differences were found in SRI T-scores for ES or MS teachers/staff, but HS teachers/staff reported a significant decrease (p<0.001). Significantly fewer ES teachers/staff felt prepared to start the day post-start time change (80 vs. 64%, p<0.001). Significantly fewer MS teachers/staff regularly had dinner with their family post-start time change (66% vs. 55%, p=0.002). No changes were found at any level for talking with family/friends about the day.

Conclusion: Similar to MS/HS students, MS/HS teachers/staff reported a significant increase in sleep after delaying start time, with less daytime sleepiness in HS teachers/staff. ES teachers/staff reported feeling less prepared to start the day and MS teachers/staff had dinner with their family less frequently. Although adolescent sleep and well-being are the primary factors driving start time changes, it is important to consider how this policy impacts other members of the school community.

Support (If Any): Robert Wood Johnson Foundation
0208  
**SLEEP DISPARITIES IN THE UNITED STATES AND THE IMPACT OF POVERTY**  
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**Introduction:** Previous studies have shown that racial/ethnic minorities are more likely to be short and/or long sleepers, which may increase risk for morbidity/mortality. This analysis provides a more recent update from a very large national dataset, including representation of additional groups and examination of the role of poverty.  

**Methods:** Data from the 2016 Behavioral Risk Factor Surveillance System (BRFSS, collected by the CDC) were used. N=464,671 adults >18yrs from all US states/territories provided data on sleep, demographics, and socioeconomic factors. Sleep duration was categorized as very short (<4h), short (5-6h), normal (7-8h as reference), and long (>9h). Race/ethnicity was self-reported as Non-Hispanic White, Black/African-American, Hispanic/Latino, American-Indian/Alaskan-Native (AIAN), Native Hawaiian/Pacific-Islander (NHPI), and Multiracial/Other. Covariates included age, sex, relationship status, education, employment, and home ownership. Interactions were explored with poverty (<$20,000) were explored. Multinomial logistic regressions were weighted using BRFSS-specific weights.  

**Results:** A race-by-poverty interaction was seen (p<0.005). Compared to non-poor Non-Hispanic White, increased very short sleep was seen among those who were non-poor Black/African-American (RRR=2.1, p=0.0005), Asian (RRR=1.6, p=0.001), AIAN (RRR=1.4, p=0.001), NHPI (RRR=2.0, p=0.002), and Multiracial/Other (RRR=2.2, p=0.005), and poor Non-Hispanic White (RRR=1.8, p<0.0005), Black/African-American (RRR=1.8, p<0.0005), AIAN (RRR=1.5, p=0.007), NHPI (RRR=2.4, p=0.005), and Multiracial/Other (RRR=3.4, p=0.005). Compared to non-poor White, increased short sleep was seen among non-poor Black/African-American (RRR=1.7, p=0.005), Asian (RRR=1.3, p=0.005), AIAN (RRR=1.2, p=0.02), NHPI (RRR=1.3, p=0.02), Multiracial/Other (RRR=1.3, p=0.005), and poor Non-Hispanic White (RRR=1.3, p=0.005), Black/African-American (RRR=1.4, p=0.005), Asian (RRR=1.3, p=0.04), and Multiracial/Other (RRR=2.2, p<0.0005). Compared to non-poor Non-Hispanic White, increased long sleep was seen for Non-Poor Black/African-American (RRR=1.4, p<0.0005), Poor Non-Hispanic White (RRR=1.3, p<0.0005), Black/African-American (RRR=1.4, p=0.005), and AIAN (RRR=1.3, p=0.05).  

**Conclusion:** Established racial/ethnic sleep disparities are supported in this large national sample, with additional information on understudied vulnerable groups including AI/AN and NHPI. Further, this study contribute the role of poverty status.  

**Support (If Any):** R01MD011600, R21ES022931  

0209  
**ASPECTS OF DISORDERED NEIGHBORHOODS ARE ASSOCIATED WITH INSOMNIA, SLEEPINESS, FATIGUE AND CONTROL OVER SLEEP**  
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**Introduction:** Previous studies showed that disordered neighborhoods experience overall worse sleep quality and that this may play a role in mental/physical health. This study expands this work by examining validated sleep questionnaires of both sleep and neighborhood disorder, and also examining specific neighborhood aspects.  

**Methods:** Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study were used, consisting of N=1,003 working-age adults age 22-60 in the Philadelphia area. Participants were administered the Neighborhood Disorder Scale which inquired about neighborhood-level graffiti, noise, vandalism, neglect, dirtiness, lack of upkeep, loitering, drug use, alcohol use, neighbor problems, crime, people not “watching out” for each other, police presence, lack of safety, and lack of trust among residents. Sleep variables included the Insomnia Severity Index, Epworth Sleepiness Scale, Fatigue Severity Scale, and Brief Inventory of Sleep Control. Linear regression analyses were adjusted for age, sex, race/ethnicity, and household income.  

**Results:** Overall neighborhood disorder (mean= 31.2, SD= 8.6, range= 15-60) was associated with more insomnia (B=0.07, 95%CI [0.02,0.11], p=0.007), more sleepiness (B=0.04, 95%CI [0.004,0.08], p=0.029), more fatigue (B=0.13, 95%CI[0.03,0.22], p=0.007), and less control over sleep (B=0.06, 95%CI[-0.09,-0.03], p<0.0001). Post-hoc analyses examined specific neighborhood items. Insomnia was most robustly associated with loitering, drug use, alcohol use, and crime. Sleepiness was most robustly associated with loitering and problems with neighbors. Fatigue was most robustly associated with noise, neglect, loitering, drugs, and problems with neighbors. Lack of control over sleep was associated with loitering, drug use, problems with neighbors, crime, lack of “watching out,” police, lack of safety, and lack of trust.  

**Conclusion:** Residents of neighborhoods with greater levels of disorder experience more insomnia, more sleepiness, more fatigue, and less control over sleep. Specific aspects of neighborhoods may differentially impact sleep health and may play a role in sleep-related physical/mental health.  

**Support (If Any):** R01MD011600, R21ES022931  

0210  
**HEALTHCARE FINANCIAL HARDSHIP AND HABITUAL SLEEP DURATION, IMPACT ON SLEEP DISPARITIES, AND IMPACT ON THE SLEEP-OBESITY RELATIONSHIP**  
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**Introduction:** Sleep is related to socioeconomic status and impacts health. This study evaluated whether foregoing medical care due to cost impacts sleep and plays a role in sleep disparities and the sleep-obesity relationship.  

**Methods:** Data from the 2017 Behavioral Risk Factor Surveillance System (N=39,267 from 7 states). Sleep duration was assessed as hours/day. Participants were asked, “Was there a time in the past 12 months when you needed to see a doctor but could not because...”  

**Results:** Overall, experiencing financial hardship was associated with lower sleep quality (B=0.23, 95%CI[0.18,0.28], p<0.0001). Lack of control over sleep was associated with financial hardship (B=0.23, 95%CI[0.18,0.28], p<0.0001). Post-hoc analyses examined specific neighborhood items. Insomnia was most robustly associated with loitering, drug use, alcohol use, and crime. Sleepiness was most robustly associated with loitering and problems with neighbors. Fatigue was most robustly associated with noise, neglect, loitering, drugs, and problems with neighbors. Lack of control over sleep was associated with loitering, drug use, problems with neighbors, crime, lack of “watching out,” police, lack of safety, and lack of trust.  

**Conclusion:** Residents of neighborhoods with greater levels of disorder experience more insomnia, more sleepiness, more fatigue, and less control over sleep. Specific aspects of neighborhoods may differentially impact sleep health and may play a role in sleep-related physical/mental health.  

**Support (If Any):** R01MD011600, R21ES022931
of cost?” They were also asked for information about age, sex, race/ethnicity, education, income, employment, overall health, and access to health insurance. They were also asked for height/weight, which was used to compute body mass index (BMI).

**Results:** Access to health insurance was not associated with habitual sleep duration. However, foregoing medical care was associated with less sleep (B=−0.26, 95%CI[-0.35,-0.17], p<0.0005). There was an interaction with race/ethnicity; compared to non-Hispanic Whites, the effect was 115% larger among Blacks/African-Americans, 13% larger in Hispanics/Latinos, 101% larger and in the opposite direction for Asians, and non-significant for Multiracial. Race/ethnicity relationships to sleep duration were stratified by foregoing care. Among those who did not (90%), both short and long sleep duration were more likely among Blacks/African-Americans and other minority groups. Among those who did forego care (10%), these effects were dramatically reduced. Further, when sleep duration was evaluated as a predictor of obesity, this relationship was only seen among those who did not forego care.

**Conclusion:** Forgoing medical care due to cost is an independent risk factor for insufficient sleep, irrespective of income, employment, and access to insurance. It disproportionately affects Blacks/African-Americans and may represent part of the reason why sleep disparities exist even after adjustment for most socioeconomic indices. Further, foregoing medical care may present such health risks that this subsumes the relationship between sleep and obesity.

**Support (If Any):** R01MD011600

**0211**

**RODENT PSYCHOMOTOR VIGILANCE TASK PERFORMANCE FOLLOWING CHRONIC SLEEP RESTRICTION IN WISTAR HAN AND SPRAGUE DAWLEY RATS**

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**Introduction:** The relationship between chronic sleep restriction and performance on the Psychomotor Vigilance Task (PVT) has been well documented in human literature with chronic sleep restriction as little as 7 hours per night resulting in significant impairment in PVT performance. However, there is considerable variability in individual responses to sleep deprivation that potentially correspond to genetic differences. Recently, an analogous version of the PVT has been developed for use with rodent models (rPVT). The purpose of this study is to compare performance on the rPVT following chronic restriction in Wistar Han (WH) and Sprague Dawley (SD) rats, two rat strains commonly used for behavioral testing.

**Methods:** After meeting baseline criterion on the rPVT, WH (n=7) and SD (n=7) rats were subjected to 6hr/day sleep restriction in forced exercise wheels for one week. Performance on the rPVT was measured daily at 1500.

**Results:** Data indicates WH rats show more prominent impairment in rPVT performance following sleep restriction compared to SD rats. WH rats show increased reaction times and decreased accuracy while SD rats show little to no change performance following chronic sleep restriction.

**Conclusion:** The results of this study suggest that SD rats may be more resilient to the effects of sleep loss on vigilant attention measured via the rPVT than WH rats. These results have significant implications for the choice of strain when conducting behavioral tasks following sleep restriction as well as implications for research concerning genetic differences underlying resiliency to sleep loss. Future research on this topic in our laboratory will explore the distinct genetic differences between these strains and others to provide further insight into the relationship between genetics, sleep loss, and cognitive performance.

**Support (If Any):** N/A

**0212**

**THE INDIRECT EFFECT OF SLEEP QUALITY ON EMOTIONAL EXHAUSTION THROUGH EMOTION REGULATION DIFFICULTIES AND PERCEIVED STRESS IN A SAMPLE OF U.S. MEDICAL STUDENTS**

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**Introduction:** Burnout, conceptualized as emotional exhaustion, depersonalization, and reduced personal accomplishment, often results in personal and professional repercussions and occurs in approximately 53% of U.S. medical students. Given the recursive nature of burnout and sleep difficulties, it is hypothesized that sleep difficulties may be maintained through work related stressors. Evidence suggests that sleep and emotion regulation function bidirectionally. Likewise, perceived stress may concurrently incline, magnify, and sustain sleep difficulties in student populations. Therefore, the specific impacts of emotion regulation difficulties, perceived stress, and sleep quality on medical student burnout were investigated in this study.

**Methods:** Data were collected from 111 medical students at a large, allopathic medical school. Participants completed a battery of online questionnaires including the Difficulties in Emotion Regulation Scale, the Pittsburgh Sleep Quality Index, the Perceived Stress Scale, and the Oldenburg Burnout Inventory.

**Results:** The results suggest an indirect effect of sleep quality on emotional exhaustion through the serial mediated pathway of emotion regulation difficulties to perceived stress (β = .0780, LLCI = .0135, ULCI = .1482). Lastly, when controlling for both mediators, the direct effect of sleep quality on emotional exhaustion was no longer significant (β = .2035, ULCI = -.0317, ULCI = .4386).

**Conclusion:** The findings suggest that emotion regulation difficulties and perceived stress symptoms function as intermediary variables in the association between sleep quality and emotional exhaustion (burnout) in medical students. The current study proposes a temporal progression whereby a decrease in sleep quality results in diminished emotion regulation abilities which subsequently leads to an increase in perceived stress likely resulting in emotional exhaustion, burnout. Based on these findings, decreased sleep quality, which is a previously established feature of burnout, might also be perceived to maintain or worsen burnout (i.e., emotional exhaustion) through the mediated pathways of emotion regulation difficulties and perceived stress.

**Support (If Any):** N/A

**0213**

**ACUTE TOTAL SLEEP DEPRIVATION IMPAIRS THE ABILITY TO MANAGE RESPONSE CONFLICT**

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**Introduction:** Sleep performs an essential role in the prevention and management of emotional exhaustion. The evidence suggests that sleep and emotion regulation function bidirectionally. Likewise, perceived stress may concurrently incline, magnify, and sustain sleep difficulties in student populations. Therefore, the specific impacts of emotion regulation difficulties, perceived stress, and sleep quality on medical student burnout were investigated in this study.

**Methods:** Data were collected from 111 medical students at a large, allopathic medical school. Participants completed a battery of online questionnaires including the Difficulties in Emotion Regulation Scale, the Pittsburgh Sleep Quality Index, the Perceived Stress Scale, and the Oldenburg Burnout Inventory.

**Results:** The results suggest an indirect effect of sleep quality on emotional exhaustion through the serial mediated pathway of emotion regulation difficulties to perceived stress (β = .0780, LLCI = .0135, ULCI = .1482). Lastly, when controlling for both mediators, the direct effect of sleep quality on emotional exhaustion was no longer significant (β = .2035, ULCI = -.0317, ULCI = .4386).

**Conclusion:** The findings suggest that emotion regulation difficulties and perceived stress symptoms function as intermediary variables in the association between sleep quality and emotional exhaustion (burnout) in medical students. The current study proposes a temporal progression whereby a decrease in sleep quality results in diminished emotion regulation abilities which subsequently leads to an increase in perceived stress likely resulting in emotional exhaustion, burnout. Based on these findings, decreased sleep quality, which is a previously established feature of burnout, might also be perceived to maintain or worsen burnout (i.e., emotional exhaustion) through the mediated pathways of emotion regulation difficulties and perceived stress.

**Support (If Any):** N/A
**Introduction:** The attention network test (ANT) measures the ability to use an alerting cue to detect a stimulus (alerting effect), use a spatial cue to shift the location of visual attention (orienting effect), and manage response conflict (conflict effect). Total sleep deprivation (TSD) has been shown to negatively affect cognitive functions, including distinct aspects of attention. As part of a laboratory study, we measured performance on the ANT to examine the impact of TSD on attentional functioning.

**Methods:** 14 healthy adults (ages 21-39; 7 females/7 males) completed a 4-day (3-night) in-laboratory study. After a baseline night of sleep (9h sleep opportunity; 22:00-07:00), subjects underwent 38h TSD, followed by one night of recovery sleep (9h sleep opportunity; 22:00-07:00). A version of the ANT with variable inter-stimulus interval was administered at 09:00 during baseline, after 26h TSD, and after recovery sleep.

**Results:** Mixed-effects analysis of variance (ANOVA) showed marked impairment in the conflict effect during TSD (F_{2,26}=4.74, P=0.018). The alerting (F_{2,26}=0.02, P=0.98) and orienting (F_{2,26}=0.25, P=0.78) effects were not significantly affected by TSD.

**Conclusion:** Consistent with earlier findings, TSD did not significantly degrade the alerting effect on the ANT. In this study, TSD also did not significantly reduce the orienting effect. Thus, subjects maintained the ability to detect a stimulus and shift visual attention in response to cues, despite sleep deprivation. However, TSD had significant impact on the conflict effect, indicating that subjects experienced considerable difficulty managing response conflict while sleep-deprived. This finding is consistent with recent evidence that, independent of its effect on vigilant attention, sleep deprivation causes profound deficits in attentional flexibility.

**Support (If Any):** Jazz Pharmaceuticals

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**0214**

THE IMPACT OF SLEEP RESTRICTION ON THE RELATIVE REINFORCING VALUES OF FOOD IN ADOLESCENTS

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**Introduction:** Sleep-restricted youth consume more calories and select higher glycemic-index foods compared to when they are well-rested. One purported mechanism is that sleep restriction might increase the appeal or reinforcing value of certain foods. The purpose of this study was to assess the relative reinforcing value of different types of food following sleep restriction in adolescents.

**Methods:** 90 adolescents (ages 14-17; 57% female) underwent a within-subject counterbalanced experimental sleep manipulation, spending either 6.5 or 9.5 hours/night in bed for five nights. Following each sleep period, adolescents completed a computer-based relative reinforcing value of food task. During this hypothetical purchase task, adolescents selected a favored food from each of 5 categories: (i.e., fruits/vegetables, fast food, sweets/desserts, meats, and snacks). They then indicated how many servings of each favored food they would hypothetically purchase with their own money at increasingly higher prices. Outcomes of interest included intensity (servings of foods purchased if the price was free) and elasticity (relationship between purchases and price, with lower elasticity indicating less sensitivity to increases in price). We used repeated measures ANOVAs to compare relative reinforcing food value in the 6.5 vs. 9.5 hour sleep condition.

**Results:** We found significant main effects for: a) food type on intensity (p<.005), with fast foods being “purchased” at a lower intensity than other food types, b) sleep condition on elasticity (p<.05), with those in the sleep restricted condition demonstrating lower elasticity, and c) food type on elasticity (p<.001), with fast foods having the lowest elasticity, followed by meats, sweets/desserts, snacks, and fruits/vegetables. Food type did not interact with sleep condition.

**Conclusion:** When sleep-restricted, adolescents appear to be less sensitive to the increase in price of a variety of foods compared to when they are well-rested. This suggests an increase in perceived value/appeal of favored foods during sleep restriction. While adolescents reported wanting to consume fewer free fast food portions, they were far more likely to continue to pay (hypothetically) high prices for fast food items.

**Support (If Any):** R01 HL120879
0216 THE SLEEP ENVIRONMENT: ASSOCIATIONS BETWEEN HOUSEHOLD-LEVEL FACTORS AND ACTIGRAPHY-BASED SLEEP DURATION AND DISRUPTION IN THE JACKSON HEART SLEEP STUDY (JHSS)
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Introduction: Suboptimal neighborhood environments are associated with poorer sleep health, but few studies have investigated the household-level environment in relation to sleep patterns. This investigation may be particularly relevant to African-Americans - a group disproportionately affected by insufficient sleep and adverse environments. We tested associations between household-level factors and activities in the bed with sleep duration and disruptions among African-Americans.

Methods: A subset of JHSS participants (N=231) completed a sleep environment questionnaire and underwent 7-day wrist actigraphy. Self-reported sleep duration and actigraphy-based sleep duration, sleep efficiency and WASO were assessed. Perceived sleep environment was evaluated based on perceptions of safety, comfort, temperature, noise, and light disturbance. Participants reported activities in bed (e.g. watching television, listening to music, reading, eating). For each of the domains we created a score to estimate the combined effect of the included variables. Scores were constructed as weighted sums of the respective questionnaire items. We regressed each sleep outcome on all sleep environment components while adjusting for demographics. The weights were the positive estimated coefficients from the regression, or zero if the estimated coefficient was negative, normalized by dividing the coefficient by the sum, to obtain scores.

Results: Participants were older in age (66.3 years, standard deviation=10.8), mostly female (69.7%), and college educated (44.6%). An increase in an adverse sleep environment score was associated with both a lower self-reported sleep duration (β=-109.2 minutes, 95% confidence interval: -204.8, -13.6) and sleep efficiency (β=-5.3%, -10.3, -0.3), but not actigraphy-based sleep duration nor WASO. Engaging in activities in bed was associated with a lower actigraphy-based sleep duration (β=-29.0 minutes, -54.1, -3.9), sleep efficiency (β=-5.2%, -8.0, -2.3), and a WASO of 23.6 minutes (9.1, 38.1), but not self-reported sleep duration.

Conclusion: Perceptions of suboptimal environments were generally associated with shorter self-reported sleep duration whereas engaging in activities in bed was related to shorter objectively-measured sleep duration and greater sleep disruptions. Interventions on the sleep environment, including interventions around in-bed activities, may improve sleep among African-Americans.

Support (If Any): No

0217 CHRONIC AND ACUTE SLEEP RESTRICTION DOES NOT ADVERSELY INFLUENCE TESTOSTERONE CONCENTRATIONS IN YOUNG HEALTHY MALES
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Introduction: Low testosterone concentrations in men increases the risk for physical, psychological, and cognitive disorders. Despite sleep being the period when the majority of testosterone production occurs, there is little information on how sleep influences testosterone concentrations. The primary goal of the present study was to examine the effects of SR on circulating testosterone levels. We hypothesized that both severe SR and milder, sustained SR would lead to reductions in circulating testosterone concentrations in healthy young males.

Methods: Study 1: Fourteen men participated in an inpatient, randomized, crossover study of habitual sleep (HS: 9 h time in bed [TIB]) or SR (4 h TIB) for 5 nights. Plasma testosterone levels were measured at baseline and endpoint. Study 2: Thirteen men participated in a randomized, crossover outpatient study of HS or SR (HS=1.5 h) for 6 wk. Plasma testosterone was measured at baseline, wk 3, and wk 6 of each phase. Linear model analyses to assess the effects of SR on testosterone were performed separately for each study.

Results: Study 1: There was no significant sleep-time interaction on testosterone concentrations (change in testosterone levels during HS=22.86±163.79ng/dL; SR=43.73±159.96 ng/dL, P=0.41) and no main effect of sleep duration (P=0.13). Study 2: There was a trend for a sleep-time interaction (P=0.067) and a main effect of sleep on testosterone concentrations from 6 wk of SR (P=0.0046). Testosterone concentrations were slightly lower but increased over time with SR relative to HS.

Conclusion: SR does not adversely affect plasma testosterone levels in healthy young men. Given prior contradicting evidence, confirmatory studies should be done to ascertain the influence of sleep duration and quality on testosterone concentrations in men throughout life.

Support (If Any): Study 1 was funded by NIH grant R01HL091352 and Study 2 was funded by NIH grant R01HL128226 (both St-Onge, PI). Studies were in part supported by an NIH Clinical and Translational Science Award (CTSA) through its Center for Advancing Translational Sciences, grant no. UL1TR001873.

0218 THE IMPACT OF SLEEP DEPRIVATION IN THE BONE MARROW PROGENITORS AND THE ROLE OF ANGIOTENSIN-CONVERTING ENZYME
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Introduction: Sleep deprivation (SD) affects immune system response and regulation of the hematopoietic stem cells (HSC). However, how SD modifies hematopoiesis is not fully elucidated.

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0217
The tetrapeptide AcSDKP, which is degraded by angiotensin converting enzyme (ACE) in the bone marrow, is a natural inhibitor of the HSC proliferation. In the present study, we test the hypothesis that SD decreases ACE activity and affects the differentiation of HSC via AcSDKP.

**Methods:** Male C57BL/6 mice (N=6/group) were subjected to SD during 72 h and to a sleep recovery (SR) period of 10 days. Whole blood and cells from the bone marrow were collected for quantification of HSC, hematopoietic progenitors, mature cells and ACE.

**Results:** White blood cells, erythrocytes and platelets did not differ in the peripheral blood between groups. Lymphoid progenitors were significantly reduced in the bone marrow of the SD (P<0.01). After the SR period, the number of myeloid progenitors increased compared to control. Interestingly, the lymphoid progenitors remain reduced during SR. ACE activity was reduced in SD (2.6 ±0.5) and remains decreased in SR (2.9 ±0.5) compared to control (4.0 ±1 AU/min/mg prot. P=0.03). To further examine whether AcSDKP explains a direct effect on the number of colony-forming unit (CFU), we quantified the number of myeloid and lymphoid progenitor-CFU in the presence or absence of AcSDKP in the bone marrow cells. AcSDKP reduced the number of CFU-Pre B of SD compared to control. The number of lymphoid-CFU returns to basal levels and myeloid-CFU remains reduced in SR.

**Conclusion:** We concluded that: SD decreases ACE and the number of lymphoid B progenitors and its ability to form colonies in murine bone marrow; SR for 10 days is insufficient to return the lymphoid progenitors. ACE/AcSDKP axis is important mediator in murine bone marrow; SR for 10 days is insufficient to return the number of lymphoid B progenitors and its ability to form colonies.

**Support (If Any):** Veteran Affairs 1I01RX00928 (MRZ), 1R21NS106406 (DG)

0219

**MICE LACKING IL-18 HAVE REDUCED SLEEP AND SLOW-WAVE ACTIVITY RESPONSES TO SLEEP PROMOTING STIMULI**

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**Introduction:** Interleukin (IL)-18 is a pro-inflammatory cytokine that is a member of the IL-1 family. IL-18 is activated by inflammatory stimuli including the gram negative bacterial cell wall component lipopolysaccharide (LPS) and influenza—both of which alter sleep and slow-wave activity (SWA). IL-18 is also enhanced in individuals with pro-inflammatory conditions such as sepsis, type 2 diabetes, and cancer. We previously found that the nucleotide-binding domain leucine-rich family pyrin containing 3 (NLRP3) inflammasome is enhanced by sleep loss and LPS. NLRP3 inflammasome activation is a primary mechanism for the activation of both IL-1beta (IL-1β) and IL-18 by its corresponding pathogen associated molecular patterns including extracellular adenosine tri-phosphate and LPS. Thus, we examined sleep architecture responses to pro-inflammatory sleep promoting stimuli in mice lacking IL-18 [i.e., IL-18 knockout (KO) mice].

**Methods:** IL-18 KO and wild-type (WT) control mice were sleep deprived for 6 h prior to dark onset using the gentle handling method, allowed to sleep ad libitum, or intracerebroventricular infusions of LPS, IL-18 protein, or vehicle. Polysomnography was performed in the mice after the preceding treatment and sleep states and SWA were analyzed. Significance was set at p < 0.05.

**Results:** IL-18 KO and WT mice both had significantly enhanced non-rapid eye movement (NREM) sleep and SWA responses after sleep deprivation or LPS compared to ad libitum sleep conditions and vehicle administration, respectively. However, a significant interaction was observed between genotypes and the treatments where WT mice exhibited significant enhancements in NREM sleep and SWA after sleep deprivation and LPS compared to IL-18 KO mice. Infusion of IL-18 significantly enhanced NREM sleep and SWA in both IL-18 KO and WT mice rescuing the sleep and SWA response of IL-18 KO mice.

**Conclusion:** These data indicate that IL-18 is, in part, involved in homeostatic sleep regulation. Moreover, these findings are consistent with the idea that IL-18 like IL-1β is, in part, activated by NLRP3 inflammasomes to promote sleep and SWA by its respective pathogen associated molecular patterns and pattern recognition receptors.

**Support (If Any):** National Institutes of Health (HL-098676) and the Portage Health Foundation.

**0220**

**TOTAL SLEEP DEPRIVATION DECREASES CARDIAC VAGAL ACTIVITY**

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**Introduction:** Acute 24-hour total sleep deprivation (TSD) elicits a consistent hypertensive response in both men and women. In contrast, divergent sympathetic neural responses to TSD have been reported in men and women, with greater sympathetic predominance in women. Given the previously reported divergence of sympathetic outflow observed between men and women, we hypothesized that TSD would elicit altered cardiac vagal control across sexes.

**Methods:** We examined 28 participants (14 men, 22 ± 1 years, 26 ± 1 kg/m²; 14 women, 22 ± 1 years, 23 ± 1 kg/m²) between the ages of 18 to 40 years. Participants were studied twice, once after 24-hour TSD and once after normal sleep (randomized, cross-over design). We recorded heart rate (electrocardiography) and beat-by-beat blood pressure (finger plethysmography) during 5-min supine, awake rest. Vagal-cardiac activity was assessed with a Fourier transform and quantified as normalized high frequency (HF; 0.15-0.4 Hz), and cardiovagal baroreflex sensitivity (BRS) was assessed with up-up (vagal activation) and down-down (vagal withdrawal) sequence analyses.

**Results:** TSD decreased normalized HF in men (0.41 ± 0.05 to 0.33 ± 0.05 n.u.) and women (0.53 ± 0.03 to 0.44 ± 0.03 n.u.; condition p<0.01), but these responses were not different between sexes (condition × sex, p>0.05). Secondary analysis of up-up and down-down sequencing revealed no difference in cardiovagal BRS.

**Conclusion:** TSD elicits significant reduction of normalized HF in men and women, but these responses were not different between sexes. Our findings provide additional insight into the complex relations between sleep deprivation, autonomic activity, and hypertension.

**Support (If Any):** National Institutes of Health (HL-098676) and the Portage Health Foundation.
ACUTE SLEEP DEPRIVATION: CONSEQUENCES ON HEALTHY FACE SKIN, A NON-INVASIVE INSTRUMENTAL INVESTIGATION

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Introduction: Sleep deprivation has a strong impact on facial appearance with visible associated signs of fatigue but the impacts on skin biophysical features still remains unknown.

Methods: The present study investigates the impact of two consecutive nights with sleep restriction to 3 hours per night on facial skin, by using noninvasive instrumental methods for sebum (sebumeter), hydration (corneometer CM 825/Courage & Khazaka), trans-epidermal water loss (teawater TM 210), biomechanical properties (cutometer MPA 580), pH (PH 900), desquamation (D-squameter and image analysis) quantification and image analysis (ColorFace/Newtone Technologies). Twenty-four healthy Caucasian women aged 30-55 were selected for their well-sleeping morning and the evening the day before and the day after the sleep deprivation. Sleep deprivation was controlled by actimetry, and a sleep diary, their circadian typology with Horne and Ostberg questionnaire. Caucasian women aged 30-55 were selected for their well-sleeping afternoon than in the morning without any impact of sleep deprivation. Biophysical measurements and image of the face were taken in the morning and the evening the day before and the day after the sleep deprivation.

Results: We observed that sebum and PIE were more intense in the afternoon than in the morning without any impact of sleep deprivation on these parameters. On the contrary, hydration of the skin surface, pH and viscoelastic properties of the skin e.g. extensibility (Uf), elasticity (Ue), and delayed extensibility (Uv) as well as well single desquamating corneocytes (invisible desquamation) and radiation were significantly reduced after sleep deprivation.

Conclusion: This study identifies several important skin facial parameters significantly affected by acute sleep deprivation e.g. hydration, acidity, desquamation homogeneity, viscoelastic properties and complexion luminosity and highlights the importance of the sleep quality (or length) in physiological skin homeostasis, aesthetic and comfort.

Support (If Any): LVMH Research, France

TOTAL SLEEP DEPRIVATION AND PAIN PERCEPTION DURING COLD NOXIOUS STIMULI IN OLDER ADULTS

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Introduction: Our laboratory has previously reported an augmented pain response to 24-hour total sleep deprivation (TSD) in young men and women. Because aging is associated with a greater prevalence of chronic pain and diminished sleep quality, we hypothesized TSD would increase pain perception to the cold pressor test (CPT) in older adults. Furthermore, we hypothesized this relationship would be stronger in postmenopausal women compared to age-matched men.

Methods: Eighteen participants (9 women) between 55 and 75 years were tested once after 24-hour TSD and once after normal sleep (NS) using a randomized, cross-over design. Following a supine baseline, subjects performed a 2-min CPT by immersing their left hand in water (0-3°C). Perceived pain was recorded every 15 seconds during simultaneous recordings of muscle sympathetic nerve activity (MSNA; microneurography).

Results: Age (61±2 vs. 60±1 years) and BMI (26±1 vs. 27±1 kg/m²) were not different between women and men, respectively.
CPT elicited a graded increase of perceived pain (time, p<0.001), and increases were significantly greater during TSD (condition, p=0.05). These responses were not different between men and women (time × condition × sex, p>0.05). The condition effect was also observed when pain was expressed as mean change from baseline (NS, Δ6.9 ± 2.4 vs. TSD, Δ5.2 ± 2.4 a.u.; p=0.041) and peak change from baseline (NS, Δ8.4 ± 2.7 vs. TSD, Δ9.7 ± 2.5 a.u.; p=0.039). Changes in pain were correlated with changes in MSNA during the initial 30 seconds of CPT during both NS (r=0.51; p=0.025) and TSD (r=0.52; p=0.020).

Conclusion: TSD significantly augments perceived pain during cold noxious stimuli in older adults. Contrary to our initial hypothesis, this increased pain perception is not significantly different between men and women. Sympathetic reactivity during the initial phase of CPT was associated with changes in pain, but the clinical relevance of this relationship remains unclear. Our findings support the concept of sleep as a cost effective, therapeutic strategy for reducing pain in older men and women.

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0224 EXPERIMENTAL SLEEP RESTRICTION INCREASES SOMATIC COMPLAINTS IN HEALTHY TEENS
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Introduction: Both sleep disturbance and somatic symptoms (bodily complaints like aches/pains, fatigue, or GI distress) are common in adolescent medical and psychiatric populations. Although sleep and somatic complaints to some degree may reflect a ‘primary’ medical or mood disorder, there is evidence in adults that short sleep alone can contribute to such symptoms. This study tested the effect of experimentally restricting sleep duration on self-reported somatic symptoms in a medically and psychologically healthy teen sample.

Methods: N=22 teens (ages 14-18) completed a 3-week, within-subject counterbalanced sleep restriction-extension experiment. Following a 7-day sleep stabilization week, teens were randomly assigned to 5 nights of either Short Sleep (6.5 hrs/night in bed) or Healthy Sleep (9.5 hrs/night in bed). Teens completed measures of number of somatic complaints (Pain and Symptom Assessment Questionnaire - PSAQ) and degree to which these symptoms are bothersome (Children’s Somatization Inventory - CSI) the morning after completing each condition. Following a 2-night washout period, teens crossed over to complete the alternate 5-night sleep condition and then repeated the PSAQ and CSI. Adherence to experimental condition was confirmed via actigraphy.

Results: Compared to the Healthy Sleep condition, teens averaged 125 minutes less nightly sleep in the Short Sleep condition. They reported significantly more somatic symptoms based on total PSAQ scores during Short Sleep (p=.01, d=55), and a modestly large effect (although not statistically significant) persisted even after excluding the fatigue sub-scale (p=.127, d=.32) to conservatively remove items more manifestly related to sleep. Teens also reported being significantly more bothered by somatic symptoms during the Short Sleep condition based on total CSI scores (p=.005, d=.60), which does not include sleep or fatigue items.

Conclusion: Among a small but healthy teen population, restricting sleep opportunity to 6.5hrs/night (an amount not unrealistic for many teens) led to causal increases in self-reported somatic symptoms. Findings point to the importance of addressing sleep complaints in adolescent populations currently experiencing or vulnerable to developing somatic symptoms.

Support (If Any): R01 HL120879

0225 CAN CAFFEINE SUSTAIN ATTENTION AND VIGILANCE UNDER PROLONGED MONOTONOUS CONDITIONS DURING 77 HOURS OF TOTAL SLEEP DEPRIVATION?
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Introduction: Sleep deprivation (SD) degrades simple attention and vigilance, and these effects are exacerbated during prolonged time-on-task, monotony, and circadian misalignment. Caffeine can counter many of these declines, but the extent of its effectiveness across multiple nights of SD, especially during prolonged, repetitive activities, has not been established. Here, we tested the efficacy of repeated doses of caffeine during the early morning hours for sustaining various aspects of attention and vigilance under repetitive, high workload conditions over three nights of SD.

Methods: Twenty-three healthy military personnel (19 males), ages 18-35, underwent a baseline night of sleep followed by 77 hours of SD. Although preliminary analyses from this dataset have been reported previously, we present the complete analyses herein. Participants completed the 5-minute Psychomotor Vigilance Test (PVT) 141 times during SD. Each night from 0100 to 0900, participants ingested caffeine (200 mg) or placebo bi-hourly, and completed the PVT every 10 minutes over the 8-hour period. PVT performance was evaluated in terms of response speed (1/RT), attentional lapses (AL: 1000-4999 ms), responsive lapses (RL: 5000-9999 ms), and non-responsive lapses (NRL: ≥10,000 ms).

Results: Although both groups declined >50% after Night 1, PVT speed was faster across all three nights for caffeine relative to placebo (p=.006). For AL, caffeine outperformed placebo only on Night 1 (p=.028), but not thereafter. For RL, there was no difference on Night 1, but caffeine outperformed placebo on Nights 2 and 3 (p=.0002). For NRL, caffeine outperformed placebo for Night 2 only (p=.005).

Conclusion: Under conditions of high workload, monotony, and circadian pressure, vigilance performance decreased severely, even with repeated doses of caffeine. While more effective than placebo, caffeine did not effectively sustain performance at baseline levels under increasing sleep pressure. Caffeine is most effective at sustaining psychomotor speed and preventing simple attentional lapses during the first night of TSD, but dangerous lapses can still occur even with caffeine if SD extends beyond one night. Caffeine is an effective countermeasure for SD, but does not replace sleep.

Support (If Any):
Introduction: Oculomotor tracking performance changes according to time awake and circadian phase following a distinct pattern of impairment. A constant routine study demonstrated that increasing time awake 1) reduces the precision of visual motion processing as evidenced by increased direction and speed noise, 2) decreases the gain and proportion of tracking that is smooth during steady-state closed-loop pursuit and 3) decreases the slope and intercept of peak saccadic velocity versus amplitude curves. Although these metrics also show circadian modulation, it is unclear what proportion of the impairment is due to circadian phase relative to homeostatic mechanisms. We aimed to determine the contribution of homeostatic sleep pressure on these oculometric changes by administering low-dose caffeine over one night of sleep deprivation.

Methods: Study participants completed two weeks of a stable schedule including 8.5 hours in bed at home, followed by a ~24-hour laboratory constant routine (CR) in semi-recumbent posture under < 4 lux of light. Isocaloric snacks were provided hourly. The visual tracking task was performed every two hours after waking and hourly overnight. We computed fourteen largely independent metrics of tracking performance, included those listed above. Low-dose caffeine of 0.3 mg/kg was administered hourly during the biological night.

Results: Nine participants (5F) completed the study. Caffeine dosing: 1) prevented the impairment of visual motion processing (no significant slope for speed or direction noise), 2) reduced by approximately half the impairment of closed-loop pursuit performance (gain, -0.47%/hr, significance of slope change: p < 0.006; proportion smooth, -0.35%/hr, p < 0.005), and 3) had an insignificant (p > 0.39) effect on the impairment of saccadic peak velocity (slope, -1.13%/hr; intercept, -0.62%/hr).

Conclusion: These results suggest that visual motion processing and some proportion of closed-loop pursuit performance are impaired due to homeostatic mechanisms during sleep deprivation.

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0227
THE ROLE OF CAFFEINE IN MITIGATING COGNITIVE DEFICITS DUE TO SLEEP DEPRIVATION
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Introduction: In a prior study, we found that sleep deprivation impaired memory maintenance in a procedural task. Caffeine benefits sustained attention under conditions of sleep deprivation; however, the extent to which caffeine helps higher-order cognition, such as memory maintenance, is unclear. Here, we investigated the extent to which caffeine affected sustained attention and memory maintenance in sleep-deprived individuals. We further examined how the timing of caffeine administration affected cognition.

Methods: In the evening, participants completed UNRAVEL, a measure of memory maintenance, and the Psychomotor Vigilance Task (PVT), a measure of sustained attention, and were randomly assigned to stay awake in the laboratory overnight or sleep at home. Sleep-deprived participants were randomly assigned to one of three groups (Sustained, Acute, or Placebo). Based on group assignment, participants received caffeine or placebo at three timepoints (00:30, 04:30, 08:30). The Sustained group received 100mg of caffeine at each timepoint. The Acute group received placebo during the first two timepoints and 200mg of caffeine at 08:30. The Placebo group received placebo at each timepoint. Rested participants received 200mg of caffeine or placebo at 08:30 when they returned. All participants then completed UNRAVEL and the PVT.

Results: Using a large sample (N=352), we replicated findings that sleep deprivation increased errors in UNRAVEL, particularly following interruptions-reflecting memory maintenance deficits. Sleep-deprived participants who received caffeine were more likely to perform to a criterion accuracy threshold that participants were instructed to maintain. However, in participants who maintained this threshold, caffeine did not mitigate memory maintenance deficits. For the PVT, sleep-deprived participants exhibited more lapses in attention; caffeine reduced lapses in sleep-deprived and rested participants. The Sustained and Acute groups did not differ on any measure.

Conclusion: Although, the effect of caffeine on higher-order cognition has been disputed in the literature, the current study suggests that caffeine is beneficial for sustained attention and less beneficial for higher-order cognition, particularly the maintenance of task-relevant representations. Thus, caffeine appears to have domain specific effects on cognition.

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0228
SLEEPINESS AND FATIGUE IN CADETS AT THE U.S. MILITARY ACADEMY: PRELIMINARY RESULTS FROM A 10-YEAR FOLLOW-ON STUDY
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Introduction: In 2003, a four-year longitudinal study was launched to assess Cadet sleep patterns in the United States Military Academy (USMA) Class of 2007. Results confirmed that Cadets received significantly less sleep than recommended for their age group. The present study is a follow-on to the 2003 research, and included two components: (1) a cross-sectional survey, and (2) a longitudinal study tracking the sleep of a representative sample of Cadets. We present the findings from the survey.

Methods: Cadets (N=857, 19% response rate) from all four classes completed the cross-sectional online survey in winter 2018. Survey questions focused on sleep-related behaviors, daytime sleepiness (Epworth Sleepiness Scale-ESS), sleep quality (Pittsburgh Sleep Quality Index-PSQI), and fatigue (Fatigue Severity Scale-FSS). Data from 726 Cadets were analyzed (median=21 years of age, ~71% males).

Results: The average ESS score was 10.5±3.93 with 363 (50.0%) Cadets reporting elevated daytime sleepiness (ESS score>10). The average PSQI score was 6.66±2.57 with 442 (64.1%) Cadets classified as poor sleepers (PSQI score>5). The average FSS score was 4.37±1.22 with 384 (69.7%) Cadets having an FSS score denoting elevated fatigue level (score>3). Approximately 30% of the Cadets scored high on all three questionnaires and ~87% reported...
not having enough time to sleep. Cadets reported light (57.3%) and noise (52.5%) in their sleeping quarters as factors disrupting their sleep. Approximately 65% of the Cadets indicated drinking caffeinated beverages (energy drinks: ~13%). Adjusted for age, gender, morningness tendency was associated with lower sleepiness (p<0.001), better sleep quality (p<0.001), and lower fatigue (p=0.004).

**Conclusion:** Given the demanding and rigid daily schedule of Cadets, elevated sleepiness, fatigue, and poor sleep quality are endemic at USMA. Cadets with morning preferences reported less severe sleep-related problems. Improving habitability in sleeping quarters may reduce the disruptive effects of light and noise on Cadet sleep. The views expressed are those of the authors and do not necessarily reflect the official policy or position of the DoD, DoD, or the U.S. Government.

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**0229**

EXAMINING CHANGES IN SUBJECTIVE SLEEP QUALITY AMONG U.S. ARMY TANKERS BEFORE AND DURING A MISSION READINESS TRAINING EXERCISE

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**Introduction:** Sustained sleep restriction associated with military operations results in a large sample of individuals who present with insomnia-like symptoms. While units deploy and train together, unit hierarchy can result in group differences. Studying active-duty Soldiers presents the unique opportunity to examine how this organization can influence sleep in the larger group. In this analysis, we examine the variance in subjective sleep quality between groups.

**Methods:** 246 tankers from battalions within a brigade participated in a study planned around a mission readiness training exercise. Crewmen completed a baseline (T1) and retrospective (T2) survey capturing subjective sleep quality. Insomnia Severity Index (ISI) scores and subjective sleep duration from the Pittsburgh Sleep Quality Index (PSQI) were analyzed. Battalion differences within the brigade were tested using t-tests and analysis of variance (ANOVA).

**Results:** For sleep duration, Soldiers reported sleeping significantly less hours per night (M=4.98, SE=0.23) at T2 compared to T1 (M=5.59, SE=0.10), t (118) = -2.52, p = 0.013. At the battalion level, there was a significant interaction for sleep duration, F (3, 115) = 6.34, p=0.001. Battalions W, Y, and Z reported sleeping significantly less at T2 compared to T1. Conversely, Battalion X reported sleeping significantly less at T1 than T2. ISI severity of all crews indicated subthreshold insomnia, in which Soldiers reported significantly more sleep problems at T2 (M=13.25, SE=0.89) than T1 (M=10.25, SE=0.72), t (143) = -2.98, p=0.005. Additionally, there was a significant interaction for the ISI among battalions, F (3, 40) = 3.34, p=0.03. Battalions W, Y, and Z reported significantly more sleep problems at T2 than T1. Battalion X reported significantly more sleep problems at T1 than T2.

**Conclusion:** Across the unit, tank crews reported restricted sleep and subthreshold insomnia symptoms prior to as well as during training despite battalion group differences. It is possible that sleep quality may impact mental health, group dynamics, leadership, and unit culture.

**Support (If Any):** Department of Defense Military Operational Medicine Research Program (MOMRP).

**0230**

PREIMMUNIZATION WITH A NON-PATHOGENIC BACTERIUM MYCOBACTERIUM VACCIE NCTC11659 PREVENTS THE DEVELOPMENT OF CORTICAL HYPERAROUSAL AND A PTSD-LIKE SLEEP PHENOTYPE FOLLOWING SLEEP DISRUPTION PLUS ACUTE STRESS IN MICE.

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**Introduction:** Because regular sleep disruption can increase vulnerability to stress-related psychiatric disorders, there is a need to explore novel countermeasures to increase stress resilience after inadequate sleep. Immunization with heat-killed Mycobacterium vaccae NCTC11659 (MV), an environmental bacterium and immunomodulator, can increase resilience to chronic stress in mice. We therefore tested the hypothesis that MV immunization would prevent the negative impacts of five days of sleep disruption on stress-induced changes in sleep in mice.

**Methods:** 120 male C57BL/6N mice were implanted with EEG/EMG recording devices and given 3 weekly injections of either MV or vehicle before entering the experimental protocol (day 0). On days 1-5, sleep was disrupted by a slowly rotating bar, with an ad libitum sleep opportunity from ZT2-ZT6. AT ZT4 of day 5, mice were exposed to a 1-hour episode of social defeat stress. Sleep recording continued for seven days after social defeat (day 12). Groups received just sleep disruption, just social defeat, both (‘double hit’), or neither.

**Results:** In vehicle-treated mice receiving just social defeat, an increase in NREM delta (0.5-4Hz) power compared to baseline was observed during the post-stress dark period (p=0.005, Wilcoxon signed rank test). However, this was absent in mice receiving the double hit, who instead had elevated power in the high frequency beta (15-30Hz) power band in both NREM (p=0.002) and REM (p=0.001). Mice receiving the double hit also had increased REM and sleep fragmentation compared to controls for at least 6 days post-stress (p<0.05, ANOVA). NREM beta power immediately post-stress correlated with REM sleep disturbances 6 days later. MV preimmunization prevented all double hit-induced sleep disturbances.

**Conclusion:** These results suggest repeated sleep disruption may increase vulnerability to an acute stressor in part by shifting the adaptive increase in delta power to a maladaptive increase in beta power during post-stress sleep. Importantly, these data provide further evidence supporting microbiota-based countermeasures to promote health.
**0231**
EFFECTS OF SLEEP RESTRICTION AND FRAGMENTATION ON THE AUTONOMIC NERVOUS SYSTEM

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**Introduction:** Many mentally and physically high demanding jobs (e.g., shift-workers, astronauts) cause sleep fragmentation and deprivation. Impaired sleep can lead to an impaired autonomic nervous system, associated with stress, and increased morbidity and mortality. We investigate the effects of short-term sleep fragmentation and sleep restriction on the autonomic tone. We hypothesized (1) that autonomic parameters mirror effects of sleep restriction and fragmentation and (2) that sleep fragmentation has stronger negative effects on the autonomic tone than sleep restriction.

**Methods:** A randomized cross-over design with 20 healthy male participants (mean age: 39.9 ± 7.4 years, mean BMI: 25.5±2.2 kg/m²) was used. Each participant underwent 2 x 4 nights, experiencing both interventions separated by a wash-out phase of one week. The protocol included one baseline night, one intervention night of either sleep deprivation (5 hours) or sleep fragmentation (light on every hour) and two recovery nights of undisturbed sleep. Full laboratory-based polysomnography was conducted. Additionally, electrocardiography and continuous blood pressure were recorded under paced breathing at 12/min before falling asleep (evenings) and after waking up (mornings). Parameters of the autonomic tone - parameter of the heart rate variability (standard deviation of normal to normal R-R intervals - SDNN).

**Results:** SDNN increased each night and was higher in the mornings compared to the evenings before. During sleep restriction, the change in SDNN (morning - evening) significantly increased from baseline to intervention (2.2±17.8ms to 22.0±26.7ms; p<0.05).

**Conclusion:** Sleep restriction had a stronger but more positive effect on the autonomic nervous system than sleep fragmentation. However, all effects remained to be small due to limited sample size and just one night intervention.

**Support (If Any):** NASA NNX14AN49G.

**0232**
HEART RATE IS DIFFERENTIALLY ALTERED BY TOTAL SLEEP DEPRIVATION AND PSYCHOLOGICAL STRESS IN RESISTANT VS. VULNERABLE INDIVIDUALS AND PREDICTS COGNITIVE PERFORMANCE

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**Introduction:** There are substantial individual differences (resistance and vulnerability) in neurobehavioral deficits from psychosocial stress and sleep loss. However, little is known about whether the time course of heart rate responses across total sleep deprivation (TSD), the combination of TSD and psychological stress, and recovery, differs in resilient vs. vulnerable individuals and whether heart rate predicts individual differences in cognitive performance.

**Methods:** Thirty-two healthy adults (ages 27-53; mean ± SD, 35.1 ± 7.1y; 14 females) participated in a five-day experiment consisting of two 8h time-in-bed (TIB) baseline nights, followed by 39h TSD and two 8h-10h TIB recovery nights. A modified Trier Social Stress Test (TSST) was conducted on the day after TSD to induce psychological stress. Heart rate was obtained at six time points during the study (pre-study, at baseline, after TSD, during TSD after the TSST, after recovery, and post-study). The 10-minute Psychomotor Vigilance Test (PVT) measured behavioral attention. Cognitively resistant (n=16) and cognitively vulnerable (n=16) groups were defined by a median split on TSD PVT performance [total lapses (>500 ms response time) and errors]. Repeated measures ANOVA and post hoc comparisons corrected for multiple testing, examined heart rate across time points between groups.

**Results:** In resistant individuals, compared with fully-rested conditions, heart rate decreased with TSD and with TSD + psychological stress, and failed to return to baseline with recovery sleep. By contrast, in vulnerable individuals, compared with fully-rested conditions, heart rate increased with TSD and with TSD + psychological stress, and returned to baseline with recovery sleep. Moreover, the cognitively resistant individuals had higher heart rate before TSD than the cognitively vulnerable individuals.

**Conclusion:** Heart rate differed between resistant and vulnerable individuals across TSD, psychological stress and recovery sleep and predicted individual differences in cognitive performance, whereby higher heart rate during full-rested conditions predicted resistance to TSD and TSD + psychological stress. As such, heart rate is a viable biomarker of sleep deprivation, psychological stress, and cognitive vulnerability in humans.

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for a 29h SD session. MRS spectra were collected using a MEGA-PRESS sequence for GABA in three a priori voxels of interest: dorsolateral prefrontal cortex (dLPFC), medial prefrontal cortex (mPFC), and the parietal-occipital region (OCC). MRS data were processed using LCModel software and expressed as a ratio to creatine. Subjects were divided into tertiles based on GABA levels for each region. MRS data were unavailable for some individuals: dLPFC (n=12), mPFC (n=4), OCC (n=7). A 10-min psychomotor vigilance test (PVT) was administered 17 times throughout the SD session. Each response time for each test bout were grouped into 1-min bins across the task duration.

**Results:** A mixed-effects ANOVA showed a significant interaction between bin and tertile (dLPFC: $F_{18,44000}=2.08$, $p<0.001$; mPFC: $F_{18,55000}=0.005$; OCC: $F_{18,55000}=5.001$). The TOT effect was reduced in subjects with low GABA in the dLPFC and OCC and increased in those with low GABA in the mPFC. There was also a significant interaction of time awake, bin, and tertile for the dLPFC ($F_{288,44000}=1.28$, $p=0.001$) and the OCC ($F_{288,50000}=5.001$, $p<0.001$), such that lower GABA was associated with an attenuated TOT effect during SD.

**Conclusion:** Baseline GABA in the dLPFC and OCC predicts TOT performance on the PVT during SD. Subjects with lower GABA levels in the dLPFC and OCC were more resilient to amplified TOT effects. These findings suggest that inhibitory neurotransmitters, like GABA, are potential predictors of resilience to impairment associated with sustained task performance during sleep loss.

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0234
ROLE OF MIDDAY NAPS ON EPISODIC MEMORY CONSOLIDATION IN PRESCHOOL CHILDREN
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Introduction: The preschool nap opportunity has been shown to enhance visuospatial learning. Specifically, on a visuospatial learning task, like the game ‘Memory,’ performance in preschool-aged children was protected following a nap while performance declined by ~12% over an equal period awake. Further, post-nap performance was associated with sleep spindles. However, it is unclear whether the association between the nap-dependent benefit and sleep characteristics generalizes to other declarative memory tasks. In this study, we used a novel storybook task to determine whether other forms of declarative learning, particularly those forms used in preschool classrooms, are benefited by naps at this age.

Methods: Preschool children (36-71 months; N=18) listened and viewed four 10-page storybooks chronicling events typical to a preschool child (e.g., baking cookies with mom). There were two conditions, a nap condition and a wake condition (within subject, order counterbalanced, ~1 week apart). Each condition began with the reading of two of the stories to the child. During immediate recall, children were asked to place picture cards portraying scenes from the stories in correct order. Children were then fitted with the polysomnography cap. Children then either spent 2 hours taking a nap (sleep condition) or engaging in quiet activities for an equivalent period of time (wake condition). After the nap/wake period, delayed recall was assessed through the picture card task and recall was probed once more 24 hours after encoding.

Results: Recall for the story was greater following the nap period than an equivalent time spent awake (p =.021). This nap-dependent benefit persisted 24 hours later (p=.008). Further, total time spent asleep was correlated with performance scores (r=.571, p =.013). Unlike prior studies, the correlation between sleep spindle density and memory performance was not significant.

Conclusion: Our results suggest that midday naps in preschool children support the consolidation of episodic declarative memories. The lack of association between spindles and performance suggests that consolidation of episodic memories may be supported through separate mechanisms. Nonetheless, naps may be critical to preschool education.

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0235
START OF DAYLIGHT SAVING TIME AND SLEEP IN YOUNG CHILDREN
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Introduction: Changing the clocks to begin daylight saving time (DST) creates an artificial time shift; however, a paucity of studies has been conducted on the impact on young children's sleep. Thus, this study measures the magnitude and duration of DLS disruption for young children.

Methods: Caregivers of 624 young children ages 0-24 mos (M=8.6 mos; 56% male) tracked their child's sleep using Johnson's® Bedtime® Baby Sleep App (free, publicly-available). Bedtime, nighttime sleep duration (NSD), and waketime were analyzed for the four weeks preceding the spring time change (baseline) and for 28 days after across infants and toddlers (0-5 months, 6-11 months, 12-17 months, and 18-24 months).

Results: For the four days after DST, bedtimes (body clock time) shifted an average of 30 minutes compared to baseline (expected shift of 60 mins). Infants (0-11 mos) returned to baseline after 8 days and toddlers (12-24 mos) after 3 days. Across the four days post-DST, morning waketime (body clock time) shifted by 40-48 minutes (expected 60 mins), with more disruption the younger the age (~59 mins at 0-5 mos to ~31 mins for 18-24 mos). Across age groups, there were no clear trends regarding the number of days to return to waketime baseline. Concomitantly, NSD was 16-22 mins shorter for the first 4 days. Older infants (6-11 mos) NSD continued to be 7-15 minutes less than baseline 4 weeks after DST, whereas toddlers returned to normal sleep duration within ~7 days.

Conclusion: DST in the spring results in a loss of nighttime sleep of 15 to 20 minutes in young children, which is associated with a greater shift in waketimes (about 45 mins) than bedtimes (about 30 mins). Return to pre-DST levels is variable across age groups, ranging from 7 to more than 28 days, with younger infants taking longer than toddlers to return to their baseline sleep schedule and typical nighttime sleep duration. These results can inform strategies and expectations for caregivers managing young children’s sleep around the start of DST.

Support (If Any): Johndon & Johnson Consumer Inc., Skillman, NJ, USA.

0236
ASSOCIATIONS OF MEDIA USE AND NOCTURNAL SLEEP DURATION AMONG US ADOLESCENTS: MEDIATING EFFECTS OF CHRONOTYPE
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Introduction: Media use may shorten the sleep period among adolescents, particularly later chronotypes. We investigated cross-sectional and longitudinal associations of time spent on gaming, social media, and television/DVDs with scheduled- and free-day sleep duration, and examined chronotype as mediating these relations.

Methods: Data drawn from the NEXT Generation Health Study’s first 3-waves (W1-W3, 10th-12th grade, n=2520) and 7th-wave (W7, 4-years post-high school) were used in path models (Mplus V7.4). W3 and W7 scheduled- and free-day sleep durations were calculated from participant reports of usual wake- and sleep-time. Chronotype was extrapolated from the adjusted free-day sleep period midpoint. Media use was assessed as average hours/day on each platform. Latent variables (W1-W3) were constructed for media use and chronotype. Models evaluated chronotype as mediating relations between each type of media use and sleep duration.

Results: Social media was directly associated with W3 scheduled-day sleep duration (~0.09, p=.001); the path between chronotype and duration was attenuated to non-significance. Results for W3 free-day sleep duration indicated a significant direct effect for TV (0.12, p=.004) and indirect effects for gaming (~0.04,
Methods: The study aims to assess the percentage of nights that infants sleep through the night. In W7 cross-sectional analyses, significant direct (game 0.07, p=0.03; social media 0.05, p=0.04) and indirect effects (game 0.03, p=0.01; social media 0.02, p<0.001; TV 0.02, p=0.02) were found for scheduled-day sleep duration. For W7 free-day duration, indirect effects were obtained (gaming -0.03, p<0.003; social media -0.02, p=0.01; TV -0.02, p=0.01).

Conclusion: Results suggest that chronotype mediates associations between sleep duration and media use. Later chronotype, typical of adolescents, contributes to short sleep duration. Social media may be a high value intervention target during high school. Longitudinal results suggest high school media use patterns may not carry over into early adulthood, although concurrent media use is related to shorter sleep duration at older ages.

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0237
INTERNIGHT VARIABILITY IN THE SLEEP CONSOLIDATION PROCESS
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Introduction: New parents are often concerned about when their infant will consolidate their sleep, a process referred to as a ‘sleeping through the night’. While the proportion of infants who sleep through the night increases with age, studies have shown considerable variability among infants in this process. The majority of studies rely on questionnaires, where mothers are asked to report their infant’s sleep patterns over a specific period of time. However, infant sleep may also vary from night to night. In order to document night-to-night variability in infant sleep consolidation, this study aims to assess the percentage of nights that infants sleep through the night, during a two-week period at 6 months of age, by maternal report.

Methods: Data from 37 mothers of typically developing infants (40% first-borns) were analyzed. At 6 months post-partum, mothers were asked to complete an infant sleep diary for 13 consecutive days. Based on these diaries, the longest consecutive sleep period (without interruption) was retrieved. Sleeping through the night was defined as 6 or 8 hours of consecutive sleep. The percentage of nights every infant was meeting this criterion over 13 nights was calculated.

Results: The mean longest consecutive sleep period (assessed for 13 nights) reported by mothers was 347.2 ± 128.7 minutes (range: 156.9 - 612.9). As hypothesized, a large inter-night variability was observed. Using a definition of 6 hours, mothers reported in average that their infant slept through the night 41.5% ± 33.0% of the time (5-6 nights out of 13); using a definition of 8 hours, mothers reported that their infant slept through the night 22.1% ± 29.3% of the time (3 nights out of 13).

Conclusion: These preliminary findings show an important inter-night variability in infant sleep consolidation process. Questionnaires that assess whether infants sleep through the night over a shorter period of time may not capture this great variability. Mothers should be informed about this variability and know that even if their infant sleeps for 6 hours consecutively one night, it does not necessarily mean that this behaviour will occur every night.

Support (If Any): -

0238
SLEEP HABITS IN TEENAGERS FROM SUMMER TIME TO SCHOOL TIME
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Introduction: Many teenagers are reporting sleep difficulties and are complaining about daytime sleepiness. Those complaints could be explained by different factors impacting sleep/wake patterns during adolescence. School start times, homework, social activities and sport enrolment are some of the constraints that can decrease adolescents’ sleep. The aim of the present study was to compare sleep patterns of teenagers during a summer period and during a school period.

Methods: Forty-two adolescents aged 13 to 15 years (23 girls and 19 boys) completed questionnaires on sleep habits, once during the summer, and again at the beginning of the school year (October). Paired t-tests were performed between bedtime, risetime and total sleep time to compare sleep habits between summer time and school time.

Results: Adolescents reported significantly earlier bedtime (21:20 ± 42min vs 22:33 ± 65min; t(41)=8.97, p<0.001, r=0.66) and earlier risetime (6:17 ± 23min vs 8:52 ± 74min; t(41)=7.42, p<0.001, r=0.81) during school time compared to summer time. Sleep duration was also significantly reduced during school time compared to summer time (8.94±0.73h vs 10.34±1.05h; t(41)=13.38, p<0.001, r2=0.81). The difference between school time and summer time represents a loss of 84 minutes in sleep duration per night.

Conclusion: These results confirm that teenagers are changing their sleep patterns during school time. Our results show that they tend to shift their sleep habits to earlier times during school time, probably in order to adapt to school schedules and demands. Our results also show that these changes cause a drastic reduction in their sleep. This may lead to excessive daytime sleepiness during school time. Moreover, the timing of this new sleep schedule may cause sleep initiation difficulties during school time because of a misalignment with their natural sleep-wake-patterns. During summer time, however, teens adopt sleep patterns that are probably more closely related to their natural sleep-wake cycle and sleep need. This will need to be investigated in further studies.

Support (If Any): -

0239
EXCESSIVE DAYTIME SLEEPINESS, REDUCED SLEEP DURATION ON WEEKEND AND SOCIAL JETLAG ARE ASSOCIATED WITH CAFFEINE CONSUMPTION IN TEENAGERS
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Introduction: Caffeine consumption is increasing in adolescents, particularly due to the gaining popularity of energy drinks. Yet, much more research is needed to better understand the motivation underlying these consumption habits and the impact of caffeine on sleep and daytime functioning in teenagers. The purpose of this study is to examine the association between sleep habits, daytime sleepiness and energy drinks and coffee consumption in adolescents.
Methods: 674 adolescents (280 boys, 394 girls, 14 to 17 years old) completed a questionnaire on sleep habits and caffeine consumption. First, Pearson’s correlations between energy drinks and coffee consumption were calculated with total sleep time (TST) on school nights (SN) and weekend nights (WN), social jetlag (SJ), and excessive daytime sleepiness (EDS). A multiple linear regression model was performed to examine the unique contribution of each variable that was significantly associated with caffeine consumption in teenagers. Since age could also be associated with this habits, this variable was added to the model.

Results: Results showed that energy drinks and coffee consumption was associated with EDS (r=.34, p<.001), TST on SN (r=-.145, p<.001) and WN (r=-.087, p<.05), and SJ (r=.18, p<.001). Multiple linear regression modeling demonstrated that 14.8% of the variance in the consumption habits can be explained by the model (p<.001). EDS was the largest predictor (β=.29, p<.001), followed by SJ (β=.18, p<.001) and TST on WN (β=-.13, p<.01). Age and TST on SN were not significant predictors of caffeine consumption.

Conclusion: These results confirm that although EDS is associated with energy drinks and coffee consumption in adolescents, sleep timing and duration on weekend also seem to be associated with this habit. Our results could suggest that caffeine is used to compensate for daytime sleepiness partly due to an increased social jetlag. It could also suggest that teenagers who consume high level of caffeine have more trouble sleeping on weekends. However, it is also possible that teenagers are deliberately using caffeine as a way to increase social and personal time during weekend. This needs to be investigated.

Support (If Any): None.

0240
NOCTURNAL MELATONIN SUPPRESSION IN ADOLESCENTS AND ADULTS FOR DIFFERENT LEVELS, SPECTRA AND DURATIONS OF LIGHT EXPOSURE
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Introduction: An altered phase relationship between the circadian system and the sleep-wake cycle can be detrimental to sleep quantity, quality, and health. The human circadian system is primarily regulated by the 24-hour light-dark cycle incident on the retina. Although, limited data related to the combined effects of various lighting characteristics has impeded the development of circadian-effective light-treatment methods. The present study intended to describe the effects of lighting exposure duration on nocturnal melatonin suppression, a circadian biomarker, for 2 contrasting spectra delivering a range of indoor light levels. Another goal was to examine whether identical light exposures can differentially affect the circadian systems of different age groups. They study also intended to empirically estimate an absolute threshold for discussing light’s impact on acute melatonin suppression.

Methods: Melatonin suppression was measured for 18 adolescents (ages: 13-18 years) and 22 adults (ages: 24-55 years) for 2 white light spectra (2700 K and 6500 K, 40-1000 lux), over a range of light exposure durations (0.5-3.0 h, starting 23:00). Lighting apparatus comprised of RGB color-tunable, diffused linear LED light bars mounted on participants’ desks.

Results: Results showed that light’s incremental effectiveness for suppressing melatonin diminishes with increasing exposure duration for both age groups and both light sources. Threshold criterion of 10% suppression was reached for lower light levels at only longer exposure durations. Depending upon the age-group, the 6500 K source required 71-85 lux for a 1-h exposure and 36-49 lux for 3-h exposure to reach the threshold criterion. Yet, the results do not statistically corroborate our hypothesis that adolescents exhibit greater circadian sensitivity to short-wavelength radiation compared to adults. Spectral sensitivity of acute melatonin suppression was found to not change with exposure duration.

Conclusion: Dose-response curves generated for each spectra, age-group and duration can guide circadian-lighting recommendations in applications such as offices, schools, residences, and healthcare facilities. Earlier proposed melatonin suppression threshold of 30 lux for 30 min for white light, by Figueiro and colleagues, appears to be an acceptable, if conservative, recommendation.

Support (If Any):

0241
RELATIONSHIP BETWEEN SLEEP, DIET, AND SES IN PRESCHOOL-AGED CHILDREN
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Introduction: Sufficient sleep and a nutritious diet are both known to encourage children’s physical growth and overall development. Previous research suggests an association between the above health factors. However, it is unclear which specific aspects of sleep quality are related to diet. We aimed to investigate the relationship between sleep quality measures and dietary habits in young children while considering the role of socioeconomic status.

Methods: Data was collected from 369 preschool-aged children (M age = 52.1 months, 46.4% female). Sleep quality was measured objectively through actigraphy watches worn for 16 days. Dietary habits were determined through questionnaires completed by the participant’s primary caregiver. Questions probed child’s average weekly consumption of fruits, vegetables, and fast food. Socioeconomic status, used as a covariate, was constructed using parent reports of income, education, and employment status.

Results: Average sleep duration was positively associated with children’s average weekly intake of fruits and vegetables (r = .17, p = .03; r = .15, p = .004, respectively) and negatively associated with average weekly intake of fast food (r = -.17, p < .001). Conversely, sleep onset was negatively associated with vegetable intake (r = -.12, p = .02) and positively with fast food consumption (r = .11, p = .04). Interestingly, average nap duration was negatively associated with weekly vegetable (r = -.11, p = .04) and fruit intake (r = -.14, p = .01). SES and age were included as covariates in all correlations.

Conclusion: Preschool-aged children who consumed fruits and vegetables on a more frequent basis experienced longer overnight sleep bouts and earlier bedtimes, while more frequent consumption of fast food was related to shorter sleep bouts and later bedtimes. Children who consumed more fruits and vegetables also experienced shorter nap durations, possibly due to a decreased need to compensate for insufficient overnight sleep. SES did not explain the associations between these sleep measures and dietary habits, though other household factors could be responsible such as parenting style, household chaos, or limited access to nutritious foods.

Support (If Any): This work was supported by NIH R01 HL111695.
Introduction: Delayed sleep timing and short sleep duration represent a significant public health burden in adolescent populations. Some substances obtained through diet (such as caffeine) are known to affect sleep, yet other dietary components that could alter sleep in adolescents are unclear. We investigated whether plasma levels of docosahexaenoic acid (DHA), a long-chain fatty acid that can be obtained through diet (e.g. from fatty fish such as tuna), were related to sleep timing and duration in adolescents.

Methods: The study population included 405 Mexico City adolescents (average age (SD)= 14.2 (2.1) years; 48% males) who took part in a 2015-2016 follow-up visit as a part of an ongoing cohort study. Fatty acid levels were measured in plasma, as percentage of total fatty acids. Sleep midpoint and duration were assessed with 7-day actigraphy immediately following the fatty acid blood draw. DHA plasma levels we categorized into quartiles (Q1-Q4; Q4=highest fatty acids). Linear regression was conducted with sleep characteristics as separate outcomes and quartiles of DHA as the exposure, adjusting for sex, age, caffeine, total energy intake, and BMI-for-age Z scores.

Results: Mean (SD) plasma DHA was 1.2 (0.4) %. In adjusted analysis, plasma DHA was positively and linearly associated with sleep duration on the weekends (e.g. those in Q4 compared to Q1 had 31 minutes longer duration [95% CI 6 to 56], P, trend=0.006). Higher DHA also associated with earlier sleep timing during both weekdays and weekends, although in a non-linear fashion (largest difference was a 0.78-hour later weekday midpoint in Q2 compared to Q4 [0.35 to 1.12]).

Conclusion: Plasma levels of DHA, which reflect typical dietary intake, were associated with earlier sleep timing and longer weekend sleep duration in Mexican adolescents. Whether dietary interventions or DHA supplementation could improve sleep in adolescent populations deserves consideration in randomized trials.

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0244 PHYSIOLOGICAL AND PSYCHOLOGICAL ASSOCIATIONS WITH HEART RATE IN COLLEGE STUDENTS
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Introduction: Epidemiological studies have long established that sleep duration and cardiovascular health are related. Additionally, studies have shown that mood, stress, cognitive performance, and sleep are intimately tied together. Some studies have shown gender differences in certain sleep factors, but these differences are not consistent. Additionally, college students often struggle with the demands of college life, which leads to increased stress, symptoms of depression and anxiety, and poor sleep. The focus of the current study was to examine habitual sleep habits in college students, in association with physiological factors (i.e., heart rate), emotional factors (i.e., depression), and fatigue.

Methods: Participants included 12 undergraduate students (5 men, average age M=19.42 years, SD=1.08) who wore wrist actigraphs for one week to measure their normal sleep habits. After one week, participants returned to the lab to complete cognitive tests (i.e., Stroop Color-Word Test) and questionnaires about psychological symptoms (i.e., the Depression Anxiety Stress Scales, DASS-21), and fatigue (Multidimensional Assessment of Fatigue Scale). Blood pressure and heart rate were measured using a wrist device.

Results: Overall TST was 6.65 hours and sleep efficiency was 84.85%. A preliminary independent-samples t-test revealed a significant difference between anxiety scores in men (M=6, SD=7.48) and women (M=5.14, SD=3.44), t(10) = 10.21, p<.001. Additionally, an independent-samples t-test demonstrated a significant difference between incongruent Stroop errors for men (M=1.60, SD=0.894) and women (M=4.29, SD=3.15), t(10) = 8.51, p<.001. No gender differences were found in sleep efficiency or duration. Pearson correlational analyses revealed positive, moderate associations between heart rate (r=79.33, SD=12.88) and depressive symptoms r(10) = 0.705, p<.010), and fatigue r(10) = 0.692, p<.023.

Support (If Any): NIDDK/NIH R01DK096488
Conclusion: Surprisingly, sleep factors (duration and efficiency) were not associated with depressive, anxious, or stress symptoms in college students. Gender differences were found in anxious symptoms and cognitive errors, but not in sleep or physiological factors. More research should be conducted to further examine the relationships between heart rate and depression, stress, and fatigue, as there may be underlying mechanisms important for cardiovascular health.

Support (If Any): None.

0245
SLEEP, ANXIETY, AND BLOOD PRESSURE IN COLLEGE STUDENTS
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Introduction: The relationship between anxiety and blood pressure has been previously examined across several fields. While anxiety has not been found to necessarily cause high blood pressure, it has been shown to cause sharp increases when high levels of acute anxiety are present. Additionally, sleep duration has been shown to impact mood states and blood pressure.

Methods: For the current study, 12 undergraduate students (5 men), average age M=19.42 years (SD=1.08) wore an actigraph watch on the non-dominant wrist to monitor normal sleep patterns for one week; sleep duration and efficiency data were collected. Anxiety was assessed using the anxiety subscale on the Depression, Anxiety, Stress Scale (DASS-21). Systolic and diastolic blood pressure was assessed with a wrist device after one week of normal sleep behavior.

Results: Preliminary Pearson correlation analyses indicated that there was a significant positive, strong association between systolic blood pressure (M=106.19, SD=7.28) and anxiety subscores (M=5.50, SD=5.20), r(10) = .863, p < .001; similarly, there was a significant positive, moderate association between diastolic blood pressure (M=67.69, SD=4.93) and anxiety subscores, r(10) = .660, p = .020. Both systolic and diastolic blood pressure were related to anxiety; as blood pressure increased, anxiety also increased. Unexpectedly, blood pressure was not related to sleep efficiency (M=84.85%, SD=3.30) or duration (M=66.55 hours, SD=63.82 minutes).

Conclusion: It is likely that further relationships will be uncovered with additional data collection and analyses. While this study did not find sleep efficiency or duration to be related to blood pressure, it is important to continue research involving the relationships involving other sleep factors, blood pressure, and anxiety. Further studies should examine sleep factors, acute anxiety levels, and blood pressure during in-lab testing to discover more about the underlying mechanisms of these relationships.

Support (If Any): none

0246
REST-ACTIVITY CIRCADIAN RHYTHM AND HAIR CORTISOL AMONG TODDLERS LIVING IN SOCIOECONOMICALLY DISADVANTAGED COMMUNITIES.
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Introduction: Early childhood adversity renders young children vulnerable to the physical effects of a prolonged stress response and socioemotional effects of being unable to verbalize the subjective feeling of stress. This study examined the associations between objective measures of chronic stress and the timing and regularity of daily activities among toddlers. Understanding these associations can help elucidate rest-activity patterns that place young children at risk for desynchronized circadian patterns that ultimately place them at risk for developing diabetes, obesity, and certain cancers independent of overall exposure.

Methods: A sample of 64 healthy toddlers living in socioeconomically low resourced communities wore an actigraph for 9 days and nights. Rest-activity patterns were generated from cosinor analysis (MESOR, amplitude, acrophase) and non-parametric circadian rhythm analysis (IS: interdaily stability; IV: intradaily variability). Chronic stress was measured by hair cortisol. We examined the associations between toddlers’ rest-activity patterns and log-transformed hair cortisol levels with Pearson correlation coefficients.

Results: The sample included 64 toddlers (Mean age=14.84 months, SD=2.72; 61% female). The children lived predominantly in single (70%), low income (86% income under $40,000) households. Overall, there was large variability in activity between days indicated by a low: IS=.02. There was a low level of fragmentation of the sleep-wake rhythm (IV=.27). The MESOR mean was 268.83 (SD=83.15) and amplitude mean was 249.53 (SD=87.55) with boys slightly but non-significantly higher. The mean hair cortisol level was 118pg/mg (SD=174.87) with boys non-significantly higher. Overall, hair cortisol was not associated with rest-activity patterns. However, there were significant sex differences; increased activity was associated with increased hair cortisol levels in boys (MESOR: r=.47, p=.02; Amplitude: r=.51, p=.01) and lower hair cortisol in girls (MESOR: r=-.27, p=.09; Amplitude: r=-.35, p=.03)

Conclusion: Our findings suggest that rest-activity patterns are similar among boys and girls but their patterns have an opposing relationship with chronic stress. Future studies should consider the unique socioecological influences on boys and girls and incorporate longitudinal analysis. Interventions to improve sleep and buffer toxic stress may require consideration of children’s gender.

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0247
RELATIONSHIPS BETWEEN CHANGES IN SLEEP AND GESTATIONAL WEIGHT GAIN AMONG PREGNANT WOMEN
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Introduction: Few studies have examined the relationship of objective sleep with gestational weight gain (GWG). We examined associations among actigraphic sleep and GWG rate over the 2nd trimester of pregnancy. We hypothesized that poor sleep early in the 2nd trimester and deterioration in sleep across the 2nd trimester would be associated with greater GWG rate.

Methods: In a pilot study of 12 pregnant women (M age=29.6±5.9y; M gestational age=15 weeks, range=13-17), wrist actigraphy data and GWG were collected three times across the 2nd trimester. Weight was collected at baseline, week 7, and week 13. Rate of GWG (i.e., total weight gain divided by total weeks in the study) was calculated over the study period and between visits. Actigraph data were collected during weeks 1-3 (21 days), 6-7 (14 days), and 12-13 (14 days). Average nocturnal total sleep time (TST) and sleep efficiency (SE) were derived for each time period and changes in average TST and SE over the study period and between study visits were calculated. Correlations were computed.
Results: Average GWG rates over the study period, weeks 1-7, and weeks 8-13 were 0.53±0.19, 0.58±0.23, and 0.48±0.23 kg/week, respectively. Average TST and SE early in the 2nd trimester (weeks 1-3) were 439.7±53.1 min and 83.9±4.3%, respectively. Average changes in TST and SE across the study period were 10.8±46.0 min, (range:-55.8-100.7) and -0.5±3.6% (range:-8.3-6.0), respectively. Greater GWG rate was significantly associated with reduced TST across the study period (r=-.76, p =.004). Greater GWG rate in the 1st half of the 2nd trimester was significantly related to decreases in TST in the 2nd half of the 2nd trimester (r=-.79, p=.006). There were no other significant relationships among the study variables.

Conclusion: In a sample of pregnant women, higher GWG rate early in the 2nd trimester was significantly associated with decreases in objective TST across the 2nd trimester. Poor sleep may be a sequela rather than a risk factor for excessive GWG. The impact of this relationship on maternal, labor, delivery, and child outcomes is uncertain.

Support (If Any): N/A

0248

STRESS, SLEEP, AND COPING SELF-EFFICACY IN ADOLESCENTS
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Introduction: Adolescence, particularly the transition to high school, is a period of development characterized by high stress and poor sleep. Bidirectional associations between stress and sleep have been established in adult populations, where a downward spiral of stress leading to worse sleep quality leading to increased stress impair socioemotional function and has serious consequences for mental health. It is not clear whether a similar spiral is evident in teenagers, and if so, what factors might interrupt this cycle. In the present study, we examined the role of coping self-efficacy: the belief in one’s capacity to cope with stresses and challenges.

Methods: In a sample of 381 9th graders, we tracked the temporal dynamics of self-reported stress, sleep quality, and coping self-efficacy in daily diary surveys across two school weeks using time-lag and cumulative multilevel models.

Results: We found that sleep quality on a given night influences next-day perceived stress and coping self-efficacy. We also found bidirectional associations, such that perceived stress and coping-self-efficacy on a given school day predicted sleep quality that night. Finally, we found that these effects accumulated over the course of the school week, so that nights of poor sleep showed larger associations with perceived stress and coping self-efficacy by Thursday and Friday. Likewise, accumulated stress and low coping self-efficacy across the school week magnified the likelihood of poor sleep quality by the end of the week. Following a weekend, cumulative sleep quality continued to impact stress and coping self-efficacy on the next Monday; however, accumulated levels of stress and coping self-efficacy no longer predicted sleep quality in a new school week.

Conclusion: This study unpacks the complex dynamics of interacting variables in a vulnerable developmental period. Our results reveal the crucial impact of students’ own beliefs in their coping skills to either exacerbate or alleviate a destructive cycle of stress and poor sleep.

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0249

NIGHT SLEEP AND NAPPING TOGETHER CONSOLIDATE INFANTS’ MOTOR PROBLEM SOLVING.
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Introduction: In adults, napping and night sleep have an additive effect on motor learning (Korman et al., 2007). Infant research typically tests the impact of either napping or night sleep on learning, but there may be a similar cumulative pattern (Seehagen et al., 2015). However, because infant sleep differs from adult sleep in duration, timing, and structure (Ednick et al., 2009), and possibly in functions, we cannot generalize across ages. The current study examines the roles of napping and night sleep on motor problem solving in infancy.

Methods: Thirty-two infants, within a week of giving up crawling, stood upright at the entrance of a tunnel. Navigating the tunnel requires a postural shift from walking to crawling, which is taxing for new walkers. A strict 15-step training protocol controlled when and how to highlight relevant details of the task. The session ended once infants exited the tunnel or exhausted the protocol. Infants were tested on this task again, after their nap (n=9), after a delay without a nap (n=13), or immediately (n=10) after training. They also received it the next morning after night sleep. The primary outcome measure for all sessions was the number of prompts.

Results: Proportion of change in prompt number from training to test and test to follow-up were calculated. The immediate group showed a 40% improvement from training to test, but a 35% decrement from test to follow-up. The nap group showed a 20% decrement from training to test, but a 47% improvement from test to follow-up. The no nap group showed a 71% decrement from training to test, and a further decrement of 9% from test to follow-up.

Conclusion: Surprisingly, the nap group did not improve from training to test; however, they were the only group to improve after night sleep. In contrast, neither of the other groups demonstrated long-term improvements. Thus, it appears that napping and night sleep have an additive effect.

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0250

GENDER MODERATES THE RELATIONSHIP BETWEEN YOUTH SLOW WAVE SLEEP AND EMOTIONAL SYMPTOMS
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Introduction: Altered sleep architecture has been associated with emotional disorders (e.g., anxiety and depression). However, research on sleep architecture and symptoms in youth is limited, with inconsistent results (Ivanenko, Crabtree, & Gozal, 2005; McMakin & Alfano, 2015). Adult studies have found reliable gender differences, with a greater decrease in slow wave activity for depressed men but not women (Armitage & Hoffmann, 2001). Research has yet to examine gender differences in child samples.

Methods: Participants were 30 healthy pre-pubertal children with no psychiatric disorders (ages 7-11; M = 9.33, SD = 1.24; 70%

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0251
IS DYSREGULATED SLEEP IN EARLY CHILDHOOD ASSOCIATED WITH DAYTIME DYADIC INTERACTIONS?
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Introduction: In early childhood, successful sleep is often conceptualized as a dyadic process which reflects child, caregiver, and contextual elements. Promoting optimal sleep often includes educating parents and structuring parent-child interactions. However, previous studies rarely assess dyadic interactions prior to treatment and do not report consistent robust associations between parent-child interactions and sleep dysregulation. The present study aims to expand our developmental understanding of sleep dysregulation within a family context by examining daytime dyadic interactions in children with regulated and dysregulated sleep.

Methods: As part of a longitudinal study on pediatric sleep and development, 50 children wore actigraphs for 3-7 nights and participated in a video-recorded mother-child play interaction, at their 18 or 24-month laboratory visit. Each child’s sleep was classified as regulated (REG; M = 30) or dysregulated (DYS; M = 20) based on the following criteria: (1) slept less than AASM recommendations for their age, (2) woke for more than an hour for at least two nights, and/or (3) had morning rise or bedtime that varied by more than two hours. Using existing coding schemes, play interactions were coded for instances of dyadic synchrony and responsiveness, as well as rated for joint engagement. Children also completed a standardized assessment to index any developmental concerns.

Results: A series of ANCOVAs were conducted, with terms for child sex, maternal education, and developmental concerns, and did not reveal significant group differences across the measured dyadic constructs. However, descriptively the DYS group engaged in less dyadic synchrony, infant responsiveness, maternal responsiveness, and joint engagement, respectively.

Conclusion: Daytime dyadic interactions (or patterns of caregiver social interactions) may influence child sleep regulation but this study did not find robust associations. These findings may reflect our sample composition (e.g., families with moderate/high socio-demographic resources), a relatively small sample, or may suggest that the impact of daytime dyadic interactions is modest when considering the large number of factors that influence sleep dysregulation. Future studies should isolate key dyadic factors by focusing on nighttime parent-child interactions and the interactions between dyadic and contextual factors.
Introduction: There is a general trend to move out of the city and into suburbs to start a family. This transition is based on a number of factors including larger housing amenities and a supposedly increased quality of life. One question that has not been asked is how different types of residential living environments might affect a child's sleep. The present study examines the effects that different types of residences; detached single-family homes, attached single-family homes, small apartment buildings, and large apartment buildings, have on sleep.

Methods: Parents of 306 preschool-aged children (143 female, M=51.73 months) completed a demographic questionnaire, which probed parents’ employment status and education level, type of residence, and household income. In addition, children wore actigraphy watches to objectively record their sleep and activity levels over the course of two weeks.

Results: Across the sample, 59.15% of children lived in detached single-family homes, 16.34% lived in attached single-family homes, 8.17% lived in apartment buildings with two to three homes, and 16.34% lived in larger buildings containing four or more apartments. With regard to sleep quality, there was a significant main effect of residence type on time spent asleep at night on the weekend (F(3,301)=3.657, p=.013), with children in detached single-family homes sleeping significantly longer than attached single-family homes or buildings with four or more apartments after controlling for socio-economic status (SES) (pairwise ps<.05). Additionally, residence type had a significant effect on time spent in bed after controlling for SES (F(3,301)=2.720, p=.045), with children sleeping in detached single-family homes staying in bed for longer than their counterparts living in large apartment buildings (ps<.05).

Conclusion: The findings suggest that type of residence, particularly detached single-family homes, have a significant effect on sleep for preschoolers. Further data should be collected to create a balanced sample size across the different kinds of residences, and other data, such as decibel levels within the home could give insight into whether proximity and volume of neighbors is driving the correlation.

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0254 CO-SLEEPING AND SLEEP QUALITY IN PRESCHOOL CHILDREN: DO CONSISTENCY AND PARTNER MATTER?
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Introduction: Bed sharing during childhood is not uncommon; however, it is unclear how different bed-sharing practices affect children's sleep. While studies have explored relations between habitual parent-child bed sharing and sleep, less is known about how differences in the consistency of bed sharing, as well as diverse co-sleep partners, might influence sleep. Thus, the present study investigated how different bed-sharing frequencies and partners might impact the effects of co-sleeping on child sleep.

Methods: Parents of 521 preschool-aged children (235 female, M=51.6 months) completed child sleep diaries over 16 days. Diaries included co-sleeping questions (presence/ frequency of bed sharing, who children shared with), along with sleep duration and timing entries. From parents’ reports, children were identified as habitual bed-sharers, inconsistent/occasional bed-sharers, solitary sleepers, or “other” (children who routinely woke to change sleeping spaces; this category was excluded). Bed-sharers were further classified as sleeping alongside parents, siblings, or other (e.g. pets). Actigraphy was collected for a subset of children (n=338), and researchers compared actigraphy-derived measures (sleep durations, WASO) among different co-sleep groups.

Results: Across the full sample, 21.3% of children were habitual bed-sharers; 10.9% were occasional; and, 63.5% were solitary sleepers. Bed-sharers most often shared with parents only (47.7% of habitual, 54.4% of occasional), though sibling-only sharing was also prominent among habitual bed-sharers (27.0%). Regarding sleep quality, co-sleeping frequency marginally predicted overnight sleep durations (F(2,318)=3.03, p=.050), with habitual bed-sharers sleeping less than solitary sleepers. Co-sleeping significantly predicted nap durations (F(2,293)=3.22, p=.042), with habitual bed-sharers napping longer than solitary sleepers and occasional bed-sharers (ps<.05). In contrast, occasional bed-sharers had greater overnight WASO compared to habitual bed-sharers and solitary sleepers (main effect: F(2,318)=3.73, p=.025; pairwise ps<.05). No sleep differences were found between children who habitually shared beds with parents vs. siblings (ps>.10).

Conclusion: Our findings suggest that different co-sleeping patterns relate differentially to sleep quality. Further analyses will explore whether napping and overnight sleep interact to alter overall sleep efficiency among co-sleepers, and future studies should determine how experimental manipulations of co-sleeping influence sleep quality.

Support (If Any): NIH R01 HL111695.
**0256**

**INFLUENCE OF LIKELY NOCTURNAL WAKEFULNESS ON 24-HOUR PATTERNS OF VIOLENT CRIME IN ADULTS AND JUVENILES**

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**Introduction:** Being awake at night is associated with cognitive/affective dysregulation. Recently, it was found that nocturnal wakefulness is also a risk factor for completed suicide (self-harm). The present analysis examines whether nocturnal wakefulness is also a risk factor for violent crime (harm to others).

**Methods:** Data were obtained from the National Archive of Criminal Justice Data and included rates of murder, violent sexual assault, robbery, aggravated assault, and simple assault across each hour of the day in 2016. These data were aggregated from law enforcement agencies in 38 states and Washington DC. Data were examined separately for adults (>18) and juveniles (<18).

**Results:** Without adjustment for likelihood of being awake, violent crime peaks at 7-10pm in juveniles and 2-4am among adults. This pattern changed after adjustment, revealing increased likelihood at night. For adults, more violent crime than would be expected by chance was observed at 23:00 (SIR=1.56), 00:00 (SIR=2.44), 1:00 (SIR=2.97), and 2:00 (SIR=2.86), and also 15:00 (SIR=1.43). For juveniles, more violent crime than would be expected by chance was observed at 22:00 (SIR=1.84), 23:00 (SIR=3.14), 00:00 (SIR=5.71), 1:00 (SIR=8.69), 2:00 (SIR=10.33), 3:00 (SIR=8.04), 4:00 (SIR=2.87).

**Conclusion:** For adults, more violent crimes than expected occurred at night, peaking around 1-2am. For juveniles, there was also an elevated likelihood of crimes at night, peaking slightly later (2-3am). This is in contrast to unweighted crime statistics, which show peaks in the early afternoon in adults and early evening for juveniles. These data lend further credibility to the concept that there may be a biological vulnerability to cognitive/affective dysfunction when awake at night.

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**0257**

**PRESCRIPTION SLEEP AID USE IMPACTS FAMILY FUNCTIONING FOR FAMILIES WITH GRANDPARENTS RAISING GRANDCHILDREN**

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**Introduction:** One in ten grandparents live with their grandchildren (GRG). GRGs are more likely to live in poverty, work at least part time, and have disability status than grandparents with no coresident grandchildren. No studies have explored if prescription sleep aid use for GRG may be related to the child’s sleep or family functioning. This study examines prescribed sleep aid use for GRGs and how it may be related to the child’s sleep and family functioning.

**Methods:** This study used twelve month follow up data from the KIN-Tech 2012 Fostering Connections federal demonstration project funded by the US Children’s Bureau. A random selection of one hundred GRGs with self-reported twelve month follow up assessments including the Protective Factors Survey (Counts, 2010) to measure family functioning for themselves and the children in their care. ANOVAs were used to compare prescription sleep aid use, chronic conditions with family functioning.

**Results:** Participants in this study included grandmothers (88%) from low income households (m=$24,000), 46 years of age, single (66%), African American (46%). Forty-one percent (n=43) of caregivers reported troubled sleep, with 41% (n=43) indicated that caregiving impacts their sleep. Twenty five percent of caregivers (n=25) take sleep aids. Caregivers with Asthma [F(2, 90)=4.11, p<.01] and other chronic conditions [F(2, 89)=3.53, p<.05] are more likely to raise children who have been prescribed sleep aids, especially medication for ADHD. Caregivers who are prescribed sleep aids are more likely to raise children who are prescribed sleep aids [F(2, 92)=3.13, p<.05] and report less resilient family functioning [F(2.92)=4.1, p<.01].

**Conclusion:** One of first studies to examine how GRG prescribed sleep aid use is related to prescribed child sleep aid and overall family functioning. Results suggest that caregivers who are prescribed sleep aids are more likely to suffer from chronic conditions and raise children who are prescribed sleep aids and have less resilient family functioning. Future studies need to examine the impact of sleep aids that are being used and how they impact family functioning on a day-to-day level.

**Support (If Any):** US Children’s Bureau

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**0258**

**SECONDHAND SMOKE EXPOSURE IN CHILDHOOD IS ASSOCIATED WITH SLEEP DURATION DURING CHILDHOOD BUT NOT DURING ADOLESCENCE**

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**Introduction:** Secondhand smoke (SHS) exposure has been associated with increased sleep disturbance but not sleep duration among children with asthma, and among adolescents a greater frequency of restless sleep and decreased sleep duration. Prior studies, however, did not examine whether SHS exposure during childhood was associated with longitudinal sleep health. This study investigated both the cross-sectional and longitudinal associations between childhood SHS exposure and sleep duration and disturbance during childhood and middle adolescence.

**Methods:** Survey data from the age 9 and 15 waves (n=2869) of the Fragile Families and Child Wellbeing Study, a longitudinal birth cohort from 20 US cities, were analyzed. At age 9, parents reported whether their child was exposed to SHS, the child’s average amount of weekday sleep duration (hours), and whether the child had trouble sleeping. At age 15, teens self-reported habitual school-day
time in bed (hours) and the number of nights they typically had problems falling or staying asleep. We tested for associations between age 9 SHS exposure and sleep duration and disturbance at ages 9 and 15 using regression analyses. Adjusted for the child’s sex, age, race, childhood diagnosis of asthma, and baseline measures of family structure, household income, and mother’s education level.

**Results:** Exposure to SHS (11.9%) was associated with approximately 15 minutes shorter weekday sleep duration at age 9 (b= -0.262, p<0.001), but was not longitudinally associated with shorter habitual time in bed at age 15. Exposure to SHS was also associated with more nights experiencing trouble falling asleep at age 15 (b=0.269, p=0.022), but was not associated with trouble sleeping at age 9 or trouble staying asleep at age 15.

**Conclusion:** Our findings indicate that childhood SHS exposure is associated cross-sectionally with shorter sleep duration in childhood and longitudinally with trouble falling asleep (even after adjustment for age 9 sleep disturbance and diagnosis of asthma). Future research should investigate potential longitudinal effects of SHS exposure on sleep health.

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**0259**

**REDUCTION OF THE APNEA-HYPOPNEA DURATION AMELIORATES ENDOTHELIAL DYSFUNCTION, VASCULAR INFLAMMATION, AND SYSTEMIC HYPERTENSION IN A RAT MODEL OF OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** We aimed to investigate the effect of the apnea-hypopnea duration on obstructive sleep apnea (OSA) and related sequelae in a rat model.

**Methods:** A novel rat model of OSA, including a body container, head cover, air bag, piston, and controller, was used to mimic the main physiological aspects of OSA. Wistar rats were randomized to six groups according to different treatments for 4 weeks: (1) OSA (apnea for 60 s in a 90-s window of breathing [60s/90s] with anesthesia), (2) OSA 30s/90s with anesthesia, (3) partial recovery (60s/90s for 2 weeks, followed by 15s/90s for 2 weeks with anesthesia), (4) complete recovery (60s/90s for 2 weeks with anesthesia, and then normal breathing for 2 weeks), (5) sham (normal breathing in the device with anesthesia), and (6) control group (normal breathing, normal cage, no anesthesia). We recorded blood pressure, endothelial function, left ventricular function, and inflammation at different time points.

**Results:** Vascular inflammation and endothelial dysfunction were observed in OSA models. A longer apnea-hypopnea duration induced worse systemic inflammatory and endothelial dysfunction. Partial and complete recovery reversed vascular inflammation and endothelial dysfunction, and delayed development of hypertension. The left ventricular weight/body weight ratio was significantly higher in the OSA (60s/90s) group compare with complete recovery, sham and control group, which persisted despite partial recovery (p<0.05).

**Conclusion:** A longer apnea-hypopnea duration is related to worse systemic inflammatory and endothelial dysfunction, and hypertension and cardiac remodeling. These side effects can be treated by complete recovery and partial recovery can achieve similar therapeutic effects to complete recovery. These results indicate that time parameters for assessing OSA, such as the apnea-hypopnea duration, should be considered instead of the apnea-hypopnea index.

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**0260**

**SHIFTING LATE- AND SHORT-SLEEPING TEENS EARLIER**

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**Introduction:** A large majority of adolescents go to bed too late to get sufficient (>8h) school-night sleep; this is partly driven by delayed circadian clocks. In this ongoing study, we are testing whether one weekend of morning bright light and a gradual advance of school-night bedtimes can advance the circadian system and increase sleep duration in high school students.

**Methods:** So far, 32 adolescents (14.6-17.9 years; 16 females) with self-reported short school-night sleep (<7h) and late bedtimes (school-night average ≥ 23:00; non-school average ≥ midnight) completed a 31-day protocol during the school year. After a 2-week baseline of usual sleep at home, participants live in the laboratory for a weekend, during which the dim light melatonin onset (DLMO) is measured. For the next two weeks, the intervention group (n=15) is instructed to advance school-night bedtime from their own baseline: 1h earlier during the first week and 2h earlier in the second week. Wake times remain unchanged. During the intervening weekend, intervention participants receive bright light in the lab on both weekend mornings (~6000 lux; 2.5 h intermittent light) and 8.5-h sleep opportunities each night. A control group (n=17) is given no instruction about bedtimes and does not attend the bright light weekend. DLMO is measured during the final (third) weekend in all participants. Actigraphic sleep is collected throughout.

**Results:** Intervention DLMOs are advancing more than controls (50.4±49.8 mins vs. -7.2±49.2 mins; t(30)=3.3, p=.003). By the final weekend, about half (n=8) of the intervention group have DLMOs > 9.5h before their school-day wake time (early enough to facilitate sufficient sleep). The intervention group is increasing total sleep time by 68 mins by falling asleep 89 mins earlier than baseline. The control group shows no changes in sleep duration nor fall asleep time.

**Conclusion:** These data suggest that one weekend of morning bright light plus earlier school-night bedtimes can advance circadian phase and increase sleep time. Variability in responses, however, suggests that some adolescents need to phase advance more to get sufficient (>8h) school-night sleep; this is partly driven by delayed circadian clocks. In this ongoing study, we are testing whether one weekend of morning bright light and a gradual advance of school-night bedtimes can advance the circadian system and increase sleep duration in high school students.

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ASSOCIATIONS BETWEEN SLEEP AND MENTAL HEALTH IN CHILDREN AGED 9 AND 10 YEARS

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Introduction: As children approach adolescence, they are at increased risk for mental health disorders, particularly girls. Sleep disturbances may contribute to this increased risk. Here, we investigated associations between sleep and mental health in a nationally-representative sample of 4521 US children (2146 female, aged 9-10 years) in the Adolescent Brain Cognitive Development (ABCD) study.

Methods: Measures of child sleep disturbance (Disorders of Initiating and Maintaining Sleep (DIMS), Disorders of Arousal (DA), Sleep-Wake transition Disorders (SWTD) and Disorders of Excessive Somnolence (DOES)) and ‘typical’ total sleep time (TST) (i.e. number of hours slept on most nights in the past six months) were obtained from the parent-report Sleep Disturbance Scale (Data Release 1.1). Parent-report measures of child mental health (anxiety, depression, internalizing and externalizing behaviors, stress) from the Child Behavior Checklist and number of hours spent using media devices (screen-time) and pubertal development scale (PDS) were also included.

Results: After controlling for PDS, parent education level, race, sex and ethnicity, DIMS and DOES were most associated with depression symptoms (β = 0.51 & β = 0.45) and weekday screen-time (β = 0.09 & β = 0.04). SWTD were most associated with anxiety symptoms (β = 0.35) and DA were most associated with internalizing behaviors (β = 0.25). Models accounted for 7-28% of the variance in each case. Compared to white participants, black participants experienced greater DIMS and SWTD and shorter TST. Lower parental education attainment was also associated with shorter TST while longer TST was identified for Hispanic, compared to non-Hispanic participants, and for girls compared to boys. Finally, more advanced PDS was associated with greater DOES, DA and SWTD and shorter TST.

Conclusion: Here we identified significant demographic differences in TST and associations between mental health symptoms and sleep disturbances in a large sample of 9-10 year olds. Future longitudinal analysis of data from the ABCD study, the largest ever, longitudinal study about adolescent development, will allow investigation of how TST and sleep quality may mediate or predict the onset of mental health disorders during adolescence.

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0264 CHILDHOOD ADVERSITY AND ADULT SLEEP: THE ROLE OF DEPRIVATION AND THREAT
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Introduction: There are robust associations between childhood adversity (CA) and poor physical health in adulthood. Sleep is a possible mechanism linking CA to adult health. The prevailing approach for testing associations between CA and adult sleep offers little insight into which aspects of CA are related to specific sleep outcomes. To better understand associations between CA and adult sleep outcomes, we tested a conceptual model that distinguishes between threat (e.g. physical, emotional and sexual abuse), and deprivation (e.g. emotional and physical neglect).

Methods: Participants (N= 79; M age = 27.48(SD=6.53); 68% Female) were screened for insomnia disorder, mental health conditions and physical illnesses. Participants completed demographic and depressive symptom measures, along with the Childhood Trauma Questionnaire, a self-report retrospective measure that captures dimensions of threat and deprivation. Sleep duration, latency, efficiency, wake after sleep onset (WASO), and secondary sleep onset latency (SSOL) were averaged across 3 consecutive days of wrist actigraphy and sleep diaries. Daily ratings of sleep quality, non-restorative sleep, alcohol use and current stress were averaged across 3 days. Structural equation modeling (SEM) was used to account for missing data. All SEM models included correlated measures of deprivation and threat along with age, sex, BMI, alcohol use, daily stress, and depressive symptoms.

Results: In SEM models, threat was significantly positively associated with non-restorative sleep (b = .046, p <.001) and sleep quality (b=.025, p=.008), but unrelated to all other diary-based and actigraphy-based sleep measures (ps > .05). Deprivation was significantly negatively associated with diary-based WASO (b = -.076, p = .003) and SSOL, but unrelated to all other diary-based and actigraphy-based sleep measures (ps > .05).

Conclusion: These results begin to clarify associations between related, but distinct forms of CA and specific adult sleep outcomes. Identifying specific pathways linking CA and adult health is critical for developing interventions and mitigating future health risk.

Support (If Any): This study was funded by a Funding Incentive Seed Grant from the University of Utah, the Mind and Life Institute, and Division 38 of the American Psychological Association.

0265 CHILDHOOD SLEEP PATTERNS PREDICT MALADAPTIVE RESPONSES TO HURRICANE HARVEY IN ADOLESCENCE
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Introduction: Research in adults suggests that certain sleep characteristics prior to trauma exposure predicts maladaptive post-trauma outcomes. However, research has yet to consider the influence of premorbid sleep in influencing child responses to trauma.

Methods: This study included 86 pre-pubertal children residing in Houston, TX several years before and during Hurricane Harvey. At time 1 (ages 7-11) children completed one week of actigraphy and one night of polysomnography. Approximately 3 years later, 6-9 months after the hurricane, youth reported on their hurricane exposure/stress (e.g., displacement, feelings of safety) and provided reports of their emotional reactions (valence and arousal) to a series of hurricane-related photos during an in-lab experimental task.

Results: Multiple regressions controlling for the time between assessments indicated less non-rapid eye movement (NREM) stage 3 sleep was associated with greater stress during the hurricane (p = .01) and marginally greater negative valence in response to flood images (p = .098). Longer childhood sleep duration (p = .01) and sleep onset latency (SOL; p = .02) were both associated with greater exposure to hurricane-related stressors. An interaction with REM sleep (p = .005) suggested hurricane-related stress was associated with greater reactivity to images (higher negative valence ratings) but only for those with greater REM sleep (p = .004). A similar interaction emerged where greater exposure was associated with greater reactivity for those with high REM (p = .03). Similarly, exposure to hurricane-related stressors was associated with higher arousal, but only for those with higher pre-hurricane SOL (p = .03). Johnson-Neyman results suggest that this effect was significant for those with a SOL of approximately 40 minutes or longer.

Conclusion: Consistent with findings in adults, specific sleep characteristics in childhood appear to increase risk for maladaptive responses to trauma during the sensitive, transitional period of adolescence. These findings support the role of sleep as a possible prevention target for those at-risk for experiencing trauma.

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0266
ACTIGRAPHY-BASED MEASUREMENT OF SLEEP AND DIURNAL RHYTHMS IN SUBJECTS WITH AGE-RELATED MACULAR DEGENERATION
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Introduction: Age-related Macular Degeneration (AMD) is the leading cause of vision loss in adults over fifty. This condition damages the macula of the eye, a pigmented area in the central retina bearing rods in the parafovea subregion as well as a dense population of cone photoreceptors within the fovea centralis. While it is known that the macula supplies image-forming data to the visual cortex required for high-level acuity, much less is known about what contributions this region makes to non-image forming functions such as circadian photentrainment or how macular light input influences the wake/sleep cycle. Such contributions are likely given the interconnections among rods, cones, and intrinsically-photoseensitive retinal ganglion cells, which are the conduits for transmitting environmental light information to the pacemaker in the suprachiasmatic nucleus. In the current study, circadian robustness and sleep were quantified in AMD patients using in-home actigraphy.

Methods: Patients with a diagnosis of intermediate or advanced dry AMD in at least one eye (the other eye could have any stage of AMD) were recruited from an ongoing study in Arizona under the direction of one of the authors (RWS). Each subject was administered a sleep/chronotype survey and given a Spectrum Pro-Plus Actiwatch to wear for 12 consecutive days of recording. Actiware files containing 1440 points of data/24 h were plotted in time series and analyzed using ClockLab or Rsstudio for assessment of various sleep metrics and quantitative description of diurnal rhythms.

Results: These are preliminary results from a small community-dwelling sample (n = 9). Data collection will be completed by Summer 2019. Preliminary findings suggest that people with AMD do not have impairments in the amplitude or consistency of their diurnal activity rhythms as measured by nonparametric rhythm analyses and are capable of maintaining consolidated 16:8 24-h wake/sleep cycles that are consistently phase-aligned from one day to the next.

Conclusion: AMD patients show no obvious sleep or circadian deficits. Other analyses are forthcoming and will consider the extent and localization of retinal pathology.

Support (If Any): UA Office of Research and Discovery

0273
THE COMBINED ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND INSOMNIA SYMPTOMS WITH PHYSICAL FUNCTION IN OLDER ADULTS
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Introduction: Physical function is critically important for older adults. Although physical function is influenced by physical activity, healthy sleep may also influence physical function, either independently or synergistically with physical activity. The aim of this analysis was to examine the association between the combination of physical activity and sleep with physical function.

Methods: Using data from the 2017 National Health and Aging Trends Study, 4382 adults aged 65 years and older were included in these cross-sectional analyses. Respondents were categorized as physically active (PA) if they indicated walking for exercise or participation in vigorous physical activities; otherwise, they were considered physically inactive (PIA). Respondents were categorized as having insomnia symptoms (IS) if they indicated taking >30 min to fall asleep or having difficulty returning to sleep after awakening on a regular basis; otherwise, they were classified as having normal sleep (NS). Physical function was assessed with the Short Physical Performance Battery (SPPB), with scores ranging from 0-12. Analysis of covariance examined SPPB scores according to the combination of physical activity and sleep categorizations following adjustment for age, race, gender, body mass index, depression,
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anxiety, and number of chronic health conditions. Due to a significant interaction, analyses were stratified based upon whether individuals had fallen in the past year.

Results: Mean ± standard error SPPB score was 8.1 ± 0.1 in the full sample. In those who had not fallen in the last year (n=2909), both PA groups (PA+NS: 9.5 ± 0.1; PA+IS: 9.5 ± 0.1) had significantly higher SPPB scores than their PIA counterparts (PIA+NS: 8.5 ± 0.2; PIA+IS: 7.9 ± 0.3; P < .001 for each PA-PIA comparison).

SPPB scores did not differ between PA+NS and PA+IS (P = .19) or between PIA+NS and PIA+IS (P = .54). Similar results were found in those who had fallen in the last year.

Conclusion: Active older adults have higher physical function than their inactive counterparts, regardless of sleep complaints. Future research should explore longitudinal associations with objective physical activity and sleep measures and examine effects of physical activity and/or sleep interventions on physical function.

Support (If Any): NIH grants UL1TR001857, U01AG032947

0269 EVALUATION OF SLEEP IN A BIRTH COHORT STUDY: INITIAL RESULTS

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Introduction: Sleep disorders are very prevalent. The most common conditions are: insomnia, obstructive sleep apnea (OSA), excessive sleepiness and Willis-Ekbom's Disease (DWE). Studies of birth cohorts bring the possibility of conducting research with a temporal window that begins at birth and extends to the present, representing a unique opportunity to understand the possible mechanisms that lead to sleep-related disorders. In these initial findings, our objective was to evaluate sleep quality, excessive sleepiness, OSA risk and DWE prevalence.

Methods: In this initial analysis of the study we carried out a temporal window that begins at birth and extends to the present, representing a unique opportunity to understand the possible mechanisms that lead to sleep-related disorders. In these initial findings, our objective was to evaluate sleep quality, excessive sleepiness, OSA risk and DWE prevalence.

Results: Of the 390 participants, 54.9% were women. This was followed longitudinally from birth. In 2017, they were reevaluated for the following outcomes: OSA risk (STOP-BANG questionnaire), sleep quality (Pittsburgh Sleep Quality Index), excessive drowsiness (Epworth Sleepiness Scale), and DWE prevalence with a one year question.

Conclusion: Our results demonstrate the development of oxidative stress in patients with insomnia in both Caucasian and Asian menopausal women.

Support (If Any): No

XIII. Sleep and Aging, Sleep and Gender

0270 LIPOPEROXIDATION PARAMETERS IN MENOPAUSAL WOMEN OF THE TWO ETHNIC GROUPS WITH INSOMNIA

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Introduction: 35-60% of menopausal women complain about certain problems with sleep. It is well known, that sleep loss may cause oxidative stress. At the present time, it is known that lipid peroxidation processes in both healthy individuals and in pathological conditions have ethnospecificity. The aim of this work was assessment of the lipid peroxidation processes in Caucasian (ethnic group - Russian) and Asian (ethnic group - Buryat) menopausal women with insomnia.

Methods: 181 menopausal women divided into Caucasian (n=91) and Asian (n=90) groups were examined. All women underwent clinic-anamnestic examination. Polysomnography and specialized questionnaires for the assessment of sleep disorders were used. Each ethnic group was divided into control (with insomnia) and main group (with insomnia). Lipid peroxidation parameters (conjugated dienes (CDs), malonyl dialdehyde (MDA)) by spectrophotometric methods were determined.

Results: In Caucasian patients compared to control was observed accumulation of lipid peroxidation products both in perimenopause (CDs) (by 25% (p<0.05)) and in postmenopause (CDs, MDA) (by 42% and 21% respectively (p<0.05)). Also, a higher content of CDs (by 37% (p<0.05)) in perimenopause and MDA (by 51% (p<0.05)) in postmenopause in Asian patients compared to control was found.

Conclusion: Our results demonstrate the development of oxidative stress in patients with insomnia in both Caucasian and Asian menopausal women.

Support (If Any): No

0271 ULTRADIAN CYCLE OF SLOW-WAVE ACTIVITY IN OLDER ADULTS.

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Introduction: Spectral analysis of slow wave activity (SWA; 0.5-4 Hz), instead of scored slow wave sleep (SWS; N3), has been used as more sensitive marker of cognitive function in older adults. SWA is thought to be more predominant in the first ultradian cycle due to its homeostatic dependency. However, little is known about the ultradian cycle of slow wave activity in this age group. In this study, we examined whether first ultradian cycle of SWA is correlated with ultradian cycle determined by REM sleep latency.

Methods: Participants were 390 community-dwelling healthy older adults. In order to define the first ultradian cycle of SWA, a generalized additive model was used to generate a smoothed estimate of the relative SWA power (0.5-4Hz band) progression for each individual over the first 300 epochs (150 minutes). Spearman’s rank correlation rho was performed to examine the correlation between the first post-elevation nadir of relative SWA power and REM latency.

Results: Of the 390 participants, 54.9% were women. This was non-obese (BMI 26.9 ± 9.0 kg/m²) cohort. Mean age of participants was 72.8 ± 8.0 years. The average distribution of sleep stages was within the range expected for a single-night sleep
0272  
SLEEP LOSS MAY MESS WITH PREMENSTRUAL SYNDROMES IN DYSMENORRHEIC WOMEN  
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Introduction: Recent EEG and fMRI studies showed that even just one night of sleeplessness tempers brain’s capacity to differentiate emotion neutrality. Dysmenorrheic women, who undertake recurrent menstrual pain stimulation, often show higher pain sensitivity and a lower sleep quality throughout the menstrual cycle (Iacovides et al. 2009; Hung et al., 2017). In view of the possible long-term effect of sleep loss on dysmenorrheic women's cognitive control of emotion, this study explored if dysmenorrheic women have higher proportion of premenstrual syndromes and their relation with sleep quality.

Methods: Pittsburgh sleep quality scale (PSQI), Ford insomnia response to stress responses (FIRST) scale, insomnia severity scale (ISS) and Epworth sleepiness scale (ESS) were administered in women with and without primary dysmenorrhea (n=60/group; matched for age, age at menarche, BMI, morningness-eveningness, and menstrual cycle length). Sleep diary and daily severity scale (for premenstrual syndrome measurements) were also recored by subjects throughout the menstrual cycle. Primary dysmenorrhea was diagnosed by a gynecologist with abdominal ultrasound.

Results: There was no group difference in PSQI or ESS scores but the proportion of subjects whose ISI score was equal to or greater than 8 (i.e. borderline of clinical insomnia) was significantly higher in dysmenorrheic than in non-dysmenorrheic women (X²[Δρ=2]=13.87, P=0.001). The mean score of FIRST was also significantly higher in dysmenorrheic than non-dysmenorrheic women (T[Δρ=1]=2.90, P=0.032). As regard to the sleep diary and daily severity of premenstrual syndromes, dysmenorrheic women, as compared with the non-dysmenorrheic, reported more waking after sleep onset, poorer sleep quality, lower alertness upon awakening, lower daytime energy and higher daytime sleepiness as well as a sever premenstrual symptoms across the menstrual cycle. Moreover, both subjective sleep quality and alertness upon awakening presented a significantly negative correlation with the premenstrual syndromes severity.

Conclusion: The long-term dysmenorrheic effect on subjective sleep perception is confirmed to negatively relate to subjective severity of premenstrual syndromes. The perpetual crappy sleep in dysmenorrhea may compromise patient’s cognitive processing, which in turns impacts their emotional reactivity to even the smallest life event.

Support (If Any): N/A
0274
DIFFERENTIAL COGNITIVE IMPAIRMENTS IN EXPERIMENTAL CHRONIC PARTIAL SLEEP RESTRICTION BETWEEN MEN AND WOMEN
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Introduction: Chronic partial sleep restriction is endemic in the general population, and few previous studies have analyzed detailed neurocognitive functional domains over a longitudinal time course of sleep restriction. We aimed to assess cognitive functioning in individuals undergoing an inpatient experimental paradigm of prolonged sleep restriction vs. control sleep.

Methods: Seventeen subjects underwent sleep restriction and a control sleep sequence in random order. The sleep restriction sequence consisted of 3 nights of acclimation (9 hours of time in bed), then a 9 night experimental phase of restricted sleep (4 hours of time in bed), followed by a 3 night recovery period of unrestricted sleep. In each phase, subjects underwent repeated sessions of neurocognitive testing (NCT) with CNS Vital Signs to determine cognitive performance. Mixed-effects regression was used to test for significant differences between sleep restriction and control sleep conditions, and explore possible differences between the sexes.

Results: Overall neurocognitive index composite score, and domain scores for cognitive flexibility and executive function were significantly lower during the restricted sequence than during the control sequence following 8 nights of sleep restriction (all p < 0.005). Men had significantly lower psychomotor and processing speed domain scores than women following 2 nights of sleep restriction (both p < 0.04). Additionally, sleep restricted men had significantly lower reaction time domain scores than women following 5 nights of sleep restriction (p = 0.035). No significant sex specific neurocognitive score differences were found during the recovery phase.

Conclusion: Partial chronic sleep restriction impairs cognitive performance, especially in men. Our findings provide further evidence demonstrating the cumulative deleterious impact of chronic partial sleep loss on cognitive functioning, and may inform patient counseling and public health initiatives to assure sufficient sleep.

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0275
AGE-RELATED CHANGES IN SLEEP-DEPENDENT PROCEDURAL LEARNING CONSOLIDATION
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Introduction: Sleep's benefit on procedural memory performance declines with age. Previous studies have investigated either underlying functional or structural neural correlates, but results are unclear. Advances in neuroimaging analysis techniques allow for combined analysis of structural and functional data, providing insights into task-related brain networks and underlying neural substrates. Here, we combine functional and structural MRI, DTI, and high-density polysomnography to investigate age-related changes in the consolidation of motor memory traces following sleep.

0276
SLEEP ATTITUDES PREDICTING SLEEP OUTCOMES: AN INTERSECTIONALITY PERSPECTIVE
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Introduction: Sleep health is emerging as a means of prevention against chronic disease and negative psychosocial outcomes. This is especially important considering that certain groups (e.g., African Americans, lower SES, women) are more likely to experience health disparities, in addition to insufficient and/or poor quality sleep. Moreover, often times these identities are not found in isolation; they intersect with other, potentially marginalized, identities. Additionally, it is also important to consider how one’s attitudes toward sleep affect sleep outcomes and how these attitudes may vary according to intersecting identities. Therefore, the purpose of the present study was to explore how the intersectionality of identities is associated with both sleep attitudes and sleep outcomes.

Methods: Participants consisted of 173 adults recruited from Amazon’s Mechanical Turk. Participants reported their age, gender, race, and SES, sleep outcomes, and sleep attitudes, which were measured via a psychometrically validated scale, the Charlotte Attitudes Towards Sleep Scale.

Results: A significant three-way interaction of gender by SES by sleep attitudes was found (b=-.13, p<.05, ΔR²=.21) predicting sleep duration only on weekends, such that higher SES males with less favorable sleep attitudes reported more weekend sleep, whereas women with higher SES and less favorable sleep attitudes received the least amount of sleep. In addition, a significant three-way interaction of gender by race by sleep attitudes (b=.52, p<.05, ΔR²=.21) was found, indicating that sleep attitudes were a strong predictor
of weekend duration among minority women, where individuals with less positive sleep attitudes slept the least on weekends.

**Conclusion:** These results suggest that the intersection of multiple identities may be important in examining how sleep attitudes predict sleep outcomes. It is possible that higher SES females are under more stress to maintain a higher SES compared to their male counterparts, especially minority women. Additional research is needed to test the mechanisms by which these intersections of identities operate in predicting sleep attitudes and outcomes, and future sleep interventions may benefit by addressing these disparities related to identity.

**Support (If Any):** UNCC Psychological Sciences Departmental funding.

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**0277**

**SEX DIFFERENCES IN THE EFFECTS OF PERCEIVED STRESS ON SLEEP QUALITY: A STRUCTURAL EQUATION MODEL APPROACH**

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**Introduction:** Sleep quality and perceived stress are often correlated with each other, but causal directionality can be difficult to assess. The goal of this study was to quantify the temporal relationship between perceived stress and sleep quality in college students over the course of a semester. We assessed the degree to which sleep and stress affect each other over time and compared these effects in males and females.

**Methods:** Undergraduate STEM students (N=335; 67.16% female), primarily chemistry and biology majors, completed questionnaires on sleep quality and stress at two timepoints approximately 6 weeks apart. We tested two complimentary models: a cross-lagged structural equation model (SEM) with Sleep Quality as a single-factor latent variable and a cross-lagged SEM with Sleep Quality as a multi-factor latent variable. In the multi-factor model, we used factor analysis to determine the dimensions of sleep quality. A model with sleep quality as three factors (Duration, Latency, and Subjective Quality) was then analyzed for differences between sexes. For both sexes, Sleep Quality at Time 1 did not predict Perceived Stress at Time 2. More Perceived Stress at Time 1 predicted shorter Sleep Duration (but not Latency or Subjective Quality) at Time 2 for females (standardized beta = 0.27, p < .01). However, Perceived Stress at Time 1 did not significantly predict any single sleep component for males at Time 2 (p > .05).

**Conclusion:** The differences between males and females in the effect of stress on subsequent sleep became clearer in a model with three factors of Sleep Quality. Stress reduced subsequent sleep quality in females, but not in males, specifically through shortened sleep duration. Differences in HPA axis function and coping strategies may contribute to sex differences in sleep-related vulnerability to stress.

**Support (If Any):** N/A

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**0278**

**SEX DIFFERENCES IN CIRCADIAN TIMING AND ALIGNMENT: ASSOCIATIONS WITH ACTigraphic AND SELF REPORTED SLEEP**

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**Introduction:** Sex differences have been demonstrated in circadian timing and alignment. The goal of this study is to examine sex differences in the relationship between circadian timing and alignment with sleep timing and quality.

**Methods:** In this secondary analysis, healthy adults with habitual sleep duration &6805; 6.5 hours completed 7 days of wrist actigraphy. Circadian timing, measured by dim light melatonin onset, was measured in the clinical research unit. Circadian alignment was calculated as the duration between dim light melatonin onset (DLMO) and average sleep onset time in the prior week (phase angle). Participants also completed measures of depressive symptoms and subjective sleep quality. Data were analyzed using bivariate correlations conducted separately for men and women.

**Results:** Participants included 36 men and 61 women. Mean age 26.4 years (SD= 7.1 years). Average sleep duration was 436.2 min (SD= 55.1 min). There were no significant sex differences in sleep or circadian variables; however, there was a trend for earlier DLMO in women compared to men, (22.41 vs. 22.95, p = 0.08). For both men and women, later DLMO was associated with shorter phase alignment (r= -0.42, p<.001), lower sleep efficiency (r= -0.37, p<.001), and higher depressive symptoms (r= 0.27, p<0.05). Among women, later DLMO was also associated with shorter sleep duration (r= -0.28, p<.05). Shorter phase alignment was associated with earlier sleep onset time among women (r= 0.43, p<.01) and among men was associated with longer sleep duration (r= -0.43, p<.01). Circadian timing and alignment were not associated with subjective sleep quality in men or women.

**Conclusion:** These data demonstrate sex differences in the relationship between circadian timing and alignment with objective measures of sleep.

**Support (If Any):** N/A

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**0279**

**WOMEN DO NOT HAVE HIGHER RDIs DURING REM SLEEP**

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**Introduction:** Epidemiologic studies have suggested that men are more likely to have obstructive sleep apnea than women. These studies typically measure the severity of OSA by calculating the average number of respiratory events per hour for the entire night, rather than evaluating OSA severity during specific sleep stages. Clinical observations and earlier smaller studies have suggested that women are more likely to experience more frequent apneas during REM sleep than men. However, women were under-represented in these earlier studies, and AHIs were used as the unit of analysis rather than the RDIs. Since women are more likely to experience higher numbers of RERAs, which may account for their greater complaints of excessive daytime sleepiness at lower levels of apnea severity, it is important to use the RDI when determining if there are sex differences in apnea severity.

**Methods:** Baseline in-home polysomnographic recordings collected between 1995 and 1998 as part of the Sleep Heart Health...
ASSOCIATION OF SLEEP ARCHITECTURE WITH SELF-REPORTED SLEEP QUALITY AND SLEEPINESS IN WOMEN EXPOSED TO REPEATED EXPERIMENTAL SLEEP FRAGMENTATION TO MODEL MENOPAUSE-RELATED SLEEP CHANGES

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Introduction: Menopause-related sleep disruption manifests as increased nighttime awakenings commonly associated with hot flashes, and with shifting toward more N1 sleep. Using an experimental model of sleep interruption, we examined the association of changes in EEG sleep architecture with changes in self-reported sleep quality and sleepiness.

Methods: To date, 5 healthy women [mean (±SD) age 28.4 ± 6.4 years] have completed 3 consecutive inpatient nights at our Intensive Physiologic Monitoring Unit. Participants received 9-h sleep opportunities (11pm - 8am) involving 1 h of experimentally induced wake after sleep onset (WASO) and allowing for up to 8 h of sleep. An automated auditory stimulus was delivered every 15 min (range 60-90 dB) to initiate wake and repeated every 10 sec to maintain wake for 2 consecutive minutes each time wake was initiated. Wakefulness was confirmed by event-marks during polysomnographically-recorded sleep. Self-reported sleep quality and sleepiness were assessed upon awakening each morning on 7-point scales.

Results: The fragmentation protocol induced [mean (±SD)] 57.6 ± 23.8 min of WASO with 7.9 ± 0.5 h of total sleep time (TST) across the 3 nights. Across the 3 nights, the amount of WASO and TST were similar (p≥0.63), whereas N3 sleep increased significantly (p=0.02). While the number of wake-initiation responses did not differ across the 3 nights (p=0.32), the response time to waking and failure to maintain wakefulness increased significantly across the nights (both p<0.01). As participants progressed across the 3 nights, complaints of poor sleep quality increased in relation to increasing REM sleep (r²=0.77, p<0.01), and complaints of increasing sleepiness in association with decreasing N2 sleep (r²=0.79, p<0.01). Neither outcome correlated with changes in TST, WASO, N1 or N3 sleep time (p≥0.15).

Conclusion: Changes in self-reported sleep quality and sleepiness are associated with changes in sleep architecture induced by repeated sleep interruption in women. These results have important implications for understanding the shifts in sleep architecture associated with menopause and hot-flash associated sleep disruption.

Support (If Any): NIH-NIA R01AG053838.

SHORT SLEEP DURATION AND POOR SLEEP EFFICIENCY EXACERBATE EFFECTS OF EXECUTIVE FUNCTIONING PROBLEMS ON FACIAL AFFECT RECOGNITION WITHIN DISADVANTAGED AND DIVERSE MOTHERS

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Introduction: Sleep problems (e.g., short duration, inefficient sleep) have been found to exacerbate effects of Executive Functioning (EF) problems on social functioning. However, this work has not utilized nuanced measures of social functioning (e.g., dynamic recognition of facial affect) and has not typically examined at-risk populations. This study examined disadvantaged and ethnically diverse mothers, many of whom had histories of perpetrating child neglect (a population at risk for EF problems and misappraisals during social interactions). Previous studies have begun to examine links between EF problems and misappraisals of social situations among this population, however, the role of EF problems in recognition of facial affect, and the moderating role of sleep problems have not been examined. This study predicted that maternal EF problems would be associated with greater inaccuracy for recognizing facial affect, and that this association would be stronger under conditions of poor sleep.

Methods: Participants: 91 disadvantaged mothers of preschool-aged children, 29 with histories of perpetrating child neglect.

Cognitive Measures: Wisconsin Card Sort (cognitive flexibility); Alternate Uses Test (divergent thinking); Trailmaking Test (EF/processing speed); WAIS-IV Coding (processing speed); WAIS-IV Digit Span (working memory)

Actigraphy-Assessed Sleep Measures: Total sleep time; Sleep efficiency

Recognition of Facial Affect: Dynamic Affect Recognition Evaluation (inaccuracy for evaluating facial affect)

Results: Factor analysis of EF measures supported a single factor representing global impairment of EF. Maternal EF problems were significantly positively associated with inaccurate recognition of facial affect (β = 0.25, p = 0.02). Moderation analyses indicated that sleep duration and sleep efficiency moderated the association between maternal EF problems and inaccurate recognition of facial affect such that the relationship between EF problems and inaccuracy was stronger at lower levels of sleep time and sleep efficiency.

Conclusion: Short sleep duration and inefficient sleep exacerbated effects of EF problems on inaccurate recognition of facial affect. Findings suggest that in addition to direct benefits, improving sleep...
among disadvantaged mothers may mitigate the impact of underlying neurocognitive problems on social functioning.

Support (If Any): #R21HD082555

0282 SLEEP IN CAREGIVERS OF DEMENTIA PATIENTS: A META-ANALYSIS

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Introduction: Caregiving may have negative consequences for the individual providing care (typically, the spouse). For example, spousal caregivers of dementia patients show decreased cognitive functioning (relative to non-caregivers) that is concomitant with the level of caregiving burden. One possibility is that cognitive impairments in caregivers could be due to impaired sleep quantity or quality. To determine whether, and how, sleep is impaired in caregivers we conducted a meta-analysis.

Methods: Cohort studies using self-report or objective sleep measures, and studies employing sleep interventions in dementia caregivers were eligible. We identified 34 eligible studies using the Pubmed and Scopus databases; 17 studies reported total sleep time, 25 studies reported caregivers’ sleep quality, and 11 studies reported sleep interventions’ impact on caregiver sleep. The studies were inclusive of 3,071 dementia caregivers and 1,219 control adults. We used NHLBI tools to systematically assess study quality.

Results: Caregivers reported total sleep times of 6.61(±1.18) hours/night; compared to non-caregiver controls, caregivers lose 0.29 hours/night of sleep (overall effect size = -0.25, 95% CI: -0.47, -0.03, p = .03). Caregivers scored 5.56 (±3.20) on the Pittsburgh sleep quality index (PSQI), which is significantly worse than non-caregiver control adults (overall effect size = 0.64, 95% CI: 0.38, 0.90, p < .001). Our pooled analysis suggested that caregivers’ sleep quality was compromised in the sleep latency (d=0.42), habitual sleep efficiency (d=0.59), and sleep disturbances (d=0.59) domains. Furthermore, we found that sleep intervention studies improved caregiver sleep quality by 0.84 points on the PSQI scale (0.26 (95% CI: 0.09, 0.43), p = .002). Medications and electrical brain stimulation did not improve sleep quality in caregivers, but non-invasive behavioral therapies (e.g., physical exercise, light therapy) did significantly improve caregiver sleep quality.

Conclusion: Sleep quality should be considered in clinical guidelines for caregivers and should be addressed at the time of dementia diagnosis. Future research should investigate whether correcting for sleep disturbances in caregivers promotes better cognition and overall health for both the patient and the caregiver.

Support (If Any): N/A

0283 SLEEP FRAGMENTATION PREDICTS RISK OF CONGESTIVE HEART FAILURE IN COMMUNITY-BASED OLDER ADULTS

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Introduction: Sleep disturbances are commonly associated with cardiovascular diseases. There is evidence that clinical heart failure predicts a reduction of sleep quality. We tested whether disturbances in sleep also predict the risk for congestive heart failure (CHF).

Methods: We studied 1,102 older adults (age: 80.7±7.4 [SD]) in the Rush Memory and Aging Project who had no history of CHF at baseline and had been followed annually for up to 13 years. Motor activity data of up to 10 days were recorded at baseline and were used to quantify sleep fragmentation. Incident CHF were obtained based on self-report. A Cox proportional hazards model was performed to examine the association of sleep fragmentation at baseline with incident CHF while adjusted for age, sex, and years of education. The model was further augmented to adjust for potential confounders including baseline vascular risk factors and vascular diseases.

Results: CHF was reported in 72 individuals (6.4% of 1,102) averaged after 4.6±2.9 [SD] years from baseline. For 1-SD increase in sleep fragmentation (0.007), the risk of CHF increased by 1.23-fold (95% CI: 1.03-1.46, p=0.02) after controlled for age, sex, and education. This effect is equivalent to the effect of being ~3.8 years older of age. In addition, the association persisted after further adjusting for all the potential confounders mentioned above.

Conclusion: Community-based older adults with more fragmented sleep had increased risk for developing CHF. Since previous studies also showed that clinical heart failure predicts poorer sleep quality, the relationship between heart failure and sleep disturbances is likely bidirectional.

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0284 PERSONALITY TRAITS, INSOMNIA SYMPTOMS AND DAYTIME SLEEPINESS IN OLDER ADULTS

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Introduction: Both personality traits and disturbed sleep are associated with morbidity and mortality in older adults, but few studies have examined associations between personality and sleep disturbance in this population. We examined the cross-sectional association of personality traits with reports of insomnia symptoms and daytime sleepiness in a cohort of well-functioning older adults.

Methods: Participants included 1,072 adults aged 60-97 years from the Baltimore Longitudinal Study of Aging. Personality was assessed by the NEO Personality Inventory (NEO-PI-R), insomnia symptoms by the Women's Health Initiative Insomnia Rating Scale (WHIIRS), and daytime sleepiness by the Epworth Sleepiness Scale (ESS). Each personality trait t-score (based on combined-gender norms) was included as the primary predictor in separate regression models; with either the WHIIRS or ESS score as the outcome.
Model 1 was adjusted for age, sex, race, and education, and Model 2 added depressive symptoms (Center for Epidemiologic Studies-Depression Scale) to Model 1 covariates.

Results: Higher scores on neuroticism were associated with more severe insomnia (Model 2: \( \beta = -0.05, 95\% \text{ CI} 0.02, -0.09 \)) and greater sleepiness (Model 2: \( \beta = 0.11, 95\% \text{ CI} 0.07, 0.14 \)), while scoring higher on conscientiousness was associated with less severe insomnia (Model 2: \( \beta = -0.07, 95\% \text{ CI} -0.10, -0.04 \)) and less sleepiness (Model 2: \( \beta = -0.08, 95\% \text{ CI} -0.11, -0.04 \)). Higher scores on extraversion were associated with less severe insomnia (Model 2: \( \beta = -0.06, 95\% \text{ CI} -0.08, -0.03 \)), but only with sleepiness in Model 1 (\( \beta = 0.04, 95\% \text{ CI} -0.07, -0.002 \)). Higher scores on openness were associated with less sleepiness (Model 2: \( \beta = -0.04, 95\% \text{ CI} -0.07, -0.002 \), and scoring higher on agreeableness was only associated with less severe insomnia in Model 2 (\( \beta = -0.03, 95\% \text{ CI} -0.06, -0.001 \)).

Conclusion: In well-functioning older adults, specific personality traits are associated with reports of insomnia and daytime sleepiness, mostly independent of depressive symptoms. Our results suggest that sleep disturbances may be one mechanism through which personality influences health. Studies with objective sleep measures are needed.


0286
SEX AS A BIOLOGICAL VARIABLE ON THE INFLAMMATORY EFFECTS OF INTERMITTENT HYPOXIA
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Introduction: Intermittent hypoxia (IH) occurs in patients with obstructive sleep apnea (OSA), which, in turn, has been associated with cardiovascular mortality. However, in observational studies, the adverse events are more pronounced in men compared to women. The mechanisms underlying such sex differences are unknown, but inflammation has been posited as a mechanism by which OSA causes cardiac disease. We aimed to determine sex differences in pro-inflammatory cytokine production by peripheral blood mononuclear cells (PBMCs) in response to in-vitro IH. We hypothesized that PBMCs derived from men produce more interleukin-6 when stimulated in-vitro with IH than PBMCs derived from women.

Methods: After overnight sleep study, venipuncture was performed and PBMCs isolated and then resuspended into specialized cell culture cassettes that allowed for oxygen and nitrogen permeability. Cells were divided into two culture preparations - one subjected to normoxia (in the incubator) and the other to IH in a programmable hypoxia chamber (Oxycycler C-chambers; Biospherix, Inc.). The IH consisted of 5 cycles/hour with a baseline of 20.9% and nadir of 5% FiO\(_2\). After 18 hours of incubation, the supernatant was collected and Interleukin-6 was measured using ELISA techniques (R&D Systems).

Results: In 39 individuals (19 men) who had OSA (n=14), asthma (n=8), chronic obstructive pulmonary disease (n=3) or healthy (n=14) confounding factors that could influence production of IL-6 by PBMCs were obtained: age, body mass index, anti-inflammatory medications, smoking history, serum testosterone levels, and number of cells in culture. PBMCs from men produced greater levels of IL-6 following exposure to IH when compared to PBMCs in normoxic conditions. In contrast, PBMCs from women appeared to produce less IL-6 following exposure to IH than those cells exposed to normoxia. These differences were adjusted for confounders and there remained an interactive effect between IH and sex (F=4.68; P=0.038); anti-inflammatory medications (F=11.4; P=0.002) and a tendency for plasma testosterone levels (F=2.7; P=0.11).

Conclusion: Sex differences in cellular response to intermittent hypoxia may explain epidemiological observations of sex as a biological variable in studies involving OSA and cardiovascular mortality.

Support (If Any): Unfunded
over ~6 years of follow up while an early acrophase appears to be protective.

**Support (If Any):** National Institutes of Health.

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**0287**

**SCHEDULED AFTERNOON-EVENING SLEEP IMPROVES NIGHT SHIFT PERFORMANCE IN OLDER ADULTS.**

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**Introduction:** We previously reported that a combined strategy of enhanced light during the latter part of the night and 8h after bed trying to sleep, is enough to extend sleep, thereby improving performance and subjective sleepiness on the night shift. This follow-up study investigates the effect of time-in-bed alone on night shift performance and subjective sleepiness. It highlights that a behavioral intervention group (n=9) were instructed to go to bed between 1-2 pm and remain, attempting to sleep, for 8h. On all shifts, subjects took an hourly PVT and rated their subjective sleepiness with a Karolinska Sleepiness Scale. Mixed model analysis was (SAS 9.4) to compare night shifts to day shifts and shifts between the groups.

**Methods:** Eighteen healthy adults (6 females) aged 57.0±4.4y (mean±SD) participated in the study; 4 day shifts, 07:00-15:00, followed by 4 night shifts, 23:00-07:00. Dim light salivary melatonin onset (DLMO) was assessed before the first and final night shifts. Subjects slept at home. Day shifts: all groups were instructed to remain in bed attempting to sleep for 8h. Night shifts: control group (n=9) were not given any sleep instructions; sleep timing (ST) intervention group (n=9) were instructed to go to bed between 1-2 pm and remain, attempting to sleep, for 8h. On all shifts, subjects slept at home. Day shifts: all groups were instructed to remain in bed attempting to sleep for 8h. Night shifts: control group (n=9) were not given any sleep instructions; sleep timing (ST) intervention group (n=9) were instructed to go to bed between 1-2 pm and remain, attempting to sleep, for 8h.

**Results:** Sleep was not significantly different between the groups on the day shifts. The ST group slept a similar amount on night shifts as they had on day shifts, whereas the control group slept less on all the night shifts (p<0.05). The ST group performed significantly better on the night shifts than the control group (p<0.0001). There was no significant difference in subjective sleepiness between the groups. The DLMO of the ST group phase advanced by nearly 1 hour (54 ±25.9 min), significantly greater (p=0.029) than the control group who phase delayed by ~10 min (9.7±9.9 min).

**Conclusion:** This study demonstrates that when older adults remain in bed attempting to sleep for 8 hours they get significantly more sleep than when sleeping ad lib. It highlights that a behavioral change solely under the control of the individual, i.e. remaining in bed trying to sleep, is enough to extend sleep, thereby improving performance and subjective sleepiness on the night shift.

**Support (If Any):** NIH grants U1LTR001102, R01AG044416, T32HL007901

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**0288**

**HIGHER STRESSOR REACTIVITY TO INSUFFICIENT SLEEP IS ASSOCIATED WITH HIGHER BODY MASS INDEX IN MIDDLE-AGED WORKERS**

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**Introduction:** Previous research reports that shorter sleep duration than usual predicts perceiving more stressors the following day. This within-person effect indicates stressor reactivity to insufficient sleep (SRIS). Less is known about whether SRIS is associated with body weight, particularly in middle-aged workers who are prone to having a lack of time for sleep and self-care, and frequent daily stressors across work and non-work domains. We examined whether SRIS was associated with body mass index (BMI) in middle-aged workers.

**Methods:** We used a sample of 128 office workers (M = 45.26) who participated in 8 consecutive days’ diary study. We evaluated within-person slope of total stressor frequency regressed on sleep duration to predict BMI (measured height and weight, kg/m²). Analyses adjusted for sociodemographics and mean stressor frequency.

**Results:** Workers reported more stressors than usual after nights with shorter sleep duration than usual (SRIS, negative slope means higher reactivity; p<.001). Compared to those whose SRIS was in the average range (within ±1SD; 35% of the sample; reference), workers with higher SRIS (≥½SD; 28%) had higher BMI (B=3.29, p<0.05). The mean BMI of these workers fell within the obese range. There were no differences in BMI between workers with lower SRIS (≥½SD; 37%) and the reference group. We further tested with reactivity to poor sleep quality; higher stressor reactivity to poorer-than-usual sleep quality was associated with higher BMI at a trend-level (p<.08). Supplementary analyses showed that higher stressor reactivity to shorter or poorer sleep were correlated with more unhealthy behaviors (encompassing smoking, alcohol consumption, lack of exercise, fast-food consumption), which were also correlated with higher BMI.

**Conclusion:** Middle-aged workers who perceive more stressors following insufficient sleep may be at greater risk for obesity. Future research could target these workers to improve their sleep and modify negative feedback on stressor perception and health behaviors.

**Support (If Any):** This research was funded by a cooperative agreement through multiple NIH grants (U01HD051217, U01HD051218, U01HD051256, U01HD051276, U01AG027669, U01OH008788, U01HD059773, and R01HL107240).

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**0289**

**SLEEP AND MORTALITY IN OLDER ADULTS: A MACHINE-LEARNING-BASED COMPARISON WITH OTHER RISK FACTORS**

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**Introduction:** Sleep characteristics related to duration, timing, continuity, and sleepiness are associated with mortality in older adults, but are rarely considered in health recommendations. Examining the predictive ability of sleep as a multidimensional construct - rather than a series of separate characteristics—may clarify its importance and influence recommendations for measuring public health. We applied machine learning to: (1) establish the predictive ability of multidimensional self-reported sleep for all-cause and mortality in older adults, and (2) compare the predictive ability of sleep to other risk factors, in particular stressor reactivity to sleeplessness.
Cardiovascular mortality relative to other established risk factors; and (2) identify which sleep characteristics are most predictive.

Methods: The analytic sample includes N=8,668 older adults (54% female) aged 65-99 with self-reported sleep characterization and longitudinal follow-up (±15.5 years), aggregated from three epidemiological cohorts. We used variable importance (VIMP) metrics from random survival forests to rank the predictive abilities of five domains and the individual measures they comprise. VIMPs > 0 indicate predictive variables/domains.

Results: The predictive ability of the multidimensional sleep domain for all-cause mortality [VIMP (99.9%) CI] = 0.94 (0.60, 1.29); 15 predictors] ranked below that of sociodemographic factors [3.94 (3.02, 4.87); 6 predictors], physical health [3.79 (3.01, 4.57); 10 predictors], and medications [1.33 (0.94, 1.73); 10 predictors] but above that of health behaviors [0.22 (0.06, 0.38); 4 predictors]. For cardiovascular mortality, multidimensional sleep was also a significant predictor [1.98 (1.31, 2.64)] and was ranked similarly among the domains. The most predictive individual sleep characteristics across outcomes were time in bed, napping, and wake-up time. Cohort-specific analyses including additional non-sleep measures that could not be harmonized across cohorts indicated our findings are robust.

Conclusion: Multidimensional sleep is an important predictor of mortality that should be considered among other more routinely used predictors. Future research should develop tools for measuring multidimensional sleep, especially those incorporating duration, timing, and napping, and test mechanistic pathways through which these characteristics relate to mortality.

Support (If Any): MR01 HL01194; HL070848; HL070847; HL070842; HL070841; HL070837; HL070838; HL070839; SOF: AG05407; AR35582; AG05394; AR35584; AR35583. SHHS: U01HLS3916; U01HLS3931; U01HLS3934; U01HLS3937; U01HLS3938; U01HLS3940; U01HLS3941; U01HLS4630. Wallace: AG056331. NSRR: HL114473.

0290
CHILDHOOD TRAUMA IS ASSOCIATED WITH NREM BETA QEEG ACTIVITY INDEPENDENT OF BIOLOGICAL SEX
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Introduction: Previous studies have examined the effects of sex and childhood trauma on subjective and polysomnographic measures of sleep, but their synergistic effects on quantitative EEG (qEEG) during sleep remain unknown. We evaluated whether sex moderates the effects of childhood trauma on sleep qEEG using power spectral analysis in a community-based sample of healthy young adults.

Methods: A sample of 77 men and 95 women aged 18-30 without any comorbid psychiatric, medical, or sleep disorders, completed the Childhood Trauma Questionnaire (CTQ) and one night of polysomnography (PSG) with spectral data extracted and averaged from F3 and F4 leads. EEG activity bands during NREM and REM sleep was extracted for delta (0.5-4 Hz), theta (4-8 Hz), alpha (8-12 Hz), sigma (12-16 Hz), and beta (16-32 Hz) relative power bands. Multiple regressions tested childhood trauma and sex interaction effects on spectral activity bands during both REM and NREM sleep. If sex was not a moderator, we examined additive effects of sex and CTQ. Models were adjusted for both race and age.

Results: Sex and childhood trauma interactions were non-significant across all bands (p>0.429). Greater CTQ was significantly associated with increased beta power during NREM sleep (p=0.042). Women had greater power than men across delta (p<0.001), theta (p<0.001), and sigma (p=0.002) bands during NREM sleep. This same pattern was seen during REM sleep: delta (p<0.001), theta (p=0.001), alpha (p<0.001), and sigma (p=0.001).

Conclusion: No sex by childhood trauma interactions on qEEG were detected in this sample. Childhood trauma had a specific association, independent of sex, on NREM beta activity. This suggests that childhood trauma has long-lasting effects on central arousal during sleep, even in healthy sleepers, and may be a marker of vulnerability to sleep disturbances. Consistent with some prior studies, women in this sample showed significantly greater power across all activity bands during NREM and REM sleep than men.

Support (If Any): DOD MOMRP Log #1129306 (Germain); Clinician Scientist Training Program, University of Pittsburgh School of Medicine

0291
SLEEP DISORDERED BREATHING ASSOCIATED WITH EPGENETIC AGE ACCELERATION: EVIDENCE FROM THE MULTI-ETHNIC STUDY OF ATHEROSCLEROSIS
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Introduction: Identifying contributors to accelerated aging may elucidate risks and mechanisms for age-related diseases and mortality. A DNA methylation (DNAm)-based marker of fast biological aging, epigenetic age acceleration, is associated with modifiable lifestyle factors. Sleep disordered breathing (SDB) is a common disorder that results in oxidative stress and inflammation and is associated with multiple age-related health disorders; however, SDB has not been well studied with respect to epigenetic aging. We examined the association of SDB traits with epigenetic age acceleration, and whether the association differed by sex.

Methods: A diverse sample (N = 622) had blood DNA methylation measured and underwent Type 2 in-home polysomnography, which assessed apnea-hypopnea index (AHI), percentage of sleep time that oxygen saturation is lower than 90% (Per90), and arousal index. Using DNA methylation, two validated epigenetic age measures were computed: DNAm Phenotype and DNAm age. Age acceleration measures were calculated as residuals from the regression of each epigenetic age on chronological age. The association
of each SDB trait with age acceleration was estimated using linear regression, controlling for socio-demographics, health behaviors, BMI, and study site.

**Results:** Participants were 53.2% female with a mean age of 68.7 (SD: 9.2) years. AHI was associated with greater DNAm PhenoAge acceleration ($\beta = 0.03; 95\% \text{ CI } [0.00, 0.06]$), equivalent to 215 days of DNAm PhenoAge acceleration for 1-SD increase in AHI. Arousal index was associated with greater DNAm age acceleration ($\beta = 0.04; 95\% \text{ CI } [0.01, 0.07]$), equivalent to 321 days of DNAm age acceleration for 1-SD increase in arousal index. Both associations were stronger in women compared to men. There was no evidence that Per90 was associated with epigenetic age acceleration or exhibited sex differences.

**Conclusion:** Increasing SDB severity and sleep disruption was associated with epigenetic age acceleration, independent of measured confounders. These associations were stronger in women than in men, suggesting that women may be particularly vulnerable to the adverse effects of SDB. Future work should study whether treatment reduces epigenetic age acceleration among those individuals with SBD.

**Support (If Any):** None.

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**0292 OBJECTIVE SHORT SLEEP DURATION IS ASSOCIATED WITH INCREASED 24-HOUR AMBULATORY BLOOD PRESSURE**

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**Introduction:** Short sleep duration is a contributor to cardiovascular disease (CVD) events and mortality. In particular, short sleep duration has been linked to an increased risk of high clinic blood pressure (BP). BP measured outside the clinic using 24-h ambulatory blood pressure monitoring (ABPM) is a better predictor of an individual’s CVD risk. We therefore aimed to examine the association between objectively-assessed sleep duration and 24-h ambulatory blood pressure (ABP).

**Methods:** The Masked Hypertension Study is a multi-site study of the prevalence and predictors of masked hypertension (i.e. ambulatory hypertension despite non-elevated clinic BP), comprising working adults from the New York area. Participants were excluded if they were taking antihypertensive drugs or had a screening BP $>$160/105 mmHg. Participants were fitted with a 24-h ABPM device (Model 90207; Spacelabs), and measures were taken at 28-30 min intervals. Objective sleep duration, and times of wakefulness and sleep during the 24-h ABPM period were derived from wrist-worn actigraphy (ActiWatch; Phillips Respironics), supplemented by diary reports. Linear regression, adjusted for age, sex, race/ethnicity, body mass index, smoking status, and diabetes were conducted on the relationship between sleep duration and the ABP measures.

**Results:** Participants (N=744, 59.5% female) were (mean ± SD) 45.2 ± 10.3 years old. Mean actigraphy-derived sleep duration was 6.8 ± 1.2 hours. Hours of sleep (continuous variable) was not associated with mean awake or asleep systolic BP (p=0.79 and p=0.75) or mean awake or asleep diastolic BP (p=0.23 and p=0.74). However, shorter sleep duration predicted higher mean 24-h systolic BP, B=-0.73, p=0.01, as well as higher mean 24-h diastolic BP, B=-0.83, p<0.001. Findings were consistent when sleep duration was dichotomized as short (<6 h) or not short (≥6 h).
0293
EFFECTS OF OBSTRUCTIVE SLEEP APNEA ON HUMAN SPATIAL NAVIGATIONAL MEMORY PROCESSING IN COGNITIVELY NORMAL OLDER ADULTS
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Methods: Obstructive sleep apnea (OSA) is a common sleep disorder associated with inconsistent cognitive consequences. Spatial disorientation increases with age and is an early sign of cognitive dysfunction in Alzheimer disease (AD). Sleep and related EEG oscillations, slow wave activity (SWA) and slow oscillations (SOs), are important for processing spatial memories, however it is not known if OSA-related sleep disruption effects spatial navigational memory processing in older adults.

Medians AHI4% was 0.5/hour in those without OSA(n=30) according to OSA diagnosis. EEG microstructure (relative SWA (0.5-4Hz) & SOs (<1Hz) spectral power) and maze completion times were explored separately according to OSA diagnosis.

Results: Median AHI4% was 0.5/hour in those without OSA(n=30) and 10.7/hour in OSA(n=12). N1 sleep was significantly increased and N2 significantly decreased with OSA. No significant group differences in SWS, REM sleep or PVT performance were observed. There were no significant group differences in pre-sleep maze completion time, whereas post-sleep maze performance was significantly different. On average participants without OSA continued to improve maze completion time across 3 morning trials whereas participants with OSA performed best on the first morning trial and performed worse on average with each subsequent trial (significant interaction between OSA group and morning trial number, p=0.016, Two Way Repeated Measures ANOVA). There were no significant differences in EEG microstructure observed between groups but in OSA, post-sleep maze performance showed a significant negative association with <1Hz spectral power at frontal (-0.78, p=0.007), central (-0.8, p=0.005) and occipital EEG (-0.71, p=0.02) during SWS.

Conclusion: Cognitively normal older adults with mild OSA demonstrated significantly worse morning spatial navigation performance compared to individuals without OSA after equivalent evening encoding. The associations between greater SOs and worse morning maze performance in OSA require replication.

Support (If Any): None

0294
EFFECTS OF EARLY LIFE SLEEP DISRUPTION ON MOTOR AND SPATIAL LEARNING IN A MOUSE MODEL OF TAUOPATHY
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Introduction: Neurodegenerative diseases characterized by tauopathy often manifest deficits in motor and spatial learning, and chronic sleep disruption has the potential capacity to accelerate tau pathology. The goals of the current study are to characterize the effects of chronic early life sleep disruption on these deficits across the lifespan in a transgenic mouse model of tauopathy.

Methods: Eight-week-old P319 (MAPT P301S) mice and wildtype littermates were subjected to chronic daily sleep disruption (SD) or allowed to sleep ad libitum for eight weeks. SD was achieved using an automated sensory stimulus every 10 seconds for 10 hours between ZT 2 and 12. Testing occurred at ages 6, 8, and 10 months. On experimental days 1 and 2, mice completed 10 consecutive rotarod trials with a 3 minute inter-trial interval at ZT0. Rod acceleration was from 4 to 40 RPM over 5 minutes, and latency to fall was measured. After a period of rest, mice completed 3 consecutive Barnes maze trials with a 45 minute inter-trial interval. Mice explored the maze for 3 minutes, and latencies to find and enter the escape box were recorded. On days 3, 4, and 5, mice completed the Barnes maze only.

Results: At 6 months, all mice showed intact spatial learning and, consistent with our prior findings, mice exhibited offline gains in rotarod motor learning. We did not observe a significant main effect of sleep condition or genotype on either learning paradigm at this age.

Conclusion: Early life sleep disruption between 2 and 4 months of age does not significantly impact spatial or motor learning at 6 months of age. We expect that as the mice age, increasing tauopathy will lead to greater behavioral differences among groups.

Support (If Any): None
Introduction: Sleep spindles and slow oscillations (SOs) are associated with cognitive function, and their temporal coupling decreases with aging in humans. The current work examines the impact of neurofibrillary tau tangles (NFTs) and cortical degeneration on spindle density and spindle-SO coupling with aging in a mouse model of tauopathy.

Methods: PS19 mice (MAPT P301S) (3 male, 3 female) and control mice, coupling of spindles to SOs was significantly reduced in 10-month-old mice compared to 2-month-old non-transgenic littermates (3 male, 3 female) were implanted with EEG electrodes targeted over bilateral anterior cortex. Twenty-four-hour recordings (12/12hr Light:Dark cycle) were performed at 2 months, when little to no overt tau pathology is present, and 10 months, when tau hyperphosphorylation and NFTs are present throughout many cortical and brainstem areas. Sleep and wake were scored manually, spindles (10-16 Hz) were detected with an automated algorithm, and their phase within cortical slow oscillations (<1 Hz) was determined.

Results: Significantly greater spindle density was observed in 2-month-old PS19 mice (3.9±0.4/min NREM) compared to 2-month-old non-transgenic littermates (5.8±0.4/min. NREM, t-test, p=0.007). This genotype difference was not observed at 10 months (PS19: 4.0±0.8/min NREM vs controls: 4.8±0.8/min NREM, t-test, p=0.491). Phase coupling of spindles to SOs was significantly reduced in 10 month PS19 mice (mean resultant vector length (MRVL)=0.029±0.004) compared to 10 month controls (MRVL=0.048±0.006, paired t-test, p=0.032). This difference was not observed in younger 2 month old mice. Additionally, we did not observe a significant difference at either age in other spindle biophysical properties such as spindle peak frequency, duration, relative power in the spindle band (10-16 Hz), or in cross-hemispheric synchrony metrics such as spindle coherence, imaginary coherency, or granger causality.

Conclusion: PS19 mice manifest an increase in spindle density at age 2 months that normalizes to control levels by age 10 months. Although spindle density is equivalent at age 10 months in PS19 and control mice, coupling of spindles to cortical slow oscillations is significantly reduced in PS19 mice at this age.

Support (If Any): NA
Shannon L. Macauley, PHD

1mg/kg IP injection of glibenclamide, a K ATP channel antagonist, the mice were challenged with a 2g/kg IP injection of glucose, a lactate. These were paired with cortical EEG and EMG recordings to measure ISF fluctuations in glucose, glutamate, and β. Biosensors were implanted bilaterally into the hippocampus of APP mice expressing CRE-dependent excitatory DREADDs. We used APP mice and nontransgenic controls that had been crossed with mice expressing CRE in GABAergic neurons. In vivo activation of DREADDs using intraperitoneal (IP) injection of CNO was confirmed by staining of brain sections with a marker of activity.

**Methods:** Selective activation of TRN in APP mice was achieved by stereotactically targeting the TRN with an AAV driving expression of CRE-dependent excitatory DREADDs. We used APP mice and nontransgenic controls that had been crossed with mice expressing CRE in GABAergic neurons. In vivo activation of DREADDs using intraperitoneal (IP) injection of CNO was confirmed by staining of brain sections with a marker of activity.

**Results:** A single IP injection of CNO led to acute activation of DREADD-expressing TRN neurons in APP mice, reduced sleep fragmentation and improved SWS. Chronic, daily CNO treatment (30 days) led to stable reductions of sleep fragmentation and enhanced SWS throughout the treatment period. We found robust reductions in Aβ plaque load relative to vehicle-treated APP mice. Therefore, the TRN may be a master regulator of pathology and function in several cognitive and behavioral domains in AD.

**Support (If Any):** Ruth K Broad Biomedical Research Foundation

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**0299**

**EFFECT OF GLYCEMIC EXTREME ON SLEEP/WAKE AND ALZHEIMER’S DISEASE PATHOPHYSIOLOGY**

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**Introduction:** Type 2 diabetes increases the risk of developing Alzheimer’s disease by 2-4-fold. Further, sleep disruption is characteristic of both Alzheimer’s disease and metabolic dysfunction. It remains unclear, however, how alterations in peripheral and brain metabolism alter pathology and, ultimately, impact the sleep/wake cycle. The goal of this study, therefore, was to elucidate how the brain regulates metabolism in euglycemic conditions, as well as when challenged with hyper- and hypoglycemic conditions, with the hypothesis that altered glucose homeostasis and sleep dysregulation may be leading to accelerated disease progression.

**Methods:** Biosensors were implanted bilaterally into the hippocampus of APP/PS1 mice, a model of amyloid-beta (Aβ) overexpression, to measure ISF fluctuations in glucose, glutamate, and lactate. These were paired with cortical EEG and EMG recordings for simultaneous sleep/wake analysis. To examine the effect of glycemic extremes on the brain’s metabolic profile and arousal state, the mice were challenged with a 2g/kg IP injection of glucose, a 1mg/kg IP injection of glibenclamide, a K ATP channel antagonist, as well as a .5U/kg injection of insulin.

**Results:** Both hyper- and hypoglycemic challenges result in significant increases in arousal in 3-month old, wildtype mice. This increased arousal matched the increases in ISF lactate, indicating an increase in overall neuronal activity. However, in an aged APP/PS1 model mouse, the metabolic response to glycemic challenges was muted and there was seemingly no impact on arousal state, which is likely due to an increase in the overall amount of time spent awake. This finding is consistent with previous data demonstrating progressive age and pathology-dependent increases in arousal time.

**Conclusion:** This study represents a novel approach to understanding the interactions between sleep, cerebral metabolism, and Alzheimer’s Disease progression. The results show both glycemic extremes and Alzheimer’s Disease pathophysiology can cause increased arousal, which is known to further contribute to metabolic dysregulation, accelerate amyloid-beta and tau deposition and neurodegeneration, suggesting a cyclic relationship between sleep and disease pathology.

**Support (If Any):** Harold and Mary Eagle Fund for Alzheimer’s Research, NIH/NIA 1K01AG050719, New Vision Award through Donors Cure Foundation

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**0300**

**LINKING SLEEP DISTURBANCES WITH AMYLOID AND TAU IMAGING. PRELIMINARY FINDINGS FROM THE HARVARD AGING BRAIN STUDY**

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**Introduction:** Growing evidence suggests that sleep disturbances can modulate the aging process and increase the risk of developing cognitive impairment and dementia. Given that sleep and cognition share biological regulatory mechanisms, the aim of this study was to characterize the association between sleep disturbances and imaging markers of Alzheimer’s disease (amyloid and Tau) in participants of the Harvard Aging Brain Study in relation to their cognitive status.

**Methods:** We carried out home level 2 polysomnography studies on 24 participants of the prospective Harvard Aging Brain Study. As part of this longitudinal study, individuals, who were recruited when cognitively intact, undergo longitudinal multi-modality imaging including Pittsburgh Compound B PET scans to detect amyloid deposition and Tau imaging using the F18-labeled ligand (T807) as well as sensitive yearly cognitive assessments, including the Preclinical Alzheimer’s Cognitive Composite (PACC), to define predictive factors of preclinical Alzheimer’s disease.

**Results:** Among the participants, 14 were female and the average age was 74.1 (±1.97). A positive correlation was found between inferior temporal Tau and percent time in N1 sleep (p=0.006), whereas percent time in N3 (slow-wave) sleep (p=0.016) and REM sleep (p = 0.05) were inversely and independently correlated with inferior temporal Tau. Cortical amyloid burden correlated positively with percent time in N1 (p=0.01). All these associations remained after controlling for age and total sleep time. PACC score correlated positively with percent time in N1 (p= 0.04) and negatively with REM sleep (p = 0.001) although this association diminished after correction for age and total sleep time. We did not find...
any associations between measures of sleep disordered breathing and amyloid or Tau.

**Conclusion:** Our preliminary findings provide evidence for a relationship between specific measures of sleep architecture and PET signals from amyloid and Tau tracers. Sleep disturbances thereby have a potential to serve as surrogate markers for cognitive decline, could help to predict high-risk individuals and offer new approaches for therapeutic targets.

**Support (If Any):** AASM Foundation Bridge to Success Award (PI: Djonlagic)

**0302**

**INTERACTIVE ASSOCIATIONS OF OBSTUCTIVE SLEEP APNEA AND β-AMYLOID BURDEN AMONG CLINICALLY NORMAL AND MILD COGNITIVE IMPAIRMENT ELDERLY INDIVIDUALS: AN EXAMINATION OF CONVERSION RISK**

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**Introduction:** We determined whether Obstructive Sleep Apnea (OSA) and β-Amyloid Burden (Aβ) act additively or synergistically to promote conversion from cognitive normal (CN) to mild cognitive impairment (MCI) and from MCI to AD.

**Methods:** In this longitudinal observational study, we examined CN (n=298) and MCI (n=418) older adults from the ADNI database (adni.loni.usc.edu). OSA was self-reported during a clinical interview. Brain Aβ was assessed using Florbetapir-PET imaging. The primary outcome of the analysis was conversion from CN to MCI (CN participants) and from MCI to AD (MCI participants). Participants were required to have a baseline and at least one follow-up clinical visit that identified their cognitive status. Logistic mixed-effects models with random intercept and slope were used to assess associations between OSA, Aβ, and risk of conversion from CN to MCI, and MCI to AD. All models included age at baseline, sex, APOE4 status, years of education, and their interactions with time.

**Results:** Of the 716 participants, 329 (46%) were women. The overall mean (SD) age was 74.7 (5.0) years, and the overall mean (SD) follow-up time was 5.5 (1.7) years (Range: 2.7 - 10.9 years). In CN participants at baseline, conversion to MCI was associated with both OSA (β=0.418; 95% CI, 0.133 to 0.703; P < .001) and higher Aβ burden (β=0.554; 95% CI, 0.215 to 0.892; P < .001). The interaction of OSA and Aβ burden with time was significant (β=1.169, 95% CI, 0.776 to 1.562; P < .001), suggesting a synergistic effect. In MCI participants at baseline, conversion to AD was associated with both OSA (β=0.637; 95% CI, 0.291 to 0.982; P < .001) and higher Aβ burden (β=1.061; 95% CI, 0.625 to 1.497; P < .001). The interaction of OSA and Aβ burden with time was significant (β=1.312, 95% CI, 0.952 to 1.671; P < .001), suggesting a synergistic effect.

**Conclusion:** In both CN and MCI elderly, Aβ modified the risk of progression to AD in OSA participants. OSA patients maybe more physiologically susceptible as Aβ load becomes increasingly abnormal.

**Support (If Any):** NIH/NIA/NHLBI-T32HL129953; RO1AG056031, R01HL118624; K07AG052685

**0303**

**NEUROBIOLOGICAL BASIS OF SLEEP DISTURBANCES IN TAUOPATHIES: HUMAN WAKE-PROMOTING NEURONS DEGENERATE MORE IN ALZHEIMER’S DISEASE**

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Introduction: Alzheimer’s disease (AD) and the four-repeat tauopathies, corticobasal degeneration (CBD) and progressive supranuclear palsy (PSP), are neurodegenerative diseases associated with accumulation of abnormal tau protein. Despite exhibiting different patterns of sleep (PSP), are neurodegenerative diseases associated with accumulation of abnormal tau protein. Despite exhibiting different patterns of sleep-wake disturbances in tauopathies is explained by a disproportional degeneration of sleep-promoting neurons (WPNs) compared to WPNs. Understanding the neurobiological basis of the differences in sleep-wake disturbances in tauopathies is crucial for developing targeted interventions.

Support (If Any): Tau Consortium, NIH

0304
DO PARKINSON’S DISEASE PATIENTS WITH PROBABLE REM BEHAVIOR DISORDER REPORT POORER SLEEP QUALITY THAN PATIENTS WITHOUT PROBABLE REM BEHAVIOR DISORDER?
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Introduction: Parkinson’s disease (PD) is a multisystem movement disorder often presenting with comorbid sleep difficulties. REM Sleep Behavior Disorder (RBD), characterized by vocalizations or complex behavior and a loss of atonia during REM sleep, often accompanies PD. The purpose of this analysis was to investigate associations between RBD and self-reported sleep features in patients with PD.

Methods: Participants included PD patients with probable RBD (n=19), PD patients without probable RBD (n=31), and matched controls free of neurodegenerative disease (n=47). Probable RBD was determined using the REM Sleep Behavior Disorder Screening Questionnaire (total score >6). Subjective total sleep time and sleep onset latency were measured with the Pittsburgh Sleep Quality Index, insomnia severity was assessed using the Insomnia Severity Index, daytime sleepiness was evaluated using the Ewphor Sleepiness Scale, and sleep disturbance and sleep-related impairment were assessed using the Patient-Reported Outcomes Measurement Information System questionnaires. Mann-Whitney U tests were used to test for group differences (all PD patients vs. matched controls and PD with probable RBD vs. PD without RBD) in these sleep features.

Results: Patients with PD had significantly higher insomnia severity, daytime sleepiness, and sleep-related impairment than matched controls: Z=-2.52, p=0.012, Z=-2.18, p=0.029, Z=-4.48, p<0.001, respectively. No significant differences were found in sleep measures between the PD with probable RBD and the PD without probable RBD groups (p>0.05).

Conclusion: Parkinson’s disease is associated with poorer sleep quality. Self-reported sleep problems are not unique to or more severe in PD patients with probable RBD. Given that RBD is associated with poorer daytime impairments on executive tasks, the finding that PD patients with probable RBD report comparable levels of sleep-related impairments as PD patients without RBD may suggest they are unaware of the impact RBD has on their daytime functioning.

Support (If Any):

0305
DEGRADED FRACTAL ACTIVITY REGULATION AND INCIDENT PARKINSONISM IN COMMUNITY-BASED OLDER ADULTS
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Introduction: Healthy physiological systems exhibit fractal regulation, generating similar fluctuation patterns in physiological outputs across different time scales from seconds to hours. Evidence indicates a mechanistic link between fractal regulation and sleep/circadian control, and both degraded with aging and in diseases. It is accepted that sleep and circadian disturbances are common non-motor symptoms of Parkinson’s disease (PD). We tested whether degraded fractal regulation is associated with incident Parkinsonism.
Methods: We examined 810 older adults (620 females; age: 80.4±7.2 [SD], range 59.4-98.9) in the Rush Memory and Aging Project who were free from any parkinsonian signs at baseline and had undergone annual motor tests for assessment of 4 parkinsonian signs (i.e., bradykinesia, gait, rigidity, and tremor) for up to 13 years. Parkinsonism was rendered if ≥2 parkinsonian signs presented. Motor activity was monitored on the wrist continuously for up to 10 days at baseline. Detrended fluctuation analysis was performed to obtain a metric α that quantifies fractal temporal correlations of motor activity at time scales ~0.1-1.5h. A Cox proportional hazards model was performed to examine the association of α with incident Parkinsonism.

Results: Parkinsonism was observed in 332 subjects (~41%) after 3.9±2.8 [SD] years on average from baseline. Older age (hazard ratio [HR]=1.07, p<0.0001) and less education (HR=1.07, p=0.002) but not sex (p=0.6) were associated with a higher risk of Parkinsonism. After controlled for age, sex, and education, 1-SD decrease in α (0.06) was also associated with increased risk for Parkinsonism with an HR of 1.22 (95% CI: 1.09-1.37, p=0.001). The effect is equivalent to that of being ~2.9 years older. The association remained after further adjusting for actigraphy-derived sleep and/or circadian metrics (i.e., sleep fragmentation and inter-daily stability).

Conclusion: Degraded fractal regulation was associated with increased PD risk. Even though previous studies have well documented the mechanistic link between fractal regulation and sleep/circadian control, the effect of fractal degradation on PD risk appears to be independent from sleep/circadian control.

Support (If Any): This work was supported by NIH grants R01AG048108, RF1AG059867, R01AG017917, and R01NS078009.
0306
SYMPTOM PHENOTYPE IN ADULTS WITH MILD OSA
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Introduction: Excessive daytime sleepiness is prevalent and clinically significant in OSA. Other symptoms are less well-understood, especially in mild OSA population. Objective: Explore symptom phenotypes in adults with mild OSA.
Methods: Observational study of 22 adults employed conveniently sampled at diagnostic polysomnography. Symptom measures: Stanford Sleepiness Scale (SSS) and Lee Fatigue and Energy Scale (LFES). Two distinct symptom clusters were identified: momentary and lasting symptom clusters. Cluster 1, momentary symptom cluster, included sleepiness (E and M) and fatigue (E and M); Cluster 2, lasting symptom cluster, included sleep-related quality of life and energy levels (E and M). In cluster 1, fatigue (E) and sleepiness (E) had the strongest connection, and perceived stress was connected to four different momentary symptoms, including sleepiness (E), sleepiness (M), fatigue (M), and diurnal symptoms, a sleep-related quality of life construct. In cluster 2, symptom vectors shared at least three connections with each other, excepting energy (E). The nocturnal symptom (i.e., nocturia, choking/gasping at night, and snoring), a sleep-related quality of life construct, was the dominant variable, showing six connections with other variables of which four symptoms had strong similarity. Sleepiness over the past month, mood disturbance, and depression were not grouped in any cluster and remained independent of other symptoms.
Conclusion: The identified two symptom clusters, momentary and lasting symptoms, in mild OSA may guide symptom management approaches. Future larger studies of mild OSA symptom clusters may suggest reference points for evaluation of mild OSA, including treatment responses.
Support (If Any): American Nurses Foundation and Sigma Theta Tau International (Hyunju Yang, PI).

0307
THE CONCEPT OF “SATISFACTION” WITH SLEEP: ASSOCIATIONS WITH SLEEP CONTINUITY, SLEEP QUALITY, DAYTIME SLEEPINESS, AND RELATED CONCEPTS OF OVERALL HEALTH, STRESS, DEPRESSION, AND ANXIETY
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Introduction: Sleep health encompasses a number of concepts, including “satisfaction,” timing, efficiency, duration, and absence of disorders, and is related to mental/physical health. This analysis aims to explore the idea of “sleep satisfaction” and how it relates to these concepts.
Methods: Data were from N=1,003 working-age adults age 22-60 in the Philadelphia area. Participants were asked to rate their satisfaction with sleep on a scale of 0-100 (100=max). Participants also completed the Insomnia Severity Index, Epworth Sleepiness Scale, Fatigue Severity Scale, Brief Inventory of Sleep Control, sleep duration (categorized as ≤4h, 5-6h, 7-8h, ≥9h), habitual bedtime, Patient Health Questionnaire (for depression), GAD7, anxiety scale, Perceived Stress Scale, and an overall indicator of health (Excellent, Very Good, Good, Fair, or Poor). Linear regression analyses examined whether each of these individually and/or uniquely contributed variance to sleep satisfaction after adjustment for age, sex, race/ethnicity, education, and income.
Results: The following significantly predicted worse sleep satisfaction (in order of decreasing magnitude): insomnia symptoms (B=-2.99, p<0.0005), sleep duration in the ≤4h (B=-3.57, p<0.0005), 5-6h (B=-1.93, p<0.0005), and ≥9h (B=-1.45, p=0.032) ranges vs 7-8h, lack of sleep control (B=-3.42, p=0.0005), later bedtime (B=-2.83, p<0.0005), sleepiness (-1.82, p<0.0005), fatigue (B=-0.86, p<0.0005), depression (B=-2.38, p<0.0005), anxiety (B=-2.16, p<0.0005), stress (B=-1.32, p<0.0005), and overall health rated as good (B=-1.29, p<0.0005), fair (B=-2.72, p<0.0005), and poor (B=-3.79, p<0.0005), vs excellent. In a model with all variables combined, unique variance was contributed only by insomnia, sleep duration, sleep control, and depression; other variables were non-significant.
Conclusion: Sleep satisfaction, as a concept, is related to nighttime sleep experiences, daytime impairment experiences, and overall mental and physical health. However, some of these relationships overlap and a combined model suggests that sleep satisfaction mostly represents a combination of nighttime sleep duration/quality, perceived control, and daytime mood.
Support (If Any): R01MD011600, R21ES022931

0308
COMPARING THE OBSERVED CHANGE SCORES OF DBAS-10 PRIOR AND POST CBT-I COULD LEAD INCORRECT CONCLUSIONS ABOUT TREATMENT EFICACY: INVESTIGATING THE IMPACTS OF PARTIAL INVARIANCE WITH AN EMPIRICALLY-BASED SIMULATION
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Introduction: Researchers have found psychological interventions could create non-invariant parameters in post-treatment clinical questionnaires, which might bias the follow-up analyses based on observed change scores. The purpose of this study is to examine whether the cognitive behavioral therapy for insomnia (CBT-I) would make similar impacts on an abbreviated measure of...
THE SLEEP HEALTH INDEX: CORRELATIONS WITH STANDARDIZED STRESS AND SLEEP MEASURES IN A PREDOMINANTLY HISPANIC COLLEGE STUDENT POPULATION

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Introduction: The National Sleep Foundation (NSF) recently developed a unique measure of “sleep health”, the Sleep Health Index (SHI). Unlike most sleep scales, the SHI provides a measure that is not restricted to an absence of disordered sleep. The aim of our study was to examine the measure in relation to established scales of stress and sleep.

Methods: 397 undergraduate students (mean age 20.3, 95% Hispanic, 76% female) completed an online survey containing the SHI and standardized measures of sleep quality (PSQI), insomnia (ISI), life-events stress (ICSRLE) and self-perceived stress (PSS).

Results: Our sample scored significantly lower on the SHI (M = 73.7, range 31-100) than the NSF’s national sample, based on both their entire sample (76) or limited to 18-29 year old respondents (78; t(382) = 6.02, p < .001). Sleep health was significantly higher in men (76.35) relative to women (72.62), t(395) = 2.27, p = .012. Sleep health was negatively correlated with life-events and self-perceived stress (-.41 and -.45, respectively), insomnia severity (-.59), and poor sleep quality (-.58). The SHI sleep quality sub-index score was negatively correlated with the PSQI sleep quality factor score (-.60). All correlations were significant at p <.001. Additionally, people who had visited the doctor for illness during the past six month had significantly poorer sleep health (71.5) than those who had not (74.9), t(394) = 2.37, p = .009.

Conclusion: Our findings add to the limited data available about the SHI measure. Our sample of college students was shown to have significantly poorer sleep health than the general population, even when matched in age range. Although the original SHI paper previously showed a relationship between sleep health scores and stress (r = -.37), this was based on a single stress question rather than established scales. We also demonstrated that the SHI was significantly correlated with established sleep measures and provided some support for the idea that poor sleep health is related to physical illness.

Support (If Any): N/A
A. Basic and Translational Sleep Science

**Introduction:** Chrononutrition, or the circadian timing of food intake, has recently garnered attention as a topic of study due to its associations with health (e.g. weight gain, insulin resistance). Though the concept of chrononutrition has become increasingly studied in laboratory research, a valid assessment of chrononutrition patterns in daily life has not yet been developed.

**Methods:** The present study therefore aimed to develop and validate both a diary and questionnaire version of the Chrononutrition Profile which assess 6 components of chrononutrition that have been associated with poor health (breakfast skipping, night eating, eating window, evening latency, largest meal, and evening eating). Raw scores from the CP can be used in calculations to determine one’s chrononutrition categorization (good; fair; poor). Based on the nature of the data, bivariate correlations, multilevel modeling, and hierarchical regression techniques were used to evaluate test-retest reliability, convergent validity, and concurrent validity of the CP.

**Results:** The measure demonstrated evidence of test-retest reliability and convergent validity, though concurrent validity was not able to be interpreted in the present sample. Based on analyses, the final diary and questionnaire versions of the CP assess 5 components of chrononutrition: breakfast skipping, night eating, eating window, evening latency, and evening eating.

**Conclusion:** The present study has provided preliminary support for the CP. The CP may be used independently as an indicator of health risk or as a supplement to traditional dietary assessment tools. This measure will provide health care professionals, researchers, and stakeholders with a cost-effective method of evaluating chrononutrition status and identifying targets for health improvement.

**Support (If Any):** None

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**0312**

**CREATING A STANDARDIZED PROCEDURE FOR SLEEP MEASURED BY ACTIGRAPHY IN AVIATION FIELD STUDIES**

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**Introduction:** The Actigraph is a wrist-worn device containing an accelerometer that can detect changes in activity to measure sleep within individuals and quantify sleep across populations. While there is some literature comparing actigraphy with other sleep scoring methods, the exact nature of data-cleaning procedures for actigraphy is not well defined, and varies from laboratory to laboratory. There is a need for a standardized data-cleaning procedure. We have developed such a procedure to showcase its use when monitoring the sleep of commercial aviation pilots.

**Methods:** Our standardized actigraphy data cleaning procedure is a two-step process. The first step is to identify by self-report, event markers, and activity level, periods of time that are highly likely to be wake in the actigraph report. The second step is to take the remainder of the report and determine which, by the same criteria, periods of time that are possibly sleep are in fact sleep. This method was compared to auto-generated sleep only and self-report only (applied to data collected from pilots) to demonstrate that our procedure more accurately measures actual sleep.

**Results:** We have found the two-step procedure renders a more accurate and reproducible sleep/wake history, compensating for mistakes made by pilots when self-reporting sleep and eliminating most inaccuracies made when only actigraph sleep algorithms are used.

**Conclusion:** In light of what our data shows, and the overall lack of literature surrounding actigraphy cleaning procedures, we highly recommend a standardized data cleaning procedure. While we apply the cleaning procedure to pilot’s sleep data and believe it should be implemented for all aviation studies, this procedure may also be useful across multiple population types.

**Support (If Any):** United Airlines

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**0313**

**VALIDATION OF A CONSUMER ACTIVITY TRACKER AGAINST POLYSOMNOGRAPHY AND ACTIGRAPHY IN INSOMNIA.**

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**Introduction:** Consumer activity trackers claiming to measure sleep/wake patterns are ubiquitous within clinical and consumer settings. However, validation of these devices in sleep disorder populations are lacking.

**Methods:** We examined one night of sleep in 28 individuals with insomnia (19-82 years-old; mean=45.2±17.3) using polysomnography, a standard wrist actigraph (Actiwatch Spectrum Pro: ACT) and a consumer activity tracker (Fitbit Alta HR: FB). Epoch-by-epoch analysis was used to determine agreement between each device and polysomnography for overall sleep/wake detection and sleep variables, including total sleep time (TST), sleep efficiency (SE), wake after sleep onset (WASO) and sleep latency (SL). Clinically meaningful limits of agreement were set a priori at ±30 minutes for TST, SL, and WASO, and ±5% for SE. Analyses compared detection of light sleep (N1+N2), deep sleep (N3), rapid eye movement (REM) and wake by FB, relative to polysomnography.

**Results:** Compared to polysomnography, both activity trackers displayed high sensitivity (96.79% and 95.73%, respectively) but low specificity (38.21% and 43.86%, respectively). Both devices overestimated TST and SE and underestimated SL and WASO, and all variables except SL exceeded clinical cut-offs. FB demonstrated sensitivity and specificity rates of 78% and 59%, respectively, in light sleep, 49% and 95% in deep sleep, 65% and 90% in REM, and 41% and 96% in stage wake.

**Conclusion:** Consistent with prior models of research-grade and consumer activity trackers, both devices in this study were more accurate in detecting sleep than wake, and sensitivity/specificity values were statistically equivalent. Thus, this model of FB could serve as a low-cost substitute for actigraphy in insomnia. Moreover, data would be as useful clinically as research-grade actigraphs (which is, admittedly, debatable). This FB model missed several occurrences of specific sleep stages, though when it did identify N3, REM or wake, it was generally accurate. Thus, it underestimates these sleep stages and overestimates light sleep, providing a picture of less quality sleep than actually obtained. Future research should examine night-to-night variability in binary sleep/wake outcomes as well as sleep variables over several days within this population.

**Support (If Any):** N/A.

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**0314**

**CHANGES IN SLEEP DEPTH FOLLOWING SLEEP DEPRIVATION ASSESSED BY THREE METHODS**

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Sleep and Performance Research Center, Washington State University, Spokane, WA, USA.

**Introduction:** Though the concept of chrononutrition has become increasingly studied in laboratory research, a valid assessment of chrononutrition patterns in daily life has not yet been developed.

**Methods:** The present study therefore aimed to develop and validate both a diary and questionnaire version of the Chrononutrition Profile which assess 6 components of chrononutrition that have been associated with poor health (breakfast skipping, night eating, eating window, evening latency, largest meal, and evening eating). Raw scores from the CP can be used in calculations to determine one’s chrononutrition categorization (good; fair; poor). Based on the nature of the data, bivariate correlations, multilevel modeling, and hierarchical regression techniques were used to evaluate test-retest reliability, convergent validity, and concurrent validity of the CP.

**Results:** The measure demonstrated evidence of test-retest reliability and convergent validity, though concurrent validity was not able to be interpreted in the present sample. Based on analyses, the final diary and questionnaire versions of the CP assess 5 components of chrononutrition: breakfast skipping, night eating, eating window, evening latency, and evening eating.

**Conclusion:** The present study has provided preliminary support for the CP. The CP may be used independently as an indicator of health risk or as a supplement to traditional dietary assessment tools. This measure will provide health care professionals, researchers, and stakeholders with a cost-effective method of evaluating chrononutrition status and identifying targets for health improvement.

**Support (If Any):** None

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Introduction: Following sleep deprivation, sleep is presumed to be deeper than during baseline sleep due to greater sleep pressure. EEG delta power, a marker of sleep pressure is higher during sleep following sleep deprivation. Delta power also returns to baseline levels at the end of the recovery night, suggesting that full recovery occurs in one night. The present study compared Initial and Terminal values of three sleep depth metrics: a) delta power, b) odds-ratio-product (ORP; 0=deep sleep, 2.5=full wakefulness), and c) arousal/awakening index (AWI), in order to better characterize recovery from sleep deprivation.

Methods: 40 healthy subjects (35.3 ± 5.3 years, 25 females) underwent two polysomnograms separated by 36 hours of sleep deprivation. Delta power, ORP, and AWI were measured in the first (Initial) and last (Terminal) 1.5 hours of NREM sleep in each study. Average values of the three metrics were also calculated for stages N1, N2 and N3.

Results: Initial delta power was higher during recovery than during baseline sleep (284 ± 157 vs. 181 ± 89 µV²; p < 0.00001). The difference in Terminal delta power (77 ± 34 vs. 62 ± 35 µV²; p = 0.02) was a small fraction (~15%) of the initial difference, suggesting nearly complete recovery. Initial ORP was lower during recovery than during baseline (0.26 ± 0.11 vs. 0.35 ± 0.11; p < 0.00001) but the difference in Terminal ORP (0.39 ± 0.19 vs. 0.45 ± 0.10; p = 0.00002), was ~67% of the initial difference indicating only modest recovery. Initial AWI was lower in recovery (13.8 ± 7.1 vs. 20.2 ± 10.3 hr⁻¹; p < 0.00005), and, like ORP, the difference in Terminal AWI (24.1 ± 10.7 vs. 27.5 ± 9.2 hr⁻¹; p < 0.03) indicated modest recovery (~50% of initial difference) Terminal delta values (77 ± 34) were lower than in stage N1 (124 ± 89 µV²) suggesting light terminal sleep, whereas Terminal ORP and Terminal AWI were both intermediate between levels found in stages N2 and N3, suggesting deeper terminal sleep than inferred by delta power.

Conclusion: ORP and AWI results indicate that sleep loss accrued during deprivation is only partially recovered during one recovery night. Delta power showed a different pattern, suggesting that delta may not be an adequate measure of sleep depth.

Support (If Any): NIH1P01-1HL094307, NIHP50HL060287, NIHT32HL0071324

0315

REPRESENTATION OF POLYSOMNOGRAPHY RECORDINGS AS LOW DIMENSIONAL TRAJECTORIES

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Introduction: Polysomnography (PSG) recording is the gold standard in the study of sleep. Qualitative evaluation of sleep (sleep scoring) is based on the visual identification of sleep stages by human experts according to the traditional Rechtschaffen and Kales standard and the more recent American Academy of Sleep Medicine standard. Considering that PSG is the best system for recording a sleep session, current rules show some limitations, such as inter-scorer accuracy (~80%), ambiguous epochs or paradoxical insomnia. Dimensional reduction methods allow us to visualize complex and synchronized data in two or three dimensions as PSG requires more precise and comprehensive analysis. We have chosen here to compare different dimension reduction methods to visualise PSG. The aim of this study is to visually find known parameters of sleep with low dimension representations of polysomnography.

Methods: We use 2 types of dimensional reduction models to project polysomnography recordings into 2 or 3 dimensions trajectories: Firstly, a Principal Component Analysis model that reduces the number of variables and makes informations less redundant. Secondly, an unsupervised machine learning model (autoencoder) that learns to compress information into lower-dimension representation (latent space). Importantly, this compression forces the model to represent similar signals into the same regions of the latent space. We applied these algorithms on a dataset of 10 chronic insomniacs, 10 patients with sleep state misperception and 10 good sleepers. Visual criterions selected were the slow wave gradient, the REM sleep differentiation and the visualization of sleep stages.

Results: With these two models we find known parameters of the sleep independently of the sleep scoring. These parameters seem invariably for each patient.

Conclusion: These low-dimensional representations of polysomnography make it possible to visually find known sleep parameters with interesting visual invariability on a dataset of 30 subjects including insomniac patients and sleep state misperception. These representations are promising tools to complement the standard hypnogram and may enable better identification of sleep disorders.

Support (If Any): Banque publique d’investissement, Dreamcare Project.

0316

AUTOMATIC DETECTION OF CORTICAL AROUSALS USING RECURRENT NEURAL NETWORKS


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Introduction: Scoring of arousals in EEG signals is a time-consuming and the agreement between experts has been reported with intraclass correlation (ICC) of 0.54 to 0.76. Advances in machine learning and artificial neural networks make it feasible to train computer models to detect arousals in EEG signals. The main challenges, in training the models, are the low agreement between experts, the scoring of arousals is often not accurate since labels are not placed exactly over the arousal, and arousals make up a small portion of the sleep study.

Methods: We present a method for detecting arousals in EEG signals from polysomnographies (PSG). Features of clinical and statistical origins were derived from the EEG signals and fed into a Bidirectional Recurrent Neural Network, using Long Short-Term Memory units (BRNN-LSTM). The predictions of five neural networks, trained using different features and training sets, were averaged for each sample. The method was developed and validated on two data sets one containing 165 clinical PSGs and the other from the PhysioNet 2018 Challenge dataset consisting of a training set of 994 subjects and a hidden test set of 989 subjects.

Results: The ICC calculated on a hidden test set of 16 recordings, randomly selected from the clinical PSG studies, was ICC(2,1) 0.88 and the area under precision-recall curve (AUPRC) was 0.81.
**A. Basic and Translational Sleep Science**

Five-fold cross-validation on the PhysioNet data set resulted in an ICC(2,1) of 0.59, AUPRC score of 0.45, and on the hidden test set the AUPRC score was 0.45.

**Conclusion:** Effectively scoring arousals automatically is important, as manual scoring of arousals is time consuming and difficult. The automatic analysis from the clinical data set showed better results than reported from manuals scoring. The PhysioNet dataset showed lower validation score due to the lower quality of the signals and the manual scoring. Implementing automatic arousal scoring into a commercial software will make new analysis available to the clinic.

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**0317 QUANTIFYING IMPORTANCE OF ELECTROENCEPHALOGRAPHY SPECTRAL DOMAIN FEATURES IN AUTOMATIC DIAGNOSIS OF CHRONIC INSOMNIA.**

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**Introduction:** Polysomnographies (PSG) electroencephalographic (EEG) records contains many relevant information unused in clinical processes. Algorithms commonly used in machine learning can help us identify the most important features used by models in classification problems. The objective is to compare the efficiency of EEG Rapid Eye Movement (REM) and Non-Rapid Eye Movement (NREM) sleep features from PSG in the detection of chronic insomnia between control records.

**Methods:** 299 PSG have included: 54 controls subjects and 245 chronic insomniacs. Spectral power of the EEG central derivations (C3-M2) have been extracted then divided into 0.5 Hertz bands from 0.5 Hz to 40 Hz with Fast Fourier Transforms (FFT) for each REM and NREM 30 seconds sleep epochs. Bands powers have been normalized by dividing by the broadband (0.5-40Hz) power. For each PSG, average power for each band have been computed for REM and NREM epochs. A few algorithms, including linear support vector machine (SVM) and random forests, have been trained, firstly with NREM, then with REM features to detect chronic insomnia diagnosis. Global performance have been estimated with a Cohen Kappa (CK) test on a data subset, unused during training (train/test split 0.7, Bootstrap method). Individual importance of each feature have been estimated with the area under the receiver operating characteristic curve (ROC AUC).

**Results:** SVM is better at chronic insomnia detection with REM features than with NREM features (CK > 0.89). REM bands between 3-6Hz have the highest ROC AUC of all the features (>0.9).

**Conclusion:** EEG spectral domain features from REM sleep are better to diagnose chronic insomnia than spectral domain features from NREM sleep. Differences appeared in specific REM sleep brain oscillations between controls and chronic insomniacs.

**Support (If Any):** Banque Publique d’Investissement, Dreemcare Project.

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**XV. Instrumentation and Methodology**

**0318 TOWARDS A DEEP LEARNING-BASED JOINT DETECTION MODEL FOR NOCTURNAL POLYSOMNOMGRAM EVENTS**

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**Introduction:** Manual analysis of nocturnal polysomnograms (PSGs) is still the standard in sleep laboratories. The process is time-consuming and prone to subjective interpretation of scoring rules and scorer fatigue. Recent developments in deep learning algorithms have shown promise for micro-event detection in PSGs. We propose a modification to the recently published DOSED algorithm that can be utilized for detection of arousals, respiratory events and leg movements, and can also automatically annotate start and duration of these events.

**Methods:** We collected event data from 1000 PSG studies in the public MESA database. Central EEG, left/right EOG and chin EMG; thoraco-abdominal belts, nasal pressure/flow, oxygen saturation and snore microphone; and leg EMG data were used to detect arousals; obstructive sleep apnea (OSA), central sleep apnea (CSA), and hypopnea events; and leg movements (LM), respectively. Briefly, the applied deep learning model consists of an initial spatial filtering layer followed by eight blocks of convolutional layers for feature extraction. Two types of classification layers were used to 1) detect the presence or absence of any type of event, and 2) automatically determine start times and duration of predicted events. The model was trained using 400 PSGs studies, validated on 100 PSGs and subsequently tested on 500 PSGs.

**Results:** Overall F1, precision and recall scores for arousal event detection were 0.712, 0.721, and 0.703, respectively, while the same metrics for OSA, CSA and hypopnea detection were 0.629, 0.546, 0.743; 0.328, 0.386, 0.284; and 0.47, 0.385, 0.604, respectively. LM detection yielded poorer performance with overall F1, precision and recall of 0.29, 0.226, and 0.402, respectively.

**Conclusion:** Preliminary results indicate that a concurrent detection model can detect and annotate with start and stop multi-variate events in the nocturnal polysomnogram, although more work in a larger cohort is needed in order to improve LM and CSA detection. However, this is a positive step towards an all-purpose sleep analysis algorithm.

**Support (If Any):** Klarman Family Foundation; Technical University of Denmark; University of Copenhagen; Reinholdt W. Jorck, Knud Hoejgaard, Otto Moensted, Vera & Carl Michaelsens, Augustinus, and Stibo foundations.

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**0319 SLEEPWAKE DETECTION BY BEHAVIORAL RESPONSE TO HAPTIC STIMULI**

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ANTHROPOMETRIC EVALUATION OF OBSTRUCTIVE SLEEP APNEA (OSA) IN A COMMUNITY POPULATION

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Introduction: Sole reliance on body mass index (BMI) as an indirect measure of obesity may lead to imprecise predictions of obstructive sleep apnea (OSA) risk. Adding an indirect measurement of fat distribution, such as neck circumference (NC), may be insufficient for improving sensitivity. A simple method without measuring blood pressure might be useful in remote locations. We compared anthropometric ratios to determine if they alone predicted the apnea hypopnea index (AHI) or could be replacement variables for the NC item in the alternative scoring of the STOP-Bang Questionnaire (SBQ).

Methods: Eighty-six participants with anthropometric measurements from the ongoing Assessing Daily Activities Patterns through occupational Transitions (ADAPT) study were included. We evaluated the following ratios: neck-stature ratio (NSR), neck-wrist ratio (NWR), and the waist-stature ratio (WSR). Receiver operating characteristic (ROC) analyses evaluated each ratio’s ability to predict AHI≥15 and AHI≥30. We further evaluated the SBQ’s ability to predict AHI≥15 and AHI≥30 with each ratio subsequently replacing the NC item in the SBQ. Each ratio was dichotomized at the mean, with a score of 1 being greater than the mean in lieu of the NC item.

Results: Mean age was 40.2 (40% male), and mean BMI was 30.2 kg/m². The mean NCs were 40.2 cm for males and 35.1 cm for females. The ROCs for the NSR, NWR, WSR, and SBQ predicting AHI≥15 were 0.72, 0.71, 0.59, and 0.64, respectively (p=.22), and were 0.57, 0.57, 0.47, and 0.56, respectively (p=.017), predicting AHI≥30. When each ratio replaced NC in the SBQ, ROCs were 0.70, 0.69, 0.69, and 0.64, respectively (p=.45), predicting AHI≥15 and 0.51, 0.54, 0.49, and 0.55, respectively (p=.08), predicting AHI≥30.

Conclusion: Anthropometric ratios that relate NC to body frame, NSR and NWR, performed similarly to the SBQ when predicting AHI≥30. The simple alternative scoring with NSR and NWR replacing NC performed similarly in SBQ prediction. The NSR and NWR may have useful application in remote areas.

Support (If Any): 1R01HL117995-01A1

0321 PILOT STUDY DETECTING PATTERNS IN REM SLEEP IN HEALTHY ADULTS FOR LATER COMPARISON WITH ALZHEIMER’S PATIENTS

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Introduction: Patients with Alzheimer’s disease (AD) spend less time in REM sleep compared to healthy controls, while the number of REM sleep episodes does not appear to differ between AD and normal. With the advent of fitness trackers capable of detecting sleep stages, sleep architecture can now be tracked daily, passively, and continuously for long durations. This pilot is the first step in a larger scale human subjects study aimed at identifying relationships between daily behaviors and sleep patterns indicative of cognitive changes, proteomic signatures, and the regenerative potential of neural networks derived from induced pluripotent stem cells donated from patients with AD and healthy controls.

Methods: We analyzed 13 healthy volunteers’ sleep and daily activity (5 male, 9 female) from October 2017 to the present, using a wearable fitness device. Volunteers were between the ages of 18 and 23, with 19 to 421 nights of sleep per subject recorded and an overall 2641 nights of data collected.

Results: Average time in REM across all participants was 95.6 (+/- 15.4) min/night with an average REM period length of 22.2
DEVELOPMENT OF COMPLEX DATA PLATFORM FOR THE STANFORD TECHNOLOGY ANALYTICS AND GENOMICS IN SLEEP (STAGES) STUDY

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Introduction: The Stanford Technology Analytics and Genomics in Sleep (STAGES) is a prospective cross-sectional, multi-site study charged with collecting and disseminating data to the scientific community. The following data elements will be obtained from 30,000 adult/adolescent sleep clinic patients: (1) in-lab polysomnography, (2) online questionnaire (Alliance Sleep Questionnaire), (3) blood sample (DNA, serum, plasma), (4) University of Pennsylvania’s computerized neurocognitive test battery (CNB), (5) 3D photo, (6) 2-weeks of actigraphy with sleep diary, and (7) clinical data from the electronic health record. The multifaceted nature of the project required a robust data platform employing creative techniques to receive, organize, and share an array of electronic data elements aggregated from multiple external systems.

Methods: STAGES partnered with Prometheus Research, LLC to design and build a customized platform using their open source integrated research registry, RexStudy. The teams met regularly to develop a system that would meet the project needs. Requirements included: mechanisms to securely transfer data from multiple disparate data sources and match to correct subject, patient portal to enroll participants via electronic consent and accommodate electronic case report forms, extensive data validation and error reporting, granular access privileges for different user classes, sophisticated querying and analytic tools, and ability to export all data for complete portability. Each phase of the project, including creation of custom APIs, was heavily tested in a user acceptance testing (UAT) environment before being deployed to production.

Results: The STAGES data platform currently holds data from the 530 enrolled research participants. Fifty members of the STAGES team have accounts for entering, analyzing, or monitoring the 75 plus data tables, and so far, there are more than 20 queries for data monitoring and quality control.

Conclusion: The STAGES data platform was successfully deployed and is being used to collect, monitor, and analyze data from multiple external sources. We are continuing to add functionality to enhance the system’s utility.

Support (If Any): UTSA Brain Health Consortium seed grant

VALIDITY OF SURVEY MEASURES OF SLEEP DURATION, EFFICIENCY, AND TIMING

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Introduction: Single time-point retrospective questionnaires of sleep, or sleep surveys, are subjective measures that briefly assess various sleep parameters typically using 1-3 questions. Surveys are the most frequently used measures of sleep in existing research yet validity research is extremely limited. The current study sought to compare survey measures of total sleep time (TST), sleep efficiency (SE), and circadian midpoint (CM) with prospective subjective (i.e., sleep diary) and objective (i.e., actigraphy, EEG) measures.

Methods: Community adults (N = 80; M age = 32.7±10.1; 63% female; 85% white) completed psychosocial baseline questionnaires. Over the next 7 days and nights, they completed a sleep diary and wore an actigraph and a single-channel EEG device in their typical sleeping environment. Participants then completed a retrospective survey of their sleep over the past 7 days and a clinical interview for sleep disorders. Sleep parameters were compared using Bland-Altman plots and prediction intervals.

Results: Bland-Altman plots revealed non-constant bias such that individuals with lower TST, SE, and CM underestimated these parameters on survey and individuals with greater TST, SE and CM overestimated on survey compared to sleep diary, actigraphy, and EEG. Prediction intervals were broad for survey compared to other measures: over 1.3 hours for TST, over 10% for SE, and over 45 minutes for CM, suggesting that precision of estimates from surveys was poor.

Conclusion: Results suggest retrospective sleep surveys demonstrated poor validity compared to other subjective and objective measures. Most concerning is the non-constant bias at different levels of TST, SE, and CM which is difficult to adjust for either clinically or statistically. Previous research suggests recall for frequent behaviors such as sleep is poor and subject to high degrees of error/reporting bias, particularly in individuals with insomnia. If attempting to approximate objective measures and limit bias, sleep diaries are the subjective measure of choice. Future research should differentiate between subjective and objective estimates of sleep parameters as related yet overlapping constructs.

Support (If Any): Research supported by grants from General Sleep Corporation (PI: Dietch) and Foundation for Rehabilitation Psychology (PI: Dietch).

2B-ALERT WEB 2.0: AN OPEN-ACCESS TOOL TO DETERMINE CAFFEINE DOSES THAT OPTIMIZE ALERTNESS

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Introduction: Caffeine is the most widely consumed stimulant to counter the effects of sleep deprivation on alertness. However, to be safe and most effective, the right amount must be consumed at the right time. Recently, we developed an algorithm that automatically provides guidance for optimal caffeine consumption to safely maximize alertness at the desired time of the day. However, to be useful to the research and schedule-planner communities, we made this capability freely available through a Web server, where users can compare and contrast the effects of different sleep/wake and caffeine schedules on alertness.

Methods: We extended our previously developed open-access Web tool, 2B-Alert Web, by incorporating the automated caffeine-guidance algorithm. Specifically, in this version, we allow users to input 1) desirable peak-alertness periods within a sleep/wake schedule, 2) the minimum desirable level of alertness, and 3) the maximum tolerable daily caffeine intake (≤ 1500 mg). The tool then provides the optimal caffeine doses (timing and amount) to achieve peak alertness levels at the desired times, while meeting user-defined constraints. It also displays the corresponding psychomotor vigilance test alertness predictions, which together with the caffeine guidance, can be exported to a spreadsheet.

Results: When we compared the 2B-Alert Web 2.0 caffeine-consumption guidance for multiple sleep-deprivation and shift-work scenarios with the U.S. Army guidelines, we observed an average improvement of 40%. The tool suggested solutions that either required 40% less caffeine or that enhanced alertness by an additional 40%.

Conclusion: With this added capability, the 2B-Alert Web 2.0 now allows users to 1) predict the alertness of an "average" individual as a function of sleep/wake and caffeine schedules and 2) automatically obtain optimal caffeine doses (timing and amount) to achieve peak alertness at the desired times. As such, the tool provides the first quantitative caffeine optimization tool for designing effective strategies to maximize alertness, while avoiding excessive caffeine consumption.

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0325 NONLINEAR SMOOTHING OF DATA WITH RANDOM GAPS AND OUTLIERS (DRAGO) IMPROVES ESTIMATION OF CIRCADIAN RHYTHM

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Introduction: Core body temperature (CBT) measurement using an ingestible pill has been proven effective for field-based ambulatory applications. However, it suffers from two key challenges: outliers due to electromagnetic interference and missing data. This work focuses on a convex-optimization method for handling missing data and outliers in the CBT signal.

Methods: Eight cognitively normal elderly subjects (age=66.7±5.2 yrs., 2M/6F) fully entrained in 24hr activity cycle without complaints of circadian rhythm sleep-disorders participated in this study. CBT was assessed using an ingestible sensor (CorTemp, HQ Inc., Palmetto, Florida, USA). As part of the study, subjects’ habitual bedtimes were assessed with 7-day actigraphy (Motionlogger, AML, NY). A nonlinear signal model for the CBT signal was formulated that comprised a smooth signal and a sparse signal representing outliers in presence of additive white Gaussian noise. A convex optimization problem was then used to estimate the smooth signal component from the raw CBT signal. The primary measures from the processed CBT signal were acrophase (time of peak temperature) and period. A fast Fourier transform (FFT) of the processed CBT signal was used to deduce the period. Primary measures from the actigraphy were acrophase (time of peak activity using MESA) and period (FFT-based).

Results: The average CBT signal duration obtained was 41.5±3.5 hrs. (mean±sd). Using Lomb-Scargle periodogram, which can handle missing/non-uniformly sampled data, the period was 27.9±3.5 hrs. In contrast, period obtained from the DRAGO-processed CBT signal was 23.8±0.31 hrs. Period obtained from the actigraphy was 24.7±0.5 hrs. Acrophase using CBT signal was not significantly different from that obtained using the actigraphy (actigraphy:14.2±1.6 hrs.; CBT:13.6±1.2 hrs., since nadir: p=0.4).

Conclusion: A convex-optimization framework accurately recovers the underlying CBT signal. The method was validated on fully entrained subjects with an expected 24hr rhythm. For field-based ambulatory applications, the period and acrophase from the CorTemp pill are similar to that obtained using an actigraph. The validity of the proposed method to estimate intrinsic circadian rhythm in a constant-routine environment remains to be tested.

Support (If Any): R21AG055002; K24HL109156; R01AG056682; R21AG059179

0326 SLEEP STAGE PREDICTION WITH RAW ACCELERATION AND PHOTOPLETHYSMOGRAPHY HEART RATE DATA DERIVED FROM A CONSUMER WEARABLE DEVICE

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Introduction: Wearable, multisensor, consumer marketed devices that estimate sleep are now commonplace, but the algorithms used by these devices to score sleep are not disclosed. Additionally, the raw acceleration and heart rate data collected by the device sensors is rarely accessible. Moreover, approaches to distinguish sleep from wake typically consider small windows of time in isolation and neglect previously established, validated mathematical models describing sleep-wake control such as the well-known contribution of the circadian oscillator.

Methods: We collected raw acceleration data (in meters per second squared) and heart rate from the Apple Watch worn by participants undergoing polysomnography using code of our own

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creation. Using this data, we compared the contributions of multiple features (motion, heart rate, and "clock proxy" -- a stand-in for circadian drive) to classifier performance across several algorithms.

**Results:** Best performance was achieved using a neural net trained on motion, heart rate, and "clock proxy" features. To assess generalizability of our results, we tested the models trained on Apple Watch data with data from the Multi-ethnic Study of Atherosclerosis (MESA) and were able to meet or exceed past sleep staging algorithm performance.

**Conclusion:** This study demonstrates, for the first time, the ability to analyze raw acceleration and heart rate data from a ubiquitous wearable device with various methods to improve accuracy of sleep and sleep stage prediction. Additionally, we demonstrate the relevance of including estimated circadian phase as an input to improve sleep and sleep stage estimation. All code used in this project is being made open source.

**Support (If Any):** This work is supported by an Exercise Sports Science Initiative grant from the University of Michigan.

**0327 RELATION BETWEEN SPEED OF WAKE-SLEEP TRANSITIONS AND WAKE TIME IN POLYSOMNOGRAMS.**

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**Introduction:** The immediate neurophysiological mechanism for excessive wake time (W) during polysomnography is unknown. Switching from wakefulness to stable sleep involves progression from full wakefulness to dozing, to light sleep to progressively deeper sleep. We hypothesized that the rate at which sleep depth increases may be an important determinant of W since the slower the rate, the longer the brain lingers in a highly arousable state, increasing the probability that the process is reversed soon after it starts.

**Methods:** We determined rate of progression of sleep depth at wake-sleep transitions using the Odds-Ratio-Product (ORP), a validated continuous index of sleep depth ranging from 0 (deep wake) to 2.5 (full wakefulness). Probability of spontaneous arousal occurring within 30 seconds increases directly with current ORP (r²=0.98). We analyzed 145 PSGs of patients referred for investigation of a sleep disorder, mostly sleep apnea. As controls, we analyzed PSGs of all Sleep-Heart-Health-Study (visit-2) subjects who had no sleep apnea (AHI<5 hr⁻¹) or complaints of insomnia or restless legs (RLS), (n=46). Time course of ORP from onset of wake-sleep transition was determined for all transitions in each PSG and average time course was calculated. Speed of transitions was expressed by average ORP 2-minutes after onset of transitions (ORP₂₀).

**Results:** Wake time was 116±80 and 56±44 minutes in patients and controls, respectively. ORP₂₀ was 1.54±0.28 and 1.05±0.26, respectively, indicating slower wake-sleep transition in patients (p=E-20). There was a significant correlation in patients (n=145) between ORP₂₀ and natural logarithm of wake time in minutes (ln(W) = 1.15*ORP₂₀ + 2.74; r²=0.19, p=E-07) and this improved further, with little change in slope and intercept, when control subjects were added (n=191): (ln(W) = 1.32*ORP₂₀ + 2.44; r²=0.29, p=E-15). Using multiple regression with ln(W) as the dependent variable and age, gender, BMI, AHI, RLS, and ORP₂₀ as independent variables, the most significant variable was ORP₂₀ (p=E-12) with age (p<0.01) and RLS (p<0.05) as distant second and third.

**Conclusion:** Slow rate of sleep depth progression at wake-sleep transitions is an important risk factor for excessive wake time.

**Support (If Any):** None

**0328 USE OF ACTIGRAPHY FOR THE EVALUATION OF SLEEP DISORDERS AND CIRCADIAN RHYTHM SLEEP-WAKE DISORDERS: AN AMERICAN ACADEMY OF SLEEP MEDICINE CLINICAL PRACTICE GUIDELINE**

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**Introduction:** The American Academy of Sleep Medicine commissioned a task force of experts in sleep medicine to develop updated clinical practice recommendations based on a systematic review of the literature.

**Methods:**

**Results:** 1. We suggest that clinicians use actigraphy to estimate sleep parameters in adult patients with insomnia disorder. (Conditional)2. We suggest that clinicians use actigraphy in the assessment of pediatric patients with insomnia disorder. (Conditional)3. We suggest that clinicians use actigraphy in the assessment of adult patients with circadian rhythm sleep-wake disorder. (Conditional)4. We suggest that clinicians use actigraphy in the assessment of pediatric patients with circadian rhythm sleep-wake disorder. (Conditional)5. We suggest that clinicians use actigraphy integrated with home sleep apnea test devices to estimate total sleep time during recording (in the absence of alternative objective measurements of total sleep time) in adult patients suspected of sleep-disordered breathing. (Conditional)6. We suggest that clinicians use actigraphy to monitor total sleep time prior to testing with the Multiple Sleep Latency Test in adult and pediatric patients with suspected central disorders of hypersomnolence. (Conditional)7. We suggest that clinicians use actigraphy to estimate total sleep time in adult patients with suspected insufficient sleep syndrome. (Conditional)8. We recommend that clinicians not use actigraphy in place of electromyography for the diagnosis of periodic limb movement disorder in adult and pediatric patients. (Strong)

**Conclusion:**

**Support (If Any):** None
B. Clinical Sleep Science and Practice

0329
BRAIN REACTIVITY TO SLEEP-RELATED PICTURES IN PATIENTS WITH CHRONIC INSOMNIA DISORDER
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Introduction: Perceived sleep need can vary among individuals. Even if it shows the same short sleeping duration, it may be caused by different reasons including insomnia symptom, a person who sleep less (short sleeper), or sleep deprivation. To answer this question, we need a fundamental approach to classify Chronic Insomnia Disorder (CID) from various sleep types and to examine neural mechanisms underlying their differences. The present study aim to explore whether brain response to sleep-related picture differs in CID and several sleep types.

Methods: 55 participants were divided into four groups: 25 Chronic Insomnia Disorder according to International Classification of Sleep Disorders-3 (ICSD-3) criteria (CID; 21 female, age=46.9±12.8), 15 Good Sleepers (GS; 10 female, age=38.4±13.7), 9 Short Sleepers (SS; sleep duration less than 6 hours per day but not have insomnia symptoms; 4 female, age=40.4±12) and 6 Insufficient Sleepers (IS; sleep duration less than 6 hours per weekday and weekend over sleep more than 2 hours; 3 female, age=32.1±16.1). During fMRI, participants completed a sleep-related picture task. To examine group differences in brain response to sleep-related pictures vs. control pictures, one-way ANOVA was conducted. Furthermore, correlation analyses were performed to test associations between neural response and clinical features including the Pittsburgh Sleep Quality Index (PSQI), the Insomnia Severity Index (ISI), and the Epworth Sleepiness Scale (ESS), and the Dysfunctional Beliefs and Attitudes about Sleep (DBAS).

Results: CID showed significantly greater PSQI, ISI and DBAS scores than three other groups (p<0.05). Compared with the other groups, CID group showed increased neural response to sleep-related pictures in bilateral insula, right anterior cingulate cortex, left postcentral gyrus, left posterior insula (p<0.001, cluster size=50). Brain response in these regions was positively correlated with PSQI and ISI scores (p<0.05).

Conclusion: CID showed increased responses to sleep-related pictures in brain regions have been implicated in attention and emotional regulation. These results suggest that there may be attentional bias or emotional response to sleep-related pictures in CID patients.

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0330
CHRONIC STRESS AND INSOMNIA: EXPLORING THE TRANSITION FROM ACUTE TO CHRONIC INSOMNIA
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Introduction: Stress-related sleep vulnerability has been shown to be a predisposing factor for insomnia. Individuals with high sleep vulnerability tend to experience sleep disturbance when facing stressful daily life events. Since being diagnosed with cancer is a huge life event that might disturb sleep by itself, it is unknown whether sleep vulnerability also play a role in the context of insomnia triggered the diagnosis of cancer. The current study aims to investigate this issue by comparing the trait sleep vulnerability between cancer-diagnosis-triggered insomnia and chronic insomnia without comorbidity.
**Methods:** Participants included 78 breast cancer patients who developed insomnia after being diagnosed with cancer, 74 breast cancer patients without insomnia, 32 primary insomnia patients, and 73 good sleep controls. All participants completed a package of questionnaires including the Ford Insomnia Response to Stress Test (FIRST) for sleep vulnerability and Insomnia Severity Index (ISI) for insomnia severity.

**Results:** One-way ANCOVA showed significant difference in their FIRST score after controlling age (F = 16.65; p<.001). Post-hoc comparisons with Bonferroni’s correction showed significant differences between breast cancer patients with and without sleep complaint (24.70±6.26 vs 20.40±5.89; F = 16.807, p <.001) as well as between insomnia patients and normal sleepers (23.31±6.36 vs 18.34±6.27; F = 12.799, p <.01). However, no difference was found between breast cancer patients with insomnia and chronic insomnia patients.

**Conclusion:** Although being diagnosed with cancer could be a huge shock that can trigger the onset of insomnia, the sleep disturbance however only occurs in some individuals but not others. The results indicate that sleep vulnerability to stress is a common predisposing factor for insomnia both with and without comorbidity. It should be addressed in the management of cancer-related insomnia.

**Support (If Any):** The Ministry of Science and Technology, Taiwan

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**0332 NEGATIVE MOOD AS A MEDIATOR OF THE ASSOCIATION BETWEEN INSOMNIA SYMPTOMS AND MARIJUANA PROBLEMS IN YOUNG ADULTS**

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**Introduction:** Insomnia symptoms have been linked to problematic marijuana use among young adults, but the mechanism underlying this association remains unclear. This study examined negative mood as a mediator of the association between insomnia and marijuana problems among young adults.

**Methods:** Undergraduate students (N=276, 62% female, 52% White, 18-26y) reporting marijuana use in the past month provided informed consent and completed a survey online from remote locations. Insomnia symptoms were assessed using the Insomnia Severity Index; negative mood was assessed using the Depression, Anxiety, and Stress Scale; and marijuana problems (e.g., getting into fights or neglecting responsibilities as a result of marijuana use) were assessed using the modified Rutger’s Marijuana Problem Index. Negative mood was examined as a mediator of the association between insomnia and marijuana problems using bootstrapped significance tests for indirect effects (n-boot=1,000). Because we were unable to account for the temporal precedence between variables, insomnia symptoms were also modeled as a mediator of the association between negative mood and marijuana problems. All analyses controlled for age, gender, and frequency of marijuana use.

**Results:** Insomnia symptoms had a significant total effect (combined direct and indirect effect) on marijuana problems (β=-0.29, SE=0.03, p<.001). There was no direct association between insomnia symptoms and marijuana problems (β=0.19, SE=0.15, p=.21); however, insomnia symptoms influenced marijuana problems indirectly through negative mood (ab=0.66, SE=0.15). This indirect effect accounted for 79% of the total effect of insomnia symptoms on marijuana problems. In the alternative temporal ordering model, there was a direct association between negative mood and marijuana problems (β=0.29, SE=0.03, p<.001), with no indirect effect through insomnia symptoms (ab=0.02, SE=0.02).

**Conclusion:** Insomnia symptoms are associated with more negative mood among young adults who use marijuana, and this effect on negative mood accounts for the influence of insomnia symptoms on marijuana-related problems. Research is needed to examine these associations prospectively among young adults.

**Support (If Any):** None

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**0333 OBJECTIVE METHODS ARE NEEDED IN THE DIAGNOSTIC ASSESSMENT OF CHRONIC INSOMNIA FOLLOWING MILD TRAUMATIC BRAIN INJURY**

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**Introduction:** Insomnia symptoms following mild traumatic brain injury (mTBI) -including concussion- are major predictors poor mTBI outcomes. Insomnia symptoms may be caused by specific sleep disorders that can be effectively treated, which in turn, may improve mTBI outcomes. Previous studies have focused on insomnia symptom assessment or evaluated samples with all TBI severities. To effectively manage insomnia following mTBI, it is important to move beyond symptom assessment and conduct a diagnostic sleep evaluation to understand which sleep disorders contribute to insomnia symptoms in this clinical group.

**Objective:** Determine the prevalence of sleep disorders that contribute to chronic insomnia symptoms in a homogeneous and representative sample of patients with mTBI.

**Methods:** Individuals with chronic insomnia symptoms following mTBI (N = 50; age 17-65; 64% females; 3 - 24 months post mTBI) participated in a multi-method sleep and circadian assessment, including a standard sleep and psychiatric interview, questionnaires, standard sleep diary, actigraphy, polysomnography and dim light melatonin onset test. Sleep and circadian disorders were diagnosed according to International Classification of Sleep Disorders criteria.

**Results:** Insomnia disorder was the most common diagnosis (62%), followed by obstructive sleep apnea (OSA) - 44%; circadian rhythm sleep-wake disorders (CRSWD) - 26% and periodic limb movement disorder (PLMD) - 8%. The most common comorbid sleep disorder conditions were insomnia disorder and OSA (34%).

**Conclusion:** OSA and CRSWD frequently occur among patients whose main presenting sleep symptom is chronic insomnia following a mTBI. Given that 72% of patients with insomnia symptoms had a specific sleep or circadian disorder (OSA, PLMD, or CRSWD) that require objective assessment methods, subjective assessment tools are insufficient for diagnostic purposes after a mTBI. Instead, strategically selected objective sleep and circadian...
assessment should be part of the diagnostic chronic insomnia evaluation following a mTBI.

Support (If Any): N/A

0334
DOES “TIB” DIFFERENTIATE BETWEEN GOOD SLEEPERS AND SUBJECTS THAT DEVELOP ACUTE OR CHRONIC INSOMNIA?

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Introduction: According to the 3P model of insomnia, the variable that mediates the transition from acute to chronic insomnia is “sleep extension”, the behavioral tendency to expand sleep opportunity to compensate for sleep loss. In the present analysis, we evaluated how Time in Bed (TIB) varies relative to the incidence of acute insomnia.

Methods: Data were from a national cohort of 1,435 subjects who were recruited as good sleepers. Subjects were monitored over one year’s time with sleep diaries. State transitions were defined as follows for Acute Insomnia (AI), Recovered (REC), Chronic Insomnia (CI), and Persistent Poor Sleep (PPS). AI: 2 consecutive weeks with a frequency ≥3 nights/week of SL and/or WASO of a severity ≥30min. REC: 12 consecutive weeks with a frequency <2 nights/week of SL and/or WASO problems. CI: 12 consecutive weeks at or above the threshold for AI. PPS: Neither CI or REC. TIB was evaluated with longitudinal mixed effects models (group x time, with GS data as a fixed comparator). In addition, graphical estimates of group differences regarding temporal patterning were obtained using median splines for TIB, TST, and TWT, relative to incident acute insomnia (12 weeks prior, week of [time 0], and 12 weeks after).

Results: 357 (24.8%) subjects developed AI per annum of these. 72.2% were classified as REC, 5.6% as CI, and 20.7% as PPS. The mixed effects models revealed that the groups tended to differ for TIB prior to (< 0.067), during (0.001), and following (0.008) the AI event. Visual inspection of the median spline data suggested that subjects that develop chronic insomnia exhibit a transient increase in TIB and that is paralleled by a transient increase in TST. This extended sleep interval appears to precede the persistent increase in TWT.

Conclusion: The transition to CI appears to be triggered by sleep extension, but not a mismatch between sleep ability and sleep opportunity. Instead a long sleep event appears to presage persistent sleep continuity disturbance. Analyses are ongoing.

Support (If Any): R01DA038177 awarded to Dr. Roehrs

0336
ASSOCIATIONS OF PSYCHOSOCIAL FACTORS, SHORT SLEEP AND INSOMNIA, AND HYPERTENSION CONTROL AMONG AFRICAN-AMERICANS: THE JACKSON HEART SLEEP STUDY (JHSS)

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Introduction: Insomnia accompanied by short sleep duration (ISSP) is an emergent risk factor for hypertension; however, few have examined this association among African-Americans. Identifying risk factors for ISSP may help to target interventions and potentially reduce hypertension burden. We examined the associations of insomnia, short sleep, and ISSP with: (1) psychosocial factors; and (2) hypertension groups among African-Americans.

Methods: Insomnia was defined by the Women’s Health Initiative Insomnia Rating Scale (WHIIRS ≥10); short sleep by wrist actigraphy (<6 hours); and ISSP by the presence of both insomnia and short sleep. Psychosocial factors included perceived stress (Perceived Stress Scale ≥18), depression (Center for Epidemiologic Studies Depression Scale ≥16), anxiety (State-Trait Anxiety Inventory score ≥38), and hostility (Cook-Medley Hostility Scale). Prevalent hypertension was defined as either a systolic blood pressure (SBP) ≥130mmHg or diastolic (DBP) ≥80mmHg, use of
antihypertensive medication, or self-report of a hypertension diagnosis; uncontrolled hypertension as SBP ≥130 or DBP ≥80 mmHg with use of 1-2 classes of antihypertensive medication; and resistant hypertension as SBP ≥130 mmHg or DBP ≥80 mmHg with the use of ≥3 classes of antihypertensive medication regardless of BP level. Logistic regression models were fit to test associations between psychosocial factors, each sleep phenotype, and hypertension groups in separate adjusted models.

**Results:** Participants (N=824) had a mean age of 63.4 years (standard deviation: 10.7). 33.6% were male, 53.6% had a college degree, and 86% had hypertension. Insomnia and short sleep were common (22.8% and 26.1%, respectively), and 7% had the ISSP. All psychosocial factors were associated with insomnia and ISSP. P<0.01. All short sleep and the ISSP (but not insomnia) were associated with higher odds of resistant hypertension (aOR=1.82 (1.02, 3.26) and aOR=3.60 (1.34, 9.67), respectively), but not with prevalent and uncontrolled hypertension.

**Conclusion:** Short sleep but not insomnia accounted for the association between ISSP and resistant hypertension. Future studies should explore whether short sleep mediates the association between psychosocial factors and hypertension control.

**Support (If Any):** K01HL138211.

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**0337 INSOMNIACS IN LATE PREGNANCY ARE CLINICALLY DEPRESSED: EXPLORING THE ROLE OF NOCTURNAL RUMINATION**

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**Introduction:** Depression afflicts 13% of pregnant women. Insomnia complaints often increase across pregnancy. As insomnia often triggers depression, women with insomnia in late pregnancy may be at high depression-risk. Cognitive-emotional dysregulation is thought to underlie both insomnia and depression. We proposed nocturnal rumination (negative repetitive thinking in bed at night) to be a key form of cognitive-emotional dysregulation linking these disorders.

**Methods:** A cross-sectional analysis of women (29.6±4.7 years) in late pregnancy (gestational weeks 26-33) receiving prenatal OB care at a large Midwestern health system completed online surveys on sleep and pregnancy-related factors.

**Results:** Over half of the sample screened positive for clinical insomnia (n=97/163; 59.5%). Pregnant women with insomnia reported sleeping a nightly average of 6 hours and 8 minutes (±1.20 hours) compared to 7 hours and 26 minutes (±1.11 hours) for their good-sleeping counterparts (t=-6.99, p<.001). Nearly half of pregnant women with insomnia (40.2%) take medication for their sleep problems. Among insomniacs, difficulty staying asleep was the most common insomnia complaint (88.7%), although trouble falling asleep was also highly prevalent (40.2%). Factors associated with insomnia included greater discomfort during sleep (t=7.54, p<.001), having a high-risk pregnancy (t=2.66, p<.01), and low income (t=-3.10, p<.01). Snoring, history of miscarriage, and having a planned pregnancy were not related to insomnia symptoms.

**Conclusion:** Insomnia is endemic to women in late pregnancy, many of whom are using sleep aids. Having a high-risk pregnancy, low household income, and discomfort during sleep potentially contribute to prenatal insomnia. Given that insomnia increases across pregnancy, it is important to regularly assess for insomnia in routine prenatal care. This will allow for identification of women early in the disease process. Early non-pharmacologic intervention carries potential to safely improve mother and infant outcomes and curb the use of sleep aids.

**Support (If Any):** N/A

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**0338 INSOMNIA IN LATE PREGNANCY: CHARACTERIZING PHENOTYPES AND IDENTIFYING ASSOCIATED FACTORS**

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**Introduction:** Insomnia increases across the prenatal period. This study characterizes insomnia phenotypes in late pregnancy, and identifies factors related to prenatal insomnia.

**Methods:** A cross-sectional analysis of pregnant women (29.6±4.7 years, gestational weeks 26-33) receiving prenatal OB care at a large Midwestern health system completed online surveys on sleep and pregnancy-related factors.

**Results:** Participants (N=824) had a mean age of 63.4 years (standard deviation: 10.7). 33.6% were male, 53.6% had a college degree, and 86% had hypertension. Insomnia and short sleep were common (22.8% and 26.1%, respectively), and 7% had the ISSP. All psychosocial factors were associated with insomnia and ISSP, P<0.01. All short sleep and the ISSP (but not insomnia) were associated with higher odds of resistant hypertension (aOR=1.82 (1.02, 3.26) and aOR=3.60 (1.34, 9.67), respectively), but not with prevalent and uncontrolled hypertension.

**Conclusion:** Short sleep but not insomnia accounted for the association between ISSP and resistant hypertension. Future studies should explore whether short sleep mediates the association between psychosocial factors and hypertension control.

**Support (If Any):** N/A

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**0339 RISK FACTORS AND CORRELATES OF INSOMNIA ACROSS U.S. ARMY DEPLOYMENT CYCLE**

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SOLDIERS ELEVATED INSOMNIA RISK AMONG DEPLOYED TRAUMATIC STRESSORS ASSOCIATED WITH

**Introduction:** The behavioral model of insomnia theorizes predispositions make people susceptible to developing insomnia in the face of precipitants. Few comprehensive longitudinal studies have investigated both predispositions and precipitants in the prediction of the development of insomnia. Many military service members face a significant potential precipitant, deployment. The current study is a prospective examination to identify predispositions and precipitants of insomnia from pre- to post-deployment in military service members.

**Methods:** Participants were part of a parent study that assessed US Army personnel (N = 4,104) pre-deployment and again in a smaller subsample (n = 1,828) willing to complete post-deployment assessments, using self-report measures of insomnia (i.e., Insomnia Severity Index; ISI) as well demographics, resilience and personality, social support, deployment stress, adversity and trauma, and other mental and physical health symptoms.

**Results:** In the subsample (n=1,828), 18% had clinically significant insomnia (ISI < 15) at baseline and the rate of insomnia increased to 31% at post-deployment. Pre- to post-deployment change in insomnia symptoms showed that 63% of the sample had no insomnia at both time points, 7% actually had insomnia that remitted (i.e., insomnia at pre-deployment but not post-deployment), 19% had new onset insomnia, and 11% had chronic insomnia (i.e., both time points). Preliminary logistic regression analyses of no insomnia vs. onset insomnia showed fewer deployments and greater insomnia symptoms (despite ISI < 15), history of stressful life events, number of children, PTSD symptoms, history of head injury, anxiety and being enlisted at baseline, all predicted onset insomnia at post-deployment. Future analyses will examine predictors of remitted vs. chronic insomnia and examine differences between all groups on deployment related stressors and post-deployment mental and physical health factors.

**Conclusion:** These are the first data to our knowledge to attempt to identify true predispositions and precipitants for the development of insomnia in either a civilian or a military sample. Implications will be discussed in depth at the conference.

**Support (If Any):** This publication is based on public use data from Army STARRS (Inter-university Consortium for Political and Social Research, University of Michigan-http://doi.org/10.3886/ICPSR35197-v1), funded by U.S. NIMH-U01MH087981. Time on this project was partially supported by U.S. Department of Veterans Affairs, Rehabilitation Research and Development Service-I1K2RX001836. Contents are solely the responsibility of authors and do not necessarily represent the views of the Army STARRS investigators, funders, or Departments of Defense, Army, or Veterans Affairs.

0340

**TRAUMATIC STRESSORS ASSOCIATED WITH ELEVATED INSOMNIA RISK AMONG DEPLOYED SOLDIERS**

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**Introduction:** Military service is associated with an increased risk of trauma and associated sleep problems. Although soldiers experience an elevated risk of lifetime and deployment-related traumatic stressors, few studies have examined the types of traumatic events that predict insomnia. Examining the types of trauma associated with elevated insomnia risk in active-duty military personnel is of critical importance.

**Methods:** Data were obtained from the All Army Study of the Army Study to Assess Risk and Resilience in Servicemembers (STARRS; unweighted N=21,449; weighted N=670,335; 18-61 years; 13.5% female). Soldiers completed the Brief Insomnia Questionnaire; DSM-5 criteria were applied to determine current insomnia status. Participants completed a 15-item lifetime trauma inventory and a 15-item deployment-related trauma inventory. Separate binomial logistic regressions identified predictors of insomnia from each inventory. Analyses adjusted for psychiatric disorders.

**Results:** Regarding lifetime traumatic stressors, the likelihood of insomnia was highest for those who endorsed combat death of a close friend or relative (OR=1.19, Chi-Square=1287.79, p<.001) followed by being bullied (ongoing comments or behaviors) during childhood or adolescence (OR=1.11, Chi-Square=1241.16, p<.001). For deployment-related traumatic stressors, the likelihood of insomnia was highest for those who endorsed being hazed or bullied by one or more unit members (OR=1.63, Chi-Square=597.27, p<.001) followed by having a close call (e.g., equipment shot off body, IED exploded nearby; OR=1.24, Chi-Square=315.19, p<.001).

**Conclusion:** In a large nationally-representative sample of Army soldiers, specific types of trauma over one's lifetime and during deployment significantly increase the likelihood of insomnia. These findings highlight the importance of addressing traumatic stress prior to and during deployment to facilitate and optimize treatment of sleep disturbance.

MEN AND WOMEN VETERANS’ MILITARY EXPERIENCES AND ASSOCIATED RISK OF INSOMNIA

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**Introduction:** Experiences during military deployment may predispose Veterans to symptoms of insomnia (difficulty falling or staying asleep, waking early) following discharge. The most recent cohort of Veterans (OEF/OIF/OND) is diverse, including a high percentage of women exposed to combat conditions. It is crucial to determine which service-related experiences are associated with insomnia after discharge and potential sex differences in those relations.

**Methods:** Women Veterans’ Cohort Study participants (N=802, Mage=43.77, 53% women) self-reported demographics, health, and military service. Hierarchical multiple regression examined the influence of service-related experiences on insomnia symptoms.
Introduction: Sleep of insufficient quantity and/or quality is common in the military due to the demands of training, missions, and work schedules or sleeping environments. These challenges negatively impact health. Researchers must determine the trajectory of Veterans’ sleep from pre- to post-deployment to understand how insomnia develops and identify opportunities for intervention.

Support (If Any): Dr. Gaffey’s efforts were sponsored by an Advanced Fellowship in Women’s Health via the VA Office of Academic Affairs.

0342
LONGITUDINAL EXAMINATION OF MILITARY-SPECIFIC FACTORS AFFECTING SLEEP QUANTITY AND QUALITY AMONG U.S. SERVICE MEMBERS
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Introduction: Sleep of insufficient quantity and/or quality is common in the military due to the demands of training, missions, and irregular work schedules or sleeping environments. These challenges can negatively affect the health and performance of military members, thereby impacting mission safety and success. We examined which military-specific factors affect sleep quantity and quality over time and across U.S. service branches.

Methods: New onsets of sleep problems and insufficient sleep hours were analyzed using data from the Millennium Cohort Study, a longitudinal study tracking military members’ experiences, behaviors, and health during and after service through triennial surveys. Eligible participants joined the military within 4 years of taking their baseline survey, had not deployed before baseline, and were actively serving between baseline and first follow-up. Those who reported sufficient sleep (7-8 hours and no trouble sleeping) and screened negative for mental health conditions at baseline were included (n=7,614). Complementary log-log models included military, demographic, and health factors measured at the survey prior to the sleep outcomes.

Results: The study population was primarily white males born after 1980, with over half being active duty, 75% enlisted, and a third had experienced combat. Army, Navy, and Marine Corps members were found to exhibit approximately an 85%, 35%, and 98% increased risk of reporting sleeping ≤5 hours a night, respectively, versus Air Force members. Furthermore, military-specific factors including combat deployment, service years, deployment length, separation status, component status, and pay grade were significantly associated with an increased risk of reporting an average of sleeping ≤5 hours per night, and reporting having one or more sleep problems.

Conclusion: Sleep quantity and quality in military members are affected by factors specific to the military experience. Strategies that improve work schedules, sleeping conditions, and screening/treatment of sleep problems should be tested and utilized when possible, within the bounds of military training and operations, to mitigate the negative impact of military factors on sleep quantity and quality over time.

Support (If Any): The Millennium Cohort Study is core funded by the Defense Health Agency.

0343
DOES INSOMNIA SYMPTOM SEVERITY VARY BY RACE/ETHNICITY?
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Introduction: While there is epidemiologic evidence that racial/ethnic minorities report shorter sleep duration and poorer sleep quality than whites, few studies have assessed sleep continuity (SC), variable by variable (e.g., SL, NWAK, WASO, EMA, & TST). The present analysis assesses in a quantitative way whether insomnia symptom severity varies by race/ethnicity.

Methods: An archival analysis was conducted on an existing database of 4,206 individuals who completed a screening survey online at www.sleeplessinphilly.com. Variables collected included estimates for: sleep latency (SL), number of awakenings (NWAK), wake after sleep onset (WASO), early morning awakenings (EMA) and total sleep time (TST).

Results: The sample for the present analysis was comprised of 2,049 whites (63.4%), 1,007 blacks (31.2%), and 175 Hispanics (5.4%). The overall mean age was 39.0±14.7, 60.4% of the sample was female, and the average BMI was 28.0±7.1.

For all SC variables, blacks significantly differed from whites: SL (49.2±38.3 vs. 42.8±30.5; p<0.001); NWAK (2.64±1.7 vs. 2.50±1.6; p<0.001); WASO (47.3±4.3 vs. 29.9±3.0; p<0.001); EMA (63.4±41.8 vs. 57.2±33.0; p<0.001); Hispanics did not significantly differ from whites with respect to the above measures.

Conclusion: Our results suggest that blacks exhibit marginally worse sleep continuity (statistically significant owing to the large
sample sizes) and shorter TSTs. Analysis is ongoing to evaluate Time in Bed [TIB], calculated TST, SE%, sleep period, sleep schedule differences, and percentage of group with Insufficient Sleep Disorder by race, in matched samples.

Support (If Any): SUPPORT:R01AG041783;K24AG055602;R01 AT003392;K23HL125939

0344
SYMPTOMS OF INSOMNIA AND DEPRESSION IN A US ETHNIC POPULATION
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Introduction: Little is known about the relationship between insomnia and depression in populations of South Asian and Middle Eastern people of Muslim origin. The purpose of this study is to investigate whether depression is associated with insomnia in this ethnic minority population.

Methods: Data for this cross-sectional study were obtained from a self-reported electronic survey given to Muslims associated with a large Islamic center in the DC Metro Area. The validated Center for Epidemiological Studies (CES-D) and the Pittsburgh Insomnia Status Questionnaire (PISQ) instruments were used to screen for depression and insomnia. Multivariable age-adjusted models were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) to describe the associations of depression and insomnia, controlling for a variety of sociodemographic characteristics and comorbidities.

Results: Among a total of 130 participants, 60% percent of the population was male. Eighty-four percent of men and 78% of women reported insomnia, respectively. Additionally, 81% of Asians, 91% of Middle Eastern people, and 66% of every other ethnicity reported having insomnia. Seventy-six percent of the sample had depression, 91% of whom had insomnia. Depression was significantly associated with insomnia (OR:7.47; 95% CI: 2.38-23.43), and this association was confounded by hypertension status.

Conclusion: Our study shows that depression is a significant risk factor for insomnia among South Asian and Middle Eastern Muslims. This study is limited to a small sample size, and further examinations of depression as a significant predictor contributing to insomnia among this ethnic population are needed.

Support (If Any): This study was supported by Sleep and Wellness Medical Associates, LLC

0345
INSOMNIA IS ASSOCIATED WITH DEPRESSION AND ANXIETY IN JAPANESE CITY GOVERNMENT EMPLOYEES
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Introduction: Depression is well known to be associated with insomnia. Anxiety is also known to associated with sleep disorders, but its association with insomnia is not well understood. Here we analyze association between insomnia and anxiety in a Japanese working population.

Methods: A cross-sectional questionnaire survey was conducted as a part of epidemiological study named “Night in Japan Home Sleep Monitoring Study (NinJaSleep Study)” in November 2017. Participants were the city government employees in a rural city in Shiga prefecture, Japan. Insomnia, anxiety and depression were analyzed by ISI (insomnia severity index), GAD-7 (Generalized Anxiety Disorder 7) and PHQ-9 (Patient Health Questionnaire 9), respectively. GAD-7≥10 and PHQ-9≥10 were categorized as anxiety and depression, respectively.

Results: 1689 responded to the survey (participation rate: 82.1%, male: 38.9%, age: 45±12.2 years, BMI: 22.5±3.64, ISI: 7.0(4.41, GAD-7: 3.26±3.91, PHQ-9: 4.71±5.48), 1413, 33, 141, 102 had no anxiety or depression, anxiety only, depression only, and both anxiety and depression, respectively. ISI scores for subjects with no anxiety or depression, anxiety only, depression only, and both anxiety and depression were 6.10±3.68, 9.42±5.26, 11.44±4.37, and 13.38±4.42, respectively (P<0.001).

Conclusion: There is high comorbidity of anxiety and depression. Insomnia was associated with both anxiety and depression. ISI was highest when participants had both anxiety and depression.

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0346
SLEEP AND SUICIDAL BEHAVIORS - RESULTS OF THE SANTÉ PUBLIQUE FRANCE HEALTH BAROMETER 2017
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Introduction: The association between insomnia and suicidality has been frequently asked. Poor sleep increases bad mood and depression is often associated to poor sleep. However, is the suicidal behavior associated to a poor quality of sleep or to a too short sleep? The goal of our analysis is to enlighten this link between suicide and poor sleep.

Methods: The Sante Publique France Health Barometer is a telephone recurrent health survey of the French population. Since 2002, it includes more than 30 items on sleep logs and sleep disorders according to the ICSD-3 definitions. In 2017 12370 subjects have been interviewed on their sleep and also on their suicidal risk with 3 items.

In the last 12 months did you think about suicide? yes or no
Along your life, did you ever try to suicide? yes or no
In the last 12 months did you think about suicide? yes or no

Results: In our group, 510 subjects had suicidal thoughts in the last 12 months (4.1%); 832 have tried at least one to suicide along their
life (6.7%) and 38 in the last 12 months (0.3%). Suicidal tentative were more often to happen in short sleepers (who slept on week-days less than 300 minutes per day) 12.3% than for those who slept from 360 to 420 minutes) 5.7% (P<10^-4). They also happen more often in subjects with sleep debt 11% vs. 5.7% (P<10^-4). Insomnia was associated with an increased suicidal risk on the entire life: 16.1 vs 5.7% (P<10^-4). Suicidal thoughts in the last 12 months were more frequently reported in short sleepers (7.1 vs. 3.9%, (P<10^-4), subjects with sleep debt (6.7 vs. 3.1% (P<10^-4), and those with insomnia (12.3 vs. 3.1%, (P<10^-4))

Conclusion: Suicidal risk was found independently increased in subjects with short sleep, sleep debt and insomnia

Support (If Any): Sante Publique France

0347 INSOMNIA AND QUALITY OF LIFE IN SLEEP PATTERN: SAO PAULO EPIDEMIOLOGIC SLEEP STUDY (EPISONE)
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Introduction: Sleep is essential for the individual's health and well-being and its deprivation brings serious physiological consequences. This study aimed to evaluate the sleep pattern through polysomnography in a general population considering the age groups and the influence of insomnia on quality of life.

Methods: This cross-sectional study recruited volunteers randomly to represent the population of Sao Paulo, according to gender, age (20-80 years) and socioeconomic status. Data from polysomnography were used to assess sleep objectively and the WHOQOL-BREF questionnaire was used to assess quality of life scores. Using validated questionnaires based on Diagnostic and Statistical Manual of Mental Disorders, 4th edition criteria, subjective insomnia was categorized in good sleepers, insomnia symptoms and insomnia syndrome. Anthropometric data, objective sleep parameters and quality of life were examined by range of decades of life in both genders. The same parameters were evaluated in subjective insomnia groups (in both men and women).

Results: A total of 1,042 participants were included, 574 women and 468 men. Groups with insomnia presented worse perception of quality of life compared to good sleepers in both genders. Women had a lower percentage of good sleepers (33.3%), as well as a higher percentage of insomnia symptoms (48.6%) and insomnia syndrome (18.1%) than men (42.1%, 47.2% and 10.7%, respectively).

Conclusion: Women presented more complaints about insomnia and lower perceived quality of life compared to men, especially in young ages. Men and women with insomnia symptoms or insomnia syndrome had a lower quality of life score.

Support (If Any): This research was supported by fellowships from Associação Fundo de Incentivo à Pesquisa (AFIP), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) - Finance Code 001 and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

0348 DEVELOPMENTAL TRAJECTORIES OF HYPNOTICS USE FREQUENCY IN TAIWAN
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Introduction: Hypnotics is recommended for short-term use but is commonly prescribed for prolonged period of time in clinical settings. Dependence is raised as a concern for long-term hypnotic use. However, past research suggested that there were individual differences in the likelihood to become dependence. The current study aims to categorize the developmental patterns of hypnotic use through trajectory analysis, and to examine the differences in the psychosocial factors associated with the different trajectories.

Methods: Insomnia patients with history of hypnotic use (n=148; mean age=45.63) from OPD clinical settings were recruited to participate in the study. They completed a package of questionnaires regarding psychosocial variables and were followed up at 6 points of time (0, 1, 3, 6, 12 and 18 months) to collect their frequency of hypnotic use. All data were used to estimate trajectories from group-based trajectory modeling. After the best fit model was found, different psychosocial measures were compared to identify the distinct psychosocial profiles of them.

Results: The analysis revealed four distinct groups. The first group (24% of the cohort) showed slowly decline in the frequency of hypnotic use and maintained in low-frequency use frequent; the second group (18%) showed a relative stable low-frequency use throughout the 6 intervals; the third group (14.5%) showed decrease dramatically at the first 3 months of follow-up and discontinue medication use after 6 months; the fourth group (42.8%) maintained high frequency of hypnotic use throughout the 6 intervals. Among psychosocial factors, the fourth group showed the highest age (48.92 years, P<0.05), total duration of hypnotic use (72.27 months, P<0.05), insomnia severity (ISI=18.79, p<0.00) and hypnotic urge (Hypnotic Use Urge Scale=99.73, p<0.00). The other groups also showed distinct profiles.

Conclusion: The results of the current study indicates that hypnotic use among individuals could have different trajectories profiles. Each trajectory has its own psychosocial profile, such as hypnotic-related background and craving. Therefore, these factors are needed to be assessed in clinical settings to assist the management of medication use.

Support (If Any): none

0349 MEDICAL ENCOUNTERS FOR SLEEP DISORDERS AMONG MIXED AGE MALE AND FEMALE ACTIVE DUTY US AIR FORCE BETWEEN 2016 AND 2017
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Introduction: Sleep disorders are prevalent among military service members. Poor sleep not only impairs mental and physical health, but is costly to treat. Although it has been shown that, among military samples, demographic variables are associated with greater risk for some sleep disorders, additional research is needed to understand the relationship. In the present study we examined the age and gender of Airmen seeking treatment for five sleep disorders that received the highest frequencies of medical encounters between fiscal years (FY) 2016 and 2017.

Methods: Data on medical encounters and demographics for active duty Airmen between FY 2016 and 2017 were obtained from the Military Health System MHS Mart (M2) database.

Results: Among 34 sleep-associated disorders identified in the dataset, the five disorders that received the most medical encounters for FY’s 2016 and 2017 were: insomnia-unspecified (58.6%)
of encounters), primary insomnia (15.16%), sleep disorder-unspecified (3.53%), other insomnia (3.46%), and inadequate sleep hygiene (3.36%). Across the five disorders the percentages of medical encounters were significantly lower for 2017 (45.36%) as compared with 2016 (54.64%) (p < .01), greater for male Airmen (70.43%) than females (29.57%) (p < .01), and significantly greater for Airmen ages 25-34 years (39.97%) than those aged 18-24 (24.11%), 35-44 (29.64%), and 45-64 years (6.28%) (p's < .01). Examination of within-disorders encounter rates revealed statistically similar percentages of encounters among inadequate sleep hygiene and other insomnia for 2016 and 2017 and for Airmen in the 18-24 and 35-44 age groups (p's > .05). Similar percentages of encounters were observed among inadequate sleep hygiene, other insomnia, and sleep disorder-unspecified and for the 18-24 and 25-34 year age groups (p's > .05). All other comparisons were statistically significantly different (p's < .05).

**Conclusion:** Despite declines in medical encounters, sleep issues persist among active duty Airmen, especially among middle-age males. Raising awareness of both the symptoms of sleep disorders and treatment options could reduce future medical encounters and improve overall health and readiness.

**Support (If Any):** None.

### 0350
**PSYCHOLOGICAL AND BEHAVIORAL FACTORS ASSOCIATED WITH INSOMNIA IN BREAST CANCER PATIENTS UNDERGOING ACTIVE TREATMENTS**

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**Introduction:** Psychological and behavioral factors play important roles in chronic insomnia. Among breast cancer patients, insomnia is one of the most common complaints. Recent researches also supported that cognitive behavioral therapy for insomnia, which targets the psychological and behavioral factors, is effective in treating insomnia in patients with breast cancer. However, the mechanism underlying cancer related insomnia may be different from chronic insomnia regarding the specific characteristics of cancer. Besides, most previous researches focused on breast cancer survivors instead of patients undergoing active treatments. Hence, our study aims to explore the psychological and behavioral factors related to insomnia among breast cancer patients undergoing active treatments.

**Methods:** 202 female breast cancer patients (age = 49.57±9.42) without comorbidity of psychiatric or sleep disorders who are preparing for surgery and/or undergoing adjuvant therapy, participated in this study. They were asked to complete a set of questionnaires, including Insomnia Severity Index (ISI), Pre-Sleep Arousal Scale (PSAS), Sleep Related Behavior Questionnaire (SRBQ), and Dysfunctional Beliefs and Attitudes about Sleep Questionnaire (DBAS-16).

**Results:** Among 202 breast cancer patients, 125 patients (62%, age 50.64±11.10) reported having sleep disturbances. T-tests showed significant differences on ISI (t=11.501, p<.001), PSAS-somatic subscale (t=6.038, p<.001), PSAS-cognitive subscale (t=7.72, p<.001), DBAS-worry (t=5.821, p<.001), DBAS-medication (t=7.17, p<.001), DBAS-consequence (t=2.926, p<.01), and SRBQ (t=6.538, p<.001), but no significant difference on DBAS-expectation (t=0.609, p=.453). Pearson's correlations also showed that total score of ISI correlates significantly with PSAS-somatic subscale (r=.432, p<.001), PSAS-cognitive subscale (r=.615, p<.001), DBAS-worry (r=.517, p<.001), DBAS-consequence (r=.313, p<.001), DBAS-medication (r=.351, p<.001), SRBQ (r=.508, p<.001), but no correlations with DBAS-expectation (r=.010, p=.895).

**Conclusion:** Similar to patients with chronic primary insomnia, sleep-related psychological and behavioral factors are associated with sleep disturbances in cancer-related insomnia. Among the factors, cognitive and behavioral factors play an important role. Somatic arousal is also relevant but to a less degree. This finding suggests that intervention addressing cognitive and behavioral factors should be instituted when patients who are still under active treatment to prevent from the sleep problem becoming chronic in course.

**Support (If Any):** None.

### 0351
**ASSOCIATIONS BETWEEN INTRAINDIVIDUAL VARIABILITY IN SUBJECTIVE SLEEP PARAMETERS AND INSOMNIA IN NURSES**

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**Introduction:** Nurses experience stressful work environments and rotating work schedules, placing them at increased risk for sleep disruptions and variable sleep. Disturbed average sleep and more variability in sleep are associated with greater functional impairment, increased risk for depressive disorder, and a greater prevalence of chronic illness. Despite this, no studies have investigated relationships between intraindividual variability (IV) in subjective sleep parameters and insomnia in nurses. Given that nurses are the first line of care in hospitals, it is essential to understand their sleep patterns to improve their health and optimize quality of care provided. This study assessed the relationship between IV in subjective sleep parameters and insomnia symptoms in a sample of nurses.

**Methods:** Participants were 257 daytime-working nurses (93.8% female; 79.8% white, mean age = 40.88) recruited for a parent study, “Sleep and Vaccine Response in Nurses (SAV-RN)” (R01AI128359-01, PIs: Taylor & Kelly). Participants completed the Sleep Condition Indicator (SCI) to assess insomnia symptoms, as well as 14 days of sleep diaries to assess mean and IV (i.e., the person-level standard deviation) in sleep quality (SQ), number of awakenings (NWAk), terminal wakefulness (TWAk), sleep onset latency (SOL), sleep efficiency (SE), circadian midpoint (CM), and total sleep time (TST). Linear regression was used to evaluate the associations between insomnia symptoms and IV in each sleep parameter, controlling for age and sleep parameter means.

**Results:** More severe insomnia symptoms were associated with greater IV in SQ (β = 0.80, p <.001), NWAk (β = 0.11, p =0.006), TWAk (β = 7.06, p <0.001), SOL (β = 2.80, p <.001), SE (β = 35.50, p <.001), and less IV in CM (β = 0.20, p =0.014). TST was not significantly associated with insomnia symptoms.

**Conclusion:** Results suggest more severe insomnia symptoms are associated with greater IV in a variety of subjective sleep parameters.
Maintaining a consistent sleep schedule is a central component of cognitive behavioral therapy for insomnia and may be a promising treatment option to help alleviate symptoms of insomnia in nurses.

**Support (If Any):** NIAID R01AI128359-01

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**0352**

**PREVALENCE OF MARIJUANA USE VERSUS EVIDENCE-BASED TREATMENTS FOR SLEEP AND RELAXATION**

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**Introduction:** Marijuana is often used to manage insomnia and anxiety symptoms, even though efficacious, evidence-based treatments (EBTs) are available. Marijuana may provide short-term sleep and relaxation benefits, followed by rapid habituation and worsening of symptoms. We compared the prevalence of marijuana use for sleep/relaxation to the use of EBTs in a large sample of recently unemployed individuals.

**Methods:** Assessing Daily Activity Patterns through Occupational Transitions (ADAPT) is a longitudinal study examining linkages between job-loss, sleep, obesity, and mental health outcomes. We examined cross-sectional data from 513 participants of the ADAPT phone screen interview who reported recent use of sleep aids or treatments for sleep/relaxation problems. EBT was defined as Cognitive Behavioral Therapy for Insomnia (CBT-I), Ambien, and Benzodiazepines. A two-sample test of proportions was conducted to determine difference in prevalence of marijuana versus use of EBTs. Sensitivity analysis redefined EBTs as including tricyclic antidepressants, a commonly-prescribed but non-evidence-based treatment for insomnia.

**Results:** Our analysis indicated a trend for higher prevalence of marijuana use (18%, n=92) than use of EBTs (14%, n=74; difference = .04, p=.08). After inclusion of tricyclic antidepressants, prevalence of use of EBTs (25%) was significantly higher than of marijuana (p=.006), but marijuana remained the single most common treatment for sleep/relaxation. Only 4% of our sample received CBT-I (n=2, difference = .18, p < .0001), 4% used Ambien (n=22, difference = 14, p < .0001), 11% used Benzodiazepines (n=58, difference = .07, p=.002), and 11% used tricyclic antidepressants (n=56, difference = .07, p=.002).

**Conclusion:** Recently unemployed individuals are more likely to use marijuana than any one evidence-based treatment for sleep/relaxation. Job loss confers occupational and economic disparities that may contribute to barriers to EBT access for sleep/relaxation. Given marijuana’s fragmented legality and the paucity of empirical evidence regarding its long-term efficacy as a sleep/relaxation aid, more research is needed into the economic, medical, and personal factors influencing individuals’ decisions to use marijuana versus EBTs, as well as the long-term effects of marijuana for sleep/relaxation.

**Support (If Any):** #1R01HL117995-01A1

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**0353**

**ALTERED MODULATION OF SPINDLE DENSITY ACROSS THE NIGHT IN OLDER ADULTS WITH CHRONIC INSOMNIA**

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**Introduction:** Sleep spindles serve critical functions for sleep promotion and maintenance by potentially gating sensory information to the cortex. A reduction in spindle density has been described in young-middle age adults with chronic insomnia suggesting a role in sleep quality. Aging is associated with increased prevalence of insomnia and concomitant reduction in spindle density and duration, yet the nature of spindle characteristics in older insomniacs remains largely unexplored. The aim of this study was to characterize spindles features and their distribution across the cycles of sleep in older adults with insomnia and good sleepers of similar age.

**Methods:** Preliminary data were obtained from 17 adults with chronic insomnia (INS: 66±8 years, 14 females) and 8 good sleepers controls (CN: 68±9 years, 8 females). Participants completed four consecutive nights of polysomnography during which they were given 8 hours of sleep opportunity based on habitual sleep time. Spindles (11-15Hz) were detected automatically during sleep stages N2 and N3 on night 4 from the left central EEG channel. Duration, amplitude, frequency and spindle density (number/min) were calculated. Spindle density distribution across four cycles of sleep was also assessed.

**Results:** Sleep macrostructure was similar in INS and CN. During N2, spindle density was reduced in INS compared to CN (3.8±2.2 and 5.8±1.8, respectively; p=0.029) while spindle duration was increased (937±79 ms, 860±81 ms, respectively; p=0.009). During N3, spindle features were similar in INS and CN. There was also a reduction in spindle density across the cycles of sleep (group effect p=0.033) during N2, particularly evident during cycle 1 (p=0.03) and 2 (p=0.01) for the insomnia group compared to controls. No significant differences were observed in spindle density across the cycles of sleep in N3.

**Conclusion:** Differences in spindle features and temporal distribution across the night may represent a neurophysiological marker of altered sleep micro-structure in older adults with insomnia.

**Support (If Any):** P01 AG11412

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**0354**

**TRAIT AND STATE AROUSAL IN INSOMNIA: UTILITY OF PATIENT-REPORTED EMOTIONAL REACTIVITY AND SOMATIC AROUSAL IN CLINICAL SAMPLES**

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**Introduction:** Hyperarousal is considered to have stable (e.g., trait) and situational (e.g., state) elements that play a role in the etiology and pathophysiology of insomnia. However, it is difficult to predict who among those presenting with insomnia carry specific traits and/or states that may require targeted treatments.

**Methods:** Participants included 298 adults with a diagnosis of chronic insomnia disorder (47.0±15.9 years old, 66.7% female and 10.6% minority) who were evaluated at the Behavioral Sleep Medicine (BSM) program of Penn State Sleep Research & Treatment Center. Participants completed the Arousal Predisposition Scale (APS), assessing trait emotional reactivity (APS-ER) and trait anxiety (APS-TA), and the Pre-sleep Arousal Scale assessing state cognitive (PSAS-C) and somatic (PSAS-S) arousal. In addition, participants completed the Insomnia Severity Index (ISI), Ford Insomnia Response to Stress Test (FIRST, sleep reactivity), and Depression Anxiety Stress Scale (DASS-D and DASS-S).
DASS-A, respectively). Multivariable stepwise regression assessed which of these clinical factors were independently associated with APS-TA, APS-ER, PSAS-C and PSAS-S. Receiver operating characteristic analysis determined the predictive value for identifying moderate-to-severe insomnia (ISI≥15), sleep reactivity (FIRST≥18), anxiety (DASS-A≥10) or depression (DASS-D≥14).

Results: The average ISI score was 17.99 (5.35) and 71.1% presented with moderate-to-severe insomnia. DASS-A (β=0.25) was the best single correlate of APS-TA and FIRST (β=0.39) was of APS-ER. Similarly, DASS-A (β=0.73) was the best single correlate of PSAS-S, while FIRST (β=0.33) was of PSAS-C. APS-TA (AUC=0.76 [95%CI=0.70-0.82]) and PSAS-S (AUC=0.87 [95%CI=0.82-0.91]) performed best when identifying moderate-to-severe anxiety, while APS-ER (AUC=0.81 [95%CI=0.75-0.87]) and PSAS-C (AUC=0.84 [95%CI=0.78-0.90]) performed best when identifying moderate-to-severe sleep reactivity.

Conclusion: Emotional reactivity and sleep reactivity are specific predisposing factors for insomnia. In contrast, trait anxiety and pre-sleep somatic arousal are, respectively, a predisposing factor and a state marker for the comorbidity of insomnia with clinical anxiety. These trait measures can help identify which individuals carry insomnia-specific predisposition, while state measures (e.g., PSAS-S) can help clinicians individualize BSM treatments and guide the inclusion of somatically-focused relaxation therapies.

Support (If Any):

0355
INSOMNIA WITH OBJECTIVE SHORT SLEEP DURATION IS ASSOCIATED WITH COGNITIVE IMPAIRMENT: A CLOSER LOOK AT CARDIOMETABOLIC BRAIN HEALTH
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Introduction: Insomnia with objective short sleep duration has been previously associated with cardiometabolic risk factors (CMR), such as hypertension or diabetes, cardiovascular or cerebrovascular disease (CBVD), and poorer cognitive performance. However, studies demonstrating an increased risk of cognitive impairment (CI) in this insomnia phenotype are lacking.

Methods: Data from the Penn State Adult Cohort (N=1,741) was used in the Penn State Adult Cohort study. CI was defined by three severity levels of normal sleep (n=1022), poor sleep (n=520) and chronic insomnia (n=199). Objective short sleep duration was defined as < 6 hours sleep based on a 1-night, 8-hours, in-lab polysomnography (PSG). Logistic regression models adjusted for age, sex, race, education, apnea/hypopnea index, mental health problems and physical health problems.

Results: Compared to the reference group, subjects with poor sleep or chronic insomnia who slept objectively < 6 hours were significantly associated with CI (OR=2.26, 95%CI=1.26-4.04 and OR=2.65, 95%CI=1.28-5.51, respectively), particularly with probable VCI (OR=2.43, 95%CI=1.25-4.73 and OR=3.15, 95%CI=1.42-7.00, respectively). In contrast, subjects with poor sleep or chronic insomnia who slept objectively > 6 hours were not significantly associated with either CI (OR=0.46, 95%CI=0.18-1.21 and OR=0.66, 95%CI=0.19-2.37, respectively) nor probable VCI (OR=0.78, 95%CI=0.29-2.10 and OR=0.63, 95%CI=0.14-2.93, respectively).

Conclusion: Insomnia with objective short sleep duration is associated with an increased risk of CI, particularly as it relates to cardiometabolic health (i.e., VCI). These data further support that this insomnia phenotype is a more severe form of the disorder associated with physiological hyperarousal and cardiometabolic and neurocognitive sequelae.

Support (If Any): AHA (14SDG19830018); NIH (R01 HL1931, R01 HL04916)

0356
SUBJECTIVE SLEEP QUALITY IN POSTPARTUM WOMEN ENROLLED IN A STUDY OF CBT FOR INSOMNIA
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Introduction: Poor sleep is frequently reported postpartum and is often attributed to factors related to the infant. This study examined how perceived infant-related sleep disturbances and maternal sleep-factors contribute to maternal subjective sleep quality.

Methods: Participants were postpartum women who enrolled in a randomized control trial for perinatal insomnia. Participants were randomized to receive either cognitive behavioral therapy for insomnia (CBTI) or an active control insomnia therapy. The analysis included 68 participants (age 34±5.6) who completed the Insomnia Severity Index (ISI) and one week of the consensus sleep diaries at 18 weeks postpartum. Sleep diary items assessing wakefulness after sleep onset (WASO) separated the number and duration of awakenings related and unrelated to the infant. An additional diary item assessed the perceived impact of the infant on maternal sleep (5-point Likert-type scale, very-little to very-much).

Results: Mean rating for sleep quality did not differ between the CBTI (n=36) and control therapy (n=32) groups (p=0.7). A linear regression analysis, with subjective sleep quality as the dependent variable and ISI and sleep diary derived variables as independent variables, revealed the following predictors of maternal subjective sleep quality: perceived impact of the infant on participants’ sleep (β=-0.45, p<0.001) and mean sleep onset latency (β=-0.19, p=0.043). In contrast, ISI, total sleep time, number and minute of WASO (both related and unrelated to infant), and treatment assignment were not significant predictors of the subjective sleep quality.

Conclusion: Maternal perception of how much her infant disturbed her sleep, rather than her reported number and duration of awakenings due to the infant, appears relevant to her perception of the quality of her sleep. Poor subjective sleep quality has been previously associated with myriad negative sequelae, including postpartum mood symptoms. Therefore, our findings point to the psychological impact of the infant on maternal sleep as an important target for sleep-related interventions during the postpartum period.

Support (If Any): N/A
A PHENOMENOLOGICAL APPROACH TO UNDERSTANDING SLEEP DISTURBANCES IN U.S. VETERANS WITH PTSD

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Introduction: Ninety percent of U.S. Veterans endorse difficulty sleeping, but there is little in the literature defining when these sleep difficulties begin or how they persist. There is also a dearth of literature to help us understand how U.S. Veterans cope with sleeplessness. The purpose of this qualitative study was to explore how OIF/OEF/OND U.S. Veterans with PTSD experience sleep, nocturnal wakefulness, and daytime sequelae.

Methods: In this phenomenological study we interviewed 18 OIF/OEF/OND U.S. Veterans who were diagnosed with PTSD and self-reported difficulty sleeping. The participants were invited to a two-hour, one-time phenomenological interview with the primary investigator. The interviews were conducted using an open-ended approach, with interview prompts used if needed. To begin the interview, participants were asked to draw a good night of sleep and a bad one, then to describe each to the interviewer. Data was collected using drawings, audiotapes of interviews, and field notes. Interviews continued to data saturation. Interviews were audi-taped and transcribed, then analyzed using Atlas ti. Participants must have served post 9/11, have a documented diagnosis of PTSD, and not have a physical diagnosis that would affect sleep (obstructive sleep apnea, restless leg syndrome). All participants were recruited from the Rocky Mountain Regional Veterans Administration.

Results: Common themes were 1) mind/body disconnection, 2) a sense of “otherness”, and 3) frustration with inability to control sleep. In addition, distinct themes emerged among combat Veterans including 1) sleeping with a weapon, 2) sleeping outside the bed (couch, closet, floor, under a table), 3) nocturnal vigilance including nightly patrols and 4) “combat sleep”. Combat Veterans were more likely to identify sleep difficulties as beginning with a traumatic combat-related event or immediately upon discharge.

Conclusion: This phenomenological study explored the experience of sleep disturbances in U.S. Veterans with PTSD. Implications for this study include the possibility that combat Veterans and non-combat Veterans may have different underlying reasons and patterns around sleep disturbances, and future research should explore whether treatment effectiveness may be different between groups.

Support (If Any): Veterans Administration

EFFICACY OF A STEPPED-CARE CBT-I APPROACH FOR INSOMNIA

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Introduction: Digital cognitive behavioral therapy for insomnia (dCBT-I) has been shown to be effective, and confers the advantages of higher accessibility and affordability; however, tradeoffs include the loss of clinician support and the ability to personalize treatment. Furthermore, many individuals do not remit following dCBT-I, and thus may benefit from an increased dose of CBT-I.

This study tested the efficacy of a stepped-care approach that combines dCBT-I (step 1) with face-to-face CBT-I (step 2).

Methods: 261 individuals with insomnia (DSM-5 diagnostic criteria) were randomized into two conditions at step 1: dCBT-I (N=104), or an online sleep education control (N=157). Participants in the dCBT-I condition who did not remit (ISI>9) were further randomized to either face-to-face CBT-I (N=23) or sleep education (N=32). Insomnia (Insomnia Severity Scale) was assessed at baseline, post-step 1, and post-step 2.

Results: Those who received stepped-care (dCBT-I to face-to-face CBT-I) achieved the same improvements in insomnia (pre-treatment ISI: 16.2, SD=4.9; post-treatment ISI: 7.5, SD=4.0) compared to those who remitted following only dCBT-I (pre-treatment ISI: 16.3, SD=3.9; post-treatment ISI: 7.5, SD=3.1). Furthermore, remission rates in the face-to-face CBT-I condition at step 2 (78.3%) was almost three-fold that of the control condition at step 2 (28.1%), indicating that the stepped-care condition produced higher rates of insomnia remission compared to dCBT-I alone.

Conclusion: Preliminary evidence from this study provide suggest that a stepped-care approach that adds face-to-face CBT-I for non-remitters to dCBT-I is an efficacious model for insomnia treatment.

Support (If Any): Support for this study was provided from the National Institute of Mental Health R56MH115150 awarded to Dr. Christopher Drake.

COMPARATIVE EFFICACY OF DIGITAL CBT-I VERSUS STEPPED-CARE CBT-I TO REDUCE COMORBID DEPRESSION

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Introduction: Depression is commonly comorbid with insomnia and can be effectively targeted with digital cognitive behavioral therapy for insomnia (dCBT-I). Digital delivery of CBT-I is advantageous because it is highly accessible and requires minimal clinical resources; however, tradeoffs include the loss of clinician support and the ability to personalize treatment. A stepped-care model can optimize care by starting with a least resource intensive intervention (step 1: dCBT-I) and stepping-up non-remitters to specialized treatment (step 2: face-to-face CBT-I). This study tested the efficacy of a stepped-care approach to target co-morbid depression.

Methods: 261 individuals with insomnia (DSM-5 diagnostic criteria) were randomized into two conditions at step 1: dCBT-I (N=104), or an online sleep education control (N=157). Participants in the dCBT-I condition who did not show remission for insomnia (ISI>9) were further randomized to either face-to-face CBT-I (N=23) or sleep education (N=32). Depression (Quick Inventory of Depressive Symptomatology) was assessed at baseline, post-step 1, and post-step 2.

Results: Those who received stepped-care (dCBT-I to face-to-face CBT-I) achieved the same improvements in depression (pre-treatment QIDS: 6.9 ± 2.1 SD; post-treatment QIDS: 4.0 ± 3.2 SD) compared to those who remitted following only dCBT-I (pre-treatment QIDS: 7.2 ± 2.2 SD; post-treatment QIDS: 4.2 ± 2.2 SD). Furthermore, depression remission (QIDS ≤ 5) in the face-to-face CBT-I condition at step 2 (82.6%) was twice as high compared to the control condition at step 2 (40.6%), indicating that the stepped-care condition produced higher rates of depression remission compared to dCBT-I alone.
**Introduction:** Cancer treatments are associated with many long-term health consequences. Insomnia is one of the most common. Though behavioral treatments for insomnia are effective, access is limited, especially at cancer centers. There is increasing interest in the implementation of stepped care models in the treatment of insomnia to potentially improve patient accessibility. We evaluated the efficacy of stepped insomnia treatment at a comprehensive cancer center. A stepped-care approach to treating cancer survivors' insomnia can improve treatment accessibility for this underserved population. A sizable proportion of survivors can benefit from a brief telephone-delivered CBT-I program, designed to be readily accessible CBT-I to cancer patients. The aim of this pilot study is to evaluate the effectiveness of CBT-I delivered over the telephone among cancer patients.

**Methods:** 51 survivors (mean age = 55 years) with elevated Insomnia Severity Index (ISI) scores (≥12) first received a single, hour-long sleep education session, and were reassessed 1-month later. Those continuing to report elevated ISI scores (≥12) were then offered a 3-session cognitive-behavioral treatment for insomnia (CBT-I) program that we previously demonstrated to be efficacious in cancer survivors. Participants were considered “treatment responders” if their ISI score improved by ≥6 points, and considered “remitted” if their post-treatment ISI score was <12. Mood was assessed with the Profile of Mood States (POMS).

**Results:** Following the single sleep education session, mean ISI scores improved (17.1 to 11.2; p < .001), with 45% of survivors responding to treatment and 41% remitted. Insomnia remission at this step was associated with lower insomnia severity and shorter duration of sleep problems at baseline. Of the 30 survivors (59%) with persistent insomnia after the single session, 14 (47%) participated in the 3-session CBT-I program. Participation in the second step of care was associated with interest in help for sleep problems, but not with any demographic, disease, or insomnia characteristics. Following the CBT-I program, mean ISI scores improved (16.9 to 8.8; p < .001), with 79% of survivors responding to treatment and 71% remitted. Mood improved significantly after both treatment steps (POMS total score; p < .001).

**Conclusion:** A stepped-care approach to treating cancer survivors' insomnia can improve treatment accessibility for this underserved population. A sizable proportion of survivors can benefit from a low-intensity session that can be delivered by non-specialists. For those requiring more intensive care, an assessment of treatment interest can identify those likely to engage in therapy.

**Support (If Any):** NCI R03CA201459-01.

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**0360**

**GOLDILOCKS'S INSOMNIA: FINDING THE JUST RIGHT TREATMENT FOR CANCER SURVIVORS IN A STEPPED CARE PROGRAM**

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**Introduction:** Insomnia is one of the most common sleep disorders reported by cancer patients. Although Cognitive Behavioral Therapy for Insomnia (CBT-I) is the first line of treatment for insomnia, it is underutilized among cancer patients. Common barriers include lack of trained providers, transportation to treatment centers, and duration of treatment. Telehealth platforms provide the unique opportunity to deliver timely, cost-effective and accessible CBT-I to cancer patients. The aim of this pilot study is to evaluate the effectiveness of CBT-I delivered over the telephone among cancer patients.

**Methods:** Participants were 13 cancer patients diagnosed with insomnia. Most participants were female (n = 11) with an average age of 58.3 (SD = 9.0). Participants attended one clinical interview in-person followed by four telephone-delivered CBT-I sessions. Pre and post measures included the Structured Clinical Interview for Sleep Disorders, Insomnia Severity Index, Pittsburg Sleep Quality Index, sleep diary, and the Hospital Anxiety and Depression. All patients completed the four treatment sessions, which were provided by master’s-level clinicians.

**Results:** Paired t-tests were conducted to compare insomnia, depressive and anxiety symptoms at pre- and post-treatment. There was a significant decrease in insomnia severity at post-treatment (M = 7.0; SD = 3.6) compared to pre-treatment (M = 16.6; SD = 3.5), t(12), 9.9, p < .001. Similarly, there was a significant improvement in sleep quality as evidenced by a reduction on sleep symptoms at post-treatment (M = 5.5; SD = 2.4) compared to pre-treatment (M = 11.3; SD = 3.3), t(12), 11.5, p < .001. However, there was not significant difference between pre- and post-treatment on depression and anxiety scores.

**Conclusion:** Brief telephone-delivered CBT-I appears to be an effective treatment option for cancer patients suffering from insomnia. Further research is needed to determine whether CBT-I could also impact anxiety and depressive symptoms.

**Support (If Any):** NA
the HALEO CBTi program. The efficacy of the HALEO CBTi program was measured by the change in the Insomnia Severity Index (ISI) scores. The Hospital Anxiety and Depression Scale (HADS) was used to measure changes in anxiety (HADS-A) and depression (HADS-D) symptoms. The ISI and HADS were filled out at the beginning of therapy (baseline) and just before the final therapy session (post-therapy). Data were analyzed with one-tailed Student paired t-tests.

Results: ISI scores were significantly lower post-therapy (M = 8.95, SD = 3.91) compared to baseline (M = 15.71, SD = 3.69; t(81) = 12.44, p < .001). Cohen’s d = 1.37. HADS-D scores were also significantly lower post-therapy (M = 2.91, SD = 2.68) versus baseline (M = 4.06, SD = 2.84; t(81) = 4.75, p < .001, d = 0.53). HADS-A scores were also significantly lower post-therapy (M = 6.30, SD = 0.35) versus baseline (M = 8.19 SD = 3.31; t(81) = 5.74, p < .001, d = 5.75).

Conclusion: The results indicate that the HALEO CBTi program is effective in reducing symptoms of insomnia, as measured by the ISI, and yields a large effect size similar to that found in studies examining traditional face-to-face CBTi therapy. Furthermore, our findings indicate that the HALEO CBTi program significantly reduces depression and anxiety symptoms as measured by the HADS. Together, the findings suggest that effective, therapist-led CBTi can be made accessible via a video-conferencing digital platform. The next phase of research will involve randomized control trials.

Support (If Any): None

**0363 Efficacy of Cognitive Behavioral Therapy Delivered Via Telemedicine vs. Face-to-Face: Preliminary Results from a Randomized Controlled Non-Inferiority Trial**

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Introduction: CBT for insomnia is effective but a barrier to its widespread use is the lack of evidence-based delivery modalities other than face-to-face (F2F). Telemedicine is increasingly used in other areas of healthcare but its efficacy and acceptability for the delivery of CBTI is unknown. In an ongoing randomized controlled non-inferiority trial comparing F2F and telementicine (via AASM SleepTM) delivery of CBTI, we compared these two modalities on measures of therapist alliance.

Methods: Adults with insomnia were screened for other sleep, medical, and mental health disorders. Eligible participants were randomized to receive CBTI either via SleepTM or F2F in six weekly sessions of 45-60 minutes each. One therapist delivered CBTI in both conditions (DAC). Participants completed the Working Alliance Inventory (WAI) after each session and the Therapy Evaluation Questionnaire (TEQ) before and after treatment. The WAI score ranges from 0-60 and assesses agreement on therapy tasks, therapy goals, and development of affective bond. We also analyzed the two items on the post-treatment TEQ that assess participant’s perception of therapist’s warmth and skills. Item scores range from 1-7.

Results: A total of 38 participants, 25 females, mean age = 52.5, SD = 14; age range = 20-72 participated. Twenty received SleepTM and 18 F2F. Mean WAI scores ranged between 34-60 in SleepTM and between 40-60 in the F2F. TEQ warmth score ranged between 3-7 in SleepTM and 5-7 in F2F. TEQ skills score ranged between 3-7 for SleepTM and 6-7 for F2F. A mixed ANOVA on WAI scores across treatment sessions did not reveal any main effects or interactions. Independent samples t-tests revealed no significant differences on therapist warmth (SleepTM, 6.0 ± 1.3 vs F2F, 6.6 ± 0.61, t = -1.7, df = 36, p = .10) or skills (Sleep TM 6.5 ± 1.1 vs F2F, 6.8 ± 0.44, t = 1.0, df = 36, p = .32).

Conclusion: Our preliminary findings suggest no differences in therapeutic alliance, warmth, or confidence in therapist’s skills between telementicine (via the AASM SleepTM) and F2F delivery of CBTI. Data collection is ongoing.

Support (If Any): Research supported by American Sleep Medicine Foundation Grant # 168-SR-17 (JT Arnedt)
B. Clinical Sleep Science and Practice

0365

ASSESSING COMPLETION OF AN ONLINE COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA COURSE

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Introduction: Cognitive behavioral therapy for insomnia (CBTI) is an effective first-line treatment for insomnia. However, limited access to trained CBTI providers can prevent patients from receiving this potent therapy. To address this access issue, the Department of Veterans Affairs (VA) released a free online CBTI course, “Path to Better Sleep” (www.sleepbettercourse.com), which has the potential to increase participation in therapy. This quality improvement project assessed whether patients who were referred to this online course during their sleep clinic visit completed the course.

Methods: Patients were referred by their sleep provider to the online CBTI course “Path to Better Sleep” during their sleep clinic visit between March and June 2018 at three VA sleep clinics. During this referral process, patients were informed of the online course and provided with the website address. Patients were called between July and August 2018, 2-5 months after being referred to the course. Patients were asked if they remembered being referred to the online CBTI course. If they answered “yes,” they were asked if they completed the course.

Results: Of the 50 patients who were contacted (92% male; mean age 48.3 years [range 26-75 years]), 34 patients were reachable by phone. 25/34 (74%) patients did not recall being referred to the online CBTI course. 9/34 (26%) recalled being referred to the online CBTI course of which: 1 (3%) patient thinks she completed the course, 1 (3%) patient partially completed the course, 3 (9%) patients remembered being referred but did not remember the website address, 3 (9%) patients remember being referred but have not yet completed the course, and 1 (3%) patient stated he no longer needed CBTI as his insomnia improved on its own.

Conclusion: Although this online course improves access to CBTI, the patient completion rate is very low (3%). The most common barriers were 1) remembering they were referred to CBTI, 2) recalling the website address, 3) making time to complete the course. Future work needs to be done to improve adherence to online CBTI therapy.

Support (If Any): (None)

0366

CHANGES IN USE OF SLEEP AIDS FOLLOWING DIGITAL COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: Cognitive behavioral therapy for insomnia is now recommended as first-line treatment for chronic insomnia, and can be delivered digitally (dCBT-I) for increased access. Furthermore, dCBT-I confers an advantage of reduced adverse events relative to pharmacologic interventions (e.g., hypnotics and other sleep aids). This study examined if treatment with dCBT-I can also reduce use of sleep aids compared to an online sleep education control.

Methods: 1232 individuals with insomnia (DSM-5 diagnostic criteria) were randomized into two conditions: dCBT-I (N=639), or an online sleep education control (N=593). Use of medications for sleep (prescription and non-prescription) were assessed pre-treatment and post-treatment. Responses were categorized into general classes of medications (i.e. benzodiazepine, hypnotic, antihistamine, etc.), and compared across time points between the two conditions.

Results: Results from a repeated-measures mixed-effects logistic regression indicated that the odds of prescription medication was significantly lower following dCBT-I compared to control (OR=0.09, 95%CI[0.02, 0.34]). Specifically, whereas prescription medication use in the control group increased from 16.5% to 18.0% at post-treatment, prescription medication use in the dCBT-I group decreased from 17.8% to 14.6%. Change in prescription medication use was more pronounced for antidepressants, followed by hypnotics. No differences were found in use of non-prescription medications.

Conclusion: This study provides preliminary evidence that use of prescription sleep aids may decrease following completion of dCBT-I. Together, this suggests that a minimally resource intensive intervention may have a small effect in reducing reliance on prescription sleep aids.

Support (If Any): Support for this study was provided from the National Institute of Mental Health R56MH115150 awarded to Dr. Christopher Drake.

0367

LEMBOREXANT TREATMENT FOR INSOMNIA: 6-MONTH SAFETY

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Introduction: There is an unmet medical need for effective, well-tolerated pharmacological treatments for insomnia disorder that are studied over the long-term. Safety results are presented from the placebo-controlled first 6 months of a 12-month Phase 3 study of lemborexant (LEM), a dual orexin receptor antagonist under development for treatment of insomnia.

Methods: SUNRISE-2 was a Phase 3, 12-month global study in female and male adults with insomnia disorder that included a 6-month double-blind, placebo (PBO)-controlled treatment period followed by a 6-month blinded active treatment period. Subjects were randomized to PBO, LEM 5mg (LEM5) or LEM 10mg (LEM10) for the 1st 6 months.

Results: 959 subjects were randomized and treated: 321 (PBO), 319 (LEM5), and 319 (LEM10). Most completed 6 months of treatment: 80.1%, 78.7% and 70.8%, on PBO, LEM5 and LEM10, respectively. Treatment-emergent adverse events (TEAEs) were reported for 62.7%, 61.1% and 59.6% of subjects on PBO, LEM5 and LEM10, respectively. Most were mild or moderate, with severe TEAEs in 3.1% (PBO), 4.1% (LEM5) and 2.5% (LEM10) of subjects. Overall, 3.8% (PBO), 4.1% (LEM5) and 8.3% (LEM10) of subjects discontinued study drug for TEAEs. TEAEs reported for ≥3% and >PBO in either LEM group were, for PBO, LEM5 and LEM10 respectively: somnolence (1.6%, 8.6%, 13.1%), headache (6.6%, 8.9%, 6.7%), influenza (4.7%, 4.8%, 5.1%), upper respiratory tract infection (3.1%, 4.1%, 3.5%), fatigue (0.3%, 3.8%, 3.5%), and back pain (2.5%, 3.8%, 2.9%). Treatment-emergent serious adverse events (SAEs) were reported by 1.6% (PBO), 2.2% (LEM5) and 2.9% (LEM10) of subjects. Most SAEs were reported in only one subject in any group. There were no deaths or clinically significant findings for laboratory tests, vital signs, weight or electrocardiograms. There were no clinically relevant differences in the safety profiles across age groups, sex, race, region, or body mass index (BMI).

I. Insomnia

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B. Clinical Sleep Science and Practice

0368 EFFICACY AND TOLERABILITY OF LEMBOREXANT IN FEMALE AND MALE SUBJECTS WITH INSOMNIA
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Introduction: In clinical trials, efficacy and tolerability are typically evaluated in subgroups, including by sex. This report presents pooled analyses of subject-reported sleep onset latency (sSOL) and wake after sleep onset (sWASO) from lemborexant (LEM; dual orexin receptor antagonist) Phase 3 studies, SUNRISE-1 and -2.

Methods: SUNRISE-1 was a 1-month, double-blind, placebo (PBO)- and active-controlled (zolpidem tartrate extended-release [ZOL]) 30 day study. Subjects were randomized to nightly PBO, ZOL, LEM 5mg (LEM5) or LEM 10mg (LEM10). Each study included a single-blind PBO run-in prior to randomization.

Results: This pooled analysis included 402 (23.7%) male and 1291 (76.3%) female subjects. Results on sSOL and sWASO were consistent with the significant results on sleep diary in the individual studies. In both sexes, sSOL was significantly reduced versus PBO for LEM5 and LEM10 during the first 7 days and end of Month 1 (P<0.05 all comparisons). In females, there were significantly greater reductions in sWASO versus PBO for both LEM doses (first 7 days and end of Month 1; P<0.0001 all comparisons). In males, sWASO decreased significantly compared with PBO for the first 7 days (LEM5 and LEM10; P<0.0001) and end of Month 1 (LEM10 only; P=0.0032). For PBO, LEM5 and LEM10, overall incidence of TEAEs was similar across sexes. Incidence of treatment-emergent serious AEs was low for both subgroups; most events occurred in 1 subject each. TEAEs leading to study drug withdrawal or interruption were few and similar across sexes for all treatments. Somnolence incidence, the most frequent TEAE, was consistent between sexes. Approximately 3% of females (0 males) reported urinary tract infection; incidence in females was similar across treatment groups.

Conclusion: LEM effectively treats both sleep onset and maintenance variables in male and female subjects with insomnia, and is well-tolerated by both sexes.

Support (If Any): Eisai, Inc., Purdue Pharma L.P.

0369 EFFECT OF LEMBOREXANT ON SLEEP ARCHITECTURE IN OLDER ADULTS WITH INSOMNIA DISORDER
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Introduction: Insomnia is characterized by changes in sleep-wake architecture, including reduction and temporal redistribution of N3 and REM sleep. For older adults, insomnia may exacerbate normal age-related changes in sleep-wake architecture. Current insomnia treatments may decrease wake after sleep onset but suppress N3 and/or REM sleep. Polysomnography data from SUNRISE-1, a Phase 3 clinical study in older (≥55y) adults with insomnia disorder, were examined to assess the effect of lemborexant (LEM) on sleep architecture.

Methods: SUNRISE-1 (NCT02783729) was a global, randomized, placebo (PBO)- and active-controlled (zolpidem tartrate extended release 6.25mg [ZOL]) 30 day study. Subjects were randomized to nightly PBO, ZOL, LEM 5mg (LEM5) or LEM 10mg (LEM10). Sleep architecture was assessed by polysomnography at baseline during a single blind placebo run-in, and during the first two (N1/2) and last two (N29/30) nights of treatment. Mean values for each sleep stage were based on 2 consecutive nights of PSG recordings.

Results: SUNRISE-1 randomized 1006 subjects (208 PBO, 263 ZOL, 266 LEM5, 269 LEM10), 86.4% female, 72.3% white, median age 63.0 years. Demographic and baseline characteristics, including PSG, were similar across treatment groups. Compared with PBO, LEM5 and LEM10 significantly increased N2, NREM, REM, and total sleep time (TST) at N1/2 and N29/30 (all p<0.0001), N1 only at N29/30 (p=0.0001), and for LEM 5, N3 at N1/2 (P<0.05). Compared with ZOL, LEM5 and LEM10 significantly increased N1, REM, and TST at N1/2 and N29/30, NREM at N29/30, and for LEM5, N2 at N1/2 (all p<0.05). REM latency was significantly reduced for LEM5 and LEM10 compared to PBO and ZOL at N1/2 and N29/30 (all p<0.0001). The reduction in REM latency was less by N29/30 than N1/2.

Conclusion: In older adults with insomnia, LEM treatment results in improvement of sleep architecture, with increased time in all stages and reduction of REM compared with PBO, and was superior to ZOL for most measures. These results suggest that LEM may ameliorate the alterations of sleep architecture in older insomnia patients.

Support (If Any): Eisai, Inc., Purdue Pharma L.P.

0370 PATIENT-REPORTED SLEEP ONSET AND SLEEP MAINTENANCE: POOLED ANALYSES OF LEMBOREXANT PHASE 3 STUDIES
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Introduction: Current insomnia treatments, such as the GABA-ergic, non-benzodiazepine sedative-hypnotics, may not adequately treat both sleep onset and sleep maintenance symptoms, and are associated with risk of falls, tolerance/dependence, and abuse potential, among others. Drugs targeting the orexin system, like lemborexant (LEM), may dampen wakefulness, facilitating sleep with fewer potential adverse consequences. These analyses are from 1-month of pooled data from 2 Phase 3 studies in adult and older subjects with DSM-5 insomnia disorder.

Support (If Any): Eisai, Inc., Purdue Pharma L.P.
**B. Clinical Sleep Science and Practice**

**Methods:** SUNRISE-1 was a 1-month, double-blind, randomized, placebo (PBO)- and active-controlled, parallel-group study in 1006 subjects (age ≥55y). Subjects were randomized to PBO, LEM 5mg (LEM5), LEM 10mg (LEM10) or zolpidem tartrate extended-release (ZOL; 6.25mg; not reported). SUNRISE-2 was a 12-month (6-month PBO-controlled, 6-month active treatment), double-blind study in 949 subjects (age ≥18y) randomized to PBO, LEMS or LEM10. Subjects completed a daily electronic diary regarding time to fall asleep (sSOL), wake after sleep onset (sWASO), time in bed, among others. Both studies included a 2-week placebo run-in. Data from the first month of treatment were pooled for sSOL, subjective sleep efficiency (sSE) and sWASO. ZOL was not studied in SUNRISE-2; data were not pooled. Data were analyzed by mixed effect model repeated measurement.

**Results:** Subjects analyzed were: PBO 527, LEM5 582, LEM10 584. Reduction in sSOL was statistically greater for both doses of LEM versus PBO for the first 7 days of treatment and end of Month 1 (all comparisons P<0.0001). Both doses, versus PBO, significantly increased sSE (P<0.0001 both time points) and reduced sWASO (P<0.001 first 7 days [both doses]; P<0.05 [LEM5] and P<0.001 [LEM10] at Month 1). Average values on sleep maintenance endpoints showed that subjects taking LEM obtained >1 hour of additional sleep per night. LEM was well-tolerated, with most adverse events (AEs) being mild to moderate in severity and low rates of serious AEs.

**Conclusion:** LEM demonstrates efficacy on sleep onset and sleep maintenance variables in a broad age range of subjects with insomnia disorder, with good tolerability.

**Support (If Any):** Eisai Inc., Purdue Pharma L.P.

**0371 LEMBOREXANT TREATMENT FOR INSOMNIA IN PHASE 3: IMPACT ON DISEASE SEVERITY**

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**Introduction:** The effectiveness of treatments for insomnia in clinical trials is generally based on polysomnographic and patient assessments of sleep onset and/or sleep maintenance relative to placebo. Ideally, treatment success should lead to decreases in disease severity, measurable by the Insomnia Severity Index (ISI). In two Phase 3 studies, lemborexant (LEM 5 and 10mg) showed statistically significant benefits in sleep diary-based sleep onset latency and sleep maintenance variables versus placebo. Results from a pooled analysis of these studies of LEM from one month of nightly use are presented here.

**Methods:** SUNRISE-1 was a 1-month blinded, placebo- and active-controlled (zolpidem extended release [ZOL]; not reported here), parallel-group study in 1006 female and male subjects with insomnia disorder age ≥55y, with baseline ISI total score (TS) ≥13 after placebo run-in. Subjects were randomized to placebo, ZOL, LEM 5mg (LEM5) or LEM 10mg (LEM10). SUNRISE-2 was a 12-month placebo-controlled (first 6 months), blinded, parallel-group study in 959 female and male subjects with insomnia disorder age ≥18y, with baseline TS ≥15 after placebo run-in. In both studies, ISI was administered at baseline and Month 1. An analysis of covariance model, with baseline TS as covariate, and region, study, and age group as factors was used for change from baseline and Cochran-Mantel-Haenszel test stratified by study, region and age group for responder rate analyses.

**Results:** Mean baseline TS was 19.2 (placebo), 19.3 (LEM5), and 19.0 (LEM10). Mean TS decreased at Month 1 relative to baseline for all treatment groups. Decreases were significantly larger for LEMS and LEM10 versus placebo (P<0.0001). The percentage whose TS decreased by ≥7 points was 33.6% (placebo) versus 47.3% (LEM5) and 47.8% (LEM10). The percentage whose TS was <10 points at Month 1 (clinical insomnia threshold) was 20.3% (placebo) versus 33.0% (LEM5) and 33.4% (LEM10). These differences versus placebo were statistically significant (P<0.0001).

**Conclusion:** Treatment with LEM significantly decreased the severity of insomnia symptoms. Approximately 1/3 of those in the LEM groups experienced declines in ISI below the threshold for clinically important insomnia.

**Support (If Any):** Eisai Inc., Purdue Pharma L.P.

**0372 AROUSABILITY OF INSOMNIA PATIENTS IS NOT IMPACTED BY THE OREXIN ANTAGONIST SUVOREXANT (10 MG AND 20 MG)**

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**Introduction:** Ability to awaken to external or internal stimuli (arousability) has significant clinical implications in patients with a variety of medical disorders (e.g., sleep related breathing disorders, GERD) and life circumstances (e.g. caregiver responsibility, environmental threat). Arousalability with an orexin antagonist has been demonstrated in an animal model. Yet, arousability has not been assessed with orexin antagonists in humans. Thus, we evaluated Auditory Awakening Threshold (AAT) with suvorexant in comparison to placebo.

**Methods:** In a placebo-controlled double-blind 3-way crossover study in 12 (7F) subjects with insomnia, AAT to 1000 Hz tones ~2-hrs after bedtime was determined following suvorexant 10 and 20 mg (SUV10, 20) compared to placebo (PBO) administered 30 minutes before bedtime. Tones were presented during stable (5 consecutive minutes) stage 2 sleep in 5db increments starting at 30db. The AAT was compared using one-way repeated measures analysis of variance. Standard sleep parameters of latency to persistent sleep (LPS), wake after sleep onset (WASO), and total sleep time (TST) were also assessed for each condition using paired comparisons.

**Results:** Neither the AAT (expressed as dB) for SUV10 (74.18 ± 23.46) nor SUV20 (83.76 ± 20.24) was significantly different from PBO (79.18 ± 22.34; p = .34). SUV was an active dose in these subjects as seen by significantly greater total sleep time following SUV20 (446.35 ± 23.94 minutes; p = 0.024) compared to placebo (401.09 ± 51.29 minutes). In addition, decreased WASO was observed following SUV20 (22.85 ± 18.50 minutes; p = 0.024) compared to placebo (55.69 ± 40.00 minutes). No significant differences were found for effects of condition on LPS likely reflecting the small sample size.

**Conclusion:** The orexin antagonist suvorexant improved sleep without decreasing nocturnal arousability. These results are in contrast to published reports demonstrating blunting of arousal response with benzodiazepine receptor agonists (e.g., zolpidem). Future studies should investigate whether differential arousal
response extends into the post-arousal period thereby impacting other behaviors such as ambulating, memory, and cognitive function.

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0373 EFFECTS OF SUVOREXANT ON SLEEP IN FIBROMYALGIA
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Introduction: The chronic widespread pain disorder, fibromyalgia, is associated with sleep disturbance, typically sleep maintenance. Pharmacological treatment studies have either focused on the pain or the sleep disturbance with equivocal results in that few studies have improved both sleep and pain. No studies have evaluated the effect of sleep medication on pain sensitivity. Suvorexant, an orexin antagonist, approved for treatment of insomnia may provide benefit for both the sleep and pain of fibromyalgia. Here we report on suvorexant’s sleep effects in patients with fibromyalgia and comorbid insomnia disorder gathered as part of a feasibility study.

Methods: Women, 21-65 yrs old, with fibromyalgia and co-morbid insomnia (n=10) were treated for 9 nights with suvorexant, 20 mg, and placebo with the order of the treatments counterbalanced. They were in good psychiatric and stable physical health and met American College of Rheumatology criteria for fibromyalgia and DSM-V criteria for insomnia. On a screening 8-hr PSG other primary sleep disorders were ruled out. On nights 8 and 9 of each treatment 8-hr PSGs were collected. All PSGs were scored following ASSM criteria and PSG measures were compared using repeated measures ANOVAs with night and drug condition as factors.

Results: Suvorexant vs placebo increased total sleep time (7.2 vs 6.7 hrs, p< .05) and reduced wake after sleep onset (37 vs 67 min, p<.04) with no night effects or interaction. Suvorexant also reduced wake during the last half (20 vs 41 min, p<.03) and quarter (13 vs 20 min, p<.03) of the night. Latency to persistent sleep and sleep stage measures were not altered by suvorexant.

Conclusion: In patients with fibromyalgia and comorbid insomnia disorder suvorexant, 20 mg, improved total sleep time and reduced wake after sleep onset with sustained effects through the last quarter of the sleep period and no alteration of normal sleep staging.

Support (If Any): Merck, grant #: 53918, awarded to Dr. Roehrs

0374 EFFECTS OF SUVOREXANT ON PAIN SENSITIVITY IN FIBROMYALGIA
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Introduction: The chronic widespread pain disorder, fibromyalgia, is known for its nociceptive hypersensitization and disturbed sleep. The relation of sleep and pain is bidirectional and data suggest that improving sleep in chronic pain disorders would attenuate daytime pain sensitivity. Here we report on suvorexant’s next-day pain effects following night-time use gathered as part of a feasibility study.

Methods: Women, 21-65 yrs old, with fibromyalgia and co-morbid insomnia (n=10) were treated for 9 nights with suvorexant 20 mg and placebo with the order of treatment nights counterbalanced. Subjects were in good psychiatric health and stable physical condition and met American College of Rheumatology criteria for fibromyalgia and DSM-V criteria for insomnia. On a baseline screening 8-hr PSG other primary sleep disorders were ruled out. On days 2 and 9 of each treatment condition pain sensitivity was assessed at 1100 and 1500 hr by measuring finger withdrawal latency (FWL) to a radiant heat stimulus at 5 randomly presented intensity levels. FWL on the two tests of days 2 and 9 were compared between treatments using repeated measures ANOVAs with days and drug condition as factors.

Results: FWL on both am and pm tests varied as a function of intensity (p<.001) with no time of day effects or interaction (hi intensity = short latency; low = long latency). On days 2 and 9 after suvorexant versus placebo pain sensitivity was reduced (i.e., latency increased). Average FWL (over 5 intensities and both days) was increased on both the am test (13.9 vs 13.1 sec) and pm tests (15.8 vs 14.1 sec; p<.03) following suvorexant the previous night. There were no time of day effects or interaction.

Conclusion: Following hypnotic use of suvorexant 20 mg versus placebo by patients with fibromyalgia, next-day pain sensitivity was reduced on both am and pm assessments of FWL to a radiant heat stimulus.

Support (If Any): Merck, grant #: 53918, awarded to Dr. Roehrs

0375 A NOVEL DUAL OREXIN RECEPTOR ANTAGONIST (ACT-541468) TO TREAT INSOMNIA: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, ACTIVE-REFERENCE PHASE 2 STUDY
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Introduction: Orexins are involved in the regulation of sleep and wakefulness. The primary objective of this Phase 2 study was to investigate the dose-response relationship of ACT-541468 on sleep variables in subjects with insomnia disorder.

Methods: Eligible adults (≤64 years) with insomnia disorder (Diagnostic and Statistical Manual of Mental Disorders, 5th Edition criteria) were randomized (1:1:1:1:1:1) to receive, 5, 10, 25, 50, and 100 mg ACT-541468, placebo or 10 mg zolpidem for 4 weeks. Main efficacy endpoints were the change from baseline (placebo run-in) to Days1&2 for wake after sleep onset (WASO; primary) and latency to persistent sleep (LPS; secondary). The dose-response of ACT-541468 was evaluated using MCP-Mod methodology.

Results: Of 1005 subjects screened, 360 (median age 47 [range, 36-53]; 64% female) were randomized. A significant dose-response of ACT-541468 was demonstrated for WASO (p<0.0007). Observed mean reductions from baseline to Days 1&2 for WASO were −28.99, −33.75, −39.64, and −45.49 min for ascending ACT-541468 doses
(placebo, −20.98 min; zolpidem, −31.23 min) and were sustained at Days2&29 (−37.76, −43.74, −39.84, −46.97 min for ascending ACT-541468 doses [placebo, −33.80 min; zolpidem, −37.08 min]). A significant dose-response for LPS at doses 10 mg and above was detected (p<0.05). Observed changes in mean LPS from baseline to Days1&2 were −26.88, −29.31, −36.14, and −36.41 min for ascending ACT-541468 doses (placebo, −22.02 min; zolpidem, −45.12 min). Reductions in LPS were sustained at Days2&29. ACT-541468 treatment was well-tolerated at all doses, with no evidence of dose-dependent adverse effects. Treatment-emergent adverse events (TEAEs) were reported in 35%, 38%, 38%, and 34% subjects treated with 5, 10, 25, and 50 mg ACT-541468, respectively (30% for placebo; 40% for zolpidem). The main TEAEs across all groups were headache, somnolence, and nasopharyngitis. No signs of next-day residual effects or rebound insomnia were observed.

**Conclusion:** ACT-541468 demonstrated a significant dose-response for WASO and LPS compared with placebo and was well-tolerated without dose-dependent safety concerns or residual negative next-day effects. Phase 3 evaluation of ACT-541468 in adults with insomnia is ongoing.

**Support (If Any):** None

### 0376

**CLINICAL PHARMACOLOGY OF THE DUAL OREXIN RECEPTOR ANTAGONIST ACT-541468 IN JAPANESE AND CAUCASIAN SUBJECTS**

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**Introduction:** The orexin system is involved in the regulation of sleep. Following administration of 25 and 50 mg once daily in the morning for 5 days, pharmacokinetics (PK), pharmacodynamics (PD), safety, and tolerability of ACT-541468 were investigated in healthy Japanese and Caucasian subjects.

**Methods:** Double-blind, placebo-controlled, randomized study in 40 subjects (age 20-50 years, 1:1 sex ratio, 10/10 Japanese/Caucasian per dose group, 8/2 active/placebo). PK, PD (saccadic peak velocity, adaptive tracking, body sway, Bond and Lader visual analog scales), safety, and tolerability were assessed.

**Results:** On Day 1 at 25 mg the PK parameters maximum plasma concentration (Cmax), time to reach Cmax (tmax), area under the curve (AUC), and terminal half-life (t½) were similar in both ethnic groups, with values of 737 and 740 ng/mL, 1.1 and 1.3 h, 3870 and 4449 ng·h/mL, and 8.7 and 7.6 h in Japanese and Caucasians, respectively. Similarly, PK variables of the ethnic groups on Day 1 at 50 mg were comparable. When variables on Day 2 were compared with Day 1, tmax and t½ were similar for both ethnic groups. On Day 5 at 50 mg (not at 25 mg), Cmax and AUC were higher in Japanese than in Caucasians (1403 vs 1006 ng/mL and 8256 vs 6306 ng·h/mL). Dose-dependent PD effects were observed with no clear differences between Day 1 and Day 5. The onset of the effects was within 1 h after drug administration, with the maximum mean effect at 1-2 h and return to baseline at 4-8 h post-dose. Overall, Japanese showed slightly larger PD effects and reported more adverse events (AEs) than compared to Caucasians. The most frequently reported AEs in both ethnic groups were somnolence, fatigue, and headache.

**Conclusion:** Administration of 25 and 50 mg ACT-541468 in Japanese and Caucasian subjects was safe, well tolerated, and showed similar PK and PD.

**Support (If Any):** Clemens Muehlən and Jasper Dingemanse are employees at Idorsia, the sponsor of the study. The investigator Rob Zuiker is an employee of CHDR.

### 0377

**CLINICAL PHARMACOLOGY OF THE DUAL OREXIN RECEPTOR ANTAGONIST ACT-541468 IN ELDERLY SUBJECTS**

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**Introduction:** The orexin system regulates sleep and arousal. Following single-ascending dose (SAD) morning and repeated evening administration of ACT-541468, pharmacokinetics (PK), pharmacodynamics (PD), safety, tolerability, and residual next-day effects were investigated in healthy elderly subjects.

**Methods:** Double-blind, placebo-controlled, randomized, SAD study (5, 15, and 25 mg in the morning) in 24 male and female elderly subjects (65-80 years, 6/2 active/placebo per group, 1:1 sex ratio). In a separate study part, 10 subjects (8/2 active/placebo) received 25 mg for 7 days at bedtime. PK, PD (saccadic peak velocity (SPV), adaptive tracking, body sway, Bond and Lader visual analog scales, Karolinska Sleepiness Scale), safety, and tolerability were assessed.

**Results:** Absorption of ACT-541468 was quick, with median maximum plasma concentrations reached at 0.8-1.0 h across the dose range. The geometric mean elimination half-life was 8.5-9.8 h, the area under the curve, and the maximum plasma concentration increased proportionally to the dose administered. Following evening administration of 25 mg for 7 days, no relevant accumulation was observed. In the SAD part, there were no PD effects at 5 mg. At 15 mg, SPV was reduced, returning to baseline after 12 h, while other PD variables showed no effects. At 25 mg, effects on all PD parameters were observed, with an onset ≤1 h post-dose and a maximum mean effect at 1-2 h. PD effects returned to baseline 8-12 h post-dose. No next-day residual effects on objective and subjective PD variables were observed when assessments were performed in the next morning after evening administration. The incidence of adverse events in the elderly subjects of this study was lower when compared to young adults in previous studies.

**Conclusion:** ACT-541468 in elderly subjects, both after morning and evening administration, was safe and PK and PD are compatible with a drug for the treatment of insomnia.

**Support (If Any):** Clemens Muehlən and Jasper Dingemanse are employees at Idorsia, the sponsor of the study. The investigators Rob Zuiker, Sander Brooks and Joop van Gerven are employees of CHDR.

### 0378

**ARE PEOPLE WITH SEVERE INSOMNIA ABLE TO DISCONTINUE HYPNOTICS AFTER CHRONIC USE?**

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**Introduction:** A concern among physicians prescribing hypnotics is the inability to discontinue hypnotics after chronic use. This concern has never been directly tested in a controlled prospective study. This is a report of results from an on-going “blinded” trial in...
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which insomnia subjects are instructed to stop taking study medication after 6 months of nightly use.

Methods: DSM-V diagnosed insomnia subjects, 23–61 yrs, (n=25, 21 females), with disturbed sleep (i.e. polysomnographic sleep efficiency of ≤85%), no other sleep disorder, unstable medical or psychiatric disorder or drug dependency completed the trial. Participants were randomized to zolpidem XR (12.5 mg), eszopiclone (3 mg) or placebo nightly for 6 months (groups: A: n=10, B: n=8, C: n=9). After 6 months of nightly use, over a 2-week choice period, they were instructed to discontinue hypnotic use, but if necessary, to take either 1, 2, or 3 capsules of medication (zolpidem XR 6.25 mg, 6.25 mg placebo; eszopiclone 2 mg, 1 mg placebo 1, 2 and 3 respectively, or 3 placebos).

Results: The number of capsules taken declined from week 1 to 2 (p<.01). Over 2 weeks 13 participants took 0 (48%), 8 ≤ 6 (32%) and 4 ≥10 capsules (1 each took 42, 19, 13, and 10). Among those taking capsules most took one capsule per night and 9 took > 1 capsule. Those 4 taking ≥10 were younger (p<.05), but did not differ in screening sleep efficiency or blinded treatment group. Importantly 1 subject took every capsule available.

Conclusion: The majority (80%) of the participants discontinued 6-month nightly hypnotic use (i.e. took < 6 total capsules over 2 weeks) and among those taking capsules the rate declined from week 1 to 2. Age may help identify the few with difficulty discontinuing.

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0379
A RANDOMIZED CONTROLLED TRIAL OF CBT-I AND CPAP FOR COMORBID INSOMNIA AND OSA: INITIAL FINDINGS FROM THE MATRICS STUDY

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Introduction: The purpose of this study was to compare the efficacy of three treatment sequences using CPAP with or without CBT-I for the treatment of comorbid insomnia and obstructive sleep apnea (COMISA).

Methods: One-hundred and twenty-one adults (52.50% female, mean age=50.00) with COMISA were randomized to receive one of three treatment models using a partial factorial design: CBT-I followed by CPAP (Model A), CBT-I concurrent with CPAP (Model B), and CPAP only (Model C). CPAP was delivered following standard procedures for in-lab CPAP titration and home set-up with a third-party vendor. CBT-I was delivered in four individual sessions. Primary outcomes were CPAP adherence across the first 90 days of use and global measures of insomnia (Insomnia Severity Index; ISI) and sleep quality (Pittsburgh Sleep Quality Index; PSQI). Planned comparisons were conducted on those who received CBT-I+CPAP (Models A and B combined) versus CPAP only (Model C) using Wilcoxon signed ranks test and linear mixed models.

Results: No significant differences were found between the CPAP+CBT-I groups versus the CPAP only group on percent of nights used (Median=48.65% vs Median=71.10%, p=.29), minutes used per night (Median=232.87 vs Median=186.06, p=.21) or percentage of participants who were regular CPAP users (≥4 hours on ≥70% of nights during 30-day period: 37.50% vs 36.99%, p=.92). For mild OSA (AHI≤5 and <15), the CPAP+CBT-I groups used CPAP on a greater percentage of nights compared to the CPAP only group (Median=30.00% vs Median=5.50%), which approached significance (p=.05). A significant main effect was found for improvement in the ISI (p<.0001) and PSQI (p<.0001) but the interaction was not significant for either measure.

Conclusion: These findings indicate that patients with COMISA show improvements in self-reported global measures of insomnia and sleep quality across all treatment models. Although no significant benefits were found for those who received CBT-I+CPAP in the overall sample, there were indications that CBT-I might improve CPAP adherence among those with mild OSA.

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0380
DOES TST APPRECIABLY CHANGE DURING OR AFTER CBT-I?

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Introduction: Most standardized approaches to CBT-I conduct sleep restriction in two phases. Phase 1 involves matching sleep ability to sleep opportunity. Phase 2 involves the titration of sleep opportunity to increase TST. When treatment occurs over 4-8 sessions, it is commonly the case that SL and WASO are substantially reduced but TST is only minimally affected. In the long term, however, it has been shown that TST increases substantially (by about 1 hour in the 6-24 months following treatment). In order to evaluate how modal mean TST effects are, an archival analyses was undertaken to assess what percentage of subjects met or exceeded baseline TST at the end of, or following, treatment.

Methods: Data were drawn from a RCT conducted to assess the value of maintenance therapies for persistent insomnia. The CBT-I arm of the study had two stages. All subjects initially received six weekly sessions and then were randomized to maintain treatment CBT-I (once monthly) or to no additional treatment. The present analyses assessed the percentage of subjects that achieved TST increases substantially (by about 1 hour in the 6-24 months following treatment). In order to evaluate how modal mean TST effects are, an archival analyses was undertaken to assess what percentage of subjects met or exceeded baseline TST at the end of, or following, treatment.

Conclusion: More than 40% of subjects do not increase TST by more than 30 min during the acute treatment or over time. Such data

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Introduction: During postpartum, mothers experience disruptions in their sleep related to their infant. Maternal sensitivity, or the mother's ability to accurately perceive and interpret her infant’s cues and respond to them, is central for the development of a healthy parent-child relationship in infancy. Using data collected in a RCT of CBT for insomnia for pregnant women, we examined the possibility that poor maternal sleep, measured via Actigraphy, will be associated with reduced maternal sensitivity during the postpartum period.

Methods: At 18 weeks postpartum, mothers completed the Insomnia Severity Index (ISI), one week of the Actiwatch™, and concurrent Consensus Sleep Diaries. Mothers were recorded during a ten-minute “free play” with their infants. The recordings were coded using the infant adaptation of the Parent-Child Interaction Rating Scale across 5 two minute intervals.

Results: Mixed effects modeling revealed that maternal wake time after sleep onset (WASO) was not associated with mean maternal sensitivity, but it was related to the change in maternal sensitivity across the five intervals (p=.018). Post-hoc simple slopes analyses revealed that sensitivity of mothers with high WASO (≥90 min) demonstrated greater decrease across the free play intervals than mothers with low WASO (≤30 min) ($B=-0.01, SE=0.04, t(217.10)=-3.58, p<.001$). The effect of the number of wake bouts mirrored the effect of WASO. Maternal sensitivity across the free play decreased more among mothers with a greater number of wake bouts ($B =-0.16, SE=0.05, t(217.15)=-3.27, p<.001, 95\% CII[-0.25, -0.06]$). Neither ISI nor sleep duration were associated with overall levels or with the trajectory of maternal sensitivity across the free play intervals ($p$-values ≥.18).

Conclusion: The results indicate that although mothers with poorer sleep continuity did not demonstrate lower levels of sensitivity overall, they struggled to sustain sensitivity across the interaction. Since both infant care and time to return to sleep contribute to maternal time awake after sleep onset, future research will need to examine the relative contribution of each in order to design interventions to improve maternal sensitivity.

Support (If Any): NR013662

0382

CBT FOR PERINATAL INSOMNIA - POSTPARTUM OUTCOME

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Introduction: Insomnia during pregnancy is a risk for sleep challenges during the postpartum periods, when nighttime awakenings related to infant care is common and may be prolonged by insomnia. We present postpartum results from an RCT of CBT for insomnia (CBTI) among pregnant women. We hypothesize that better response to treatment during pregnancy would result in lower insomnia severity during the postpartum period.

Methods: Pregnant women (N=179) meeting DSM-5 criteria for Insomnia Disorder, with duration criterion relaxed to one month, were randomized to five weekly sessions of CBTI or an active control (CTRL) therapy during pregnancy plus session at 6 weeks postpartum. Participants were excluded if they used prescription medications that could impact sleep or mood. The Insomnia Severity Index (ISI) was administered at 8, 18, and 30 weeks postpartum. Included in the analyses were 117 women (62 in CBTI; 55 in CTRL) who provided data for at least one of three postpartum assessments. At study entry, the mean maternal and gestational ages were 33.5 (SD 5.1) years and 24.7 (SD 5.1) weeks respectively. Thirty percent of the participants indicated Hispanic ethnicity.

Results: Piecewise mixed effects models revealed that higher ISI at the end of pregnancy predicted higher overall ISI during the postpartum (p=.0001). Two distinct trajectories of postpartum ISI scores were observed (a) among CBTI participants who had at least 50% reduction in ISI during pregnancy (CBTI responders), mean ISI scores at the three postpartum time-points were below 6; (b) among CBTI participants with lower reduction in ISI during pregnancy (non-responders) and those assigned to the CTRL group, ISI scores during the postpartum were either variable (unstable) or elevated. The percentages of responders during pregnancy were 58.1% in CBTI and 17.0% in CTRL.

Conclusion: We have previously reported that CBTI is effective in treating insomnia during pregnancy in the same study. Our current findings extend the benefits of CBTI for perinatal insomnia into at least 4.5 months postpartum. Importantly, good response to CBTI during pregnancy resulted in consistently low insomnia symptom severity during the postpartum period.

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0383

A NON-INFERIORITY TRIAL OF BBTI VS. CBTI: PRELIMINARY RESULTS

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Introduction: Insomnia is a prevalent and impactful disorder among Veterans. An evidence-based behavioral intervention, cognitive behavioral therapy for insomnia (CBTI), has strong evidence but its use in the VA is still limited by numerous barriers. An alternative behavioral treatment with comparable evidence and that addresses barriers of CBTI delivery could improve access to care.

Methods: This randomized trial compares CBTI (5 in-person sessions within 8 weeks) to a newer, brief behavioral treatment for insomnia (BBTI; 2 in-person/2 phone sessions within 5 weeks) to assess non-inferiority. The primary outcome is the Insomnia Severity Index (ISI). To confirm non-inferiority, the 95% confidence interval for the mean ΔISI (pre- to post-treatment) between groups is <5.2, the non-inferiority margin (NIM) determined by the Reliable Change Index. Preliminary analyses, using linear mixed models, were completed on the first 10 participants with baseline and post-treatment assessments in each group.
Results: The 20 participants were older (61±13), white (90%), and male (90%). At post-treatment, participants in both groups significantly improved (p < 0.001; Glass’ Δg > 2.5) and there were no between-group ISI differences. The groups had similar treatment response (ASI ≥ 8: 70%, BBTi; 80% CBTi) and treatment remission (ASI ≥ 8 + ISI post-treatment ≤ 40%, BBTi; 20% CBTi). The mean ΔASI post-treatment between groups was 1.9 (95% CI -2.92, 6.72).

Conclusion: While ISI between BBTi and CBTi was less than the NIM, the confidence interval was too wide to confirm non-inferiority. However, BBTi was effective and can be offered alongside CBTi as a comparable treatment, especially for Veterans who prefer a brief intervention and varied delivery (in-person + phone). Key limitations of this study include small sample size, single study site, and a large NIM. BBTi shows promise in increasing access to care because it is easier to deliver and attend than CBTi in non-speciality mental health care settings (e.g., primary care).

Support (If Any): US Department of Veterans Affairs, HSRD CDA 13-260. The views expressed are the authors and do not necessarily represent those of the US Department of Veterans Affairs or the US Government.

0384 IMPACT OF BRIEF BEHAVIORAL TREATMENT FOR INSOMNIA (BBTI) ON META-COGNITION IN OLDER ADULTS
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Introduction: Evidence links insomnia to both objective and subjective cognitive disruption in older adults. Brief (<5 sessions) behavioral treatment for insomnia (BBTi) improves insomnia in older adults with insomnia (OAWI). Whether BBTi improves cognition is unclear, with our prior trial reporting no effects on objective cognition. Meta-cognition (subjective appraisal of one’s own performance) has not been examined. This study examines the effects of BBTi on meta-cognition in OAWI.

Methods: Older adults with chronic insomnia [N=62, Mage=69.45(SD=7.71)] were randomized to 4-weeks of BBTi (n=32; education, sleep hygiene, stimulus control, sleep restriction, relaxation) or self-monitoring control (SMC; n=30). Meta-cognition was assessed daily and two-week averages were calculated for baseline, treatment-first half, treatment-second half, post-treatment, and 3-month follow-up. Participants completed daily cognitive tasks and then rated meta-cognition (0-worst, 100-best) in four areas: quality, satisfaction, compared to same age peers, compared to their own ability. Multilevel Modeling examined treatment effects (BBTi, SMC) over time on meta-cognition, controlling for age and gender.

Results: A significant group by time interaction (F=2.41, p=0.05) revealed consistent improvements in ratings of better cognitive performance relative to same age peers for BBTi over time, relative to baseline; SMC prompted inconsistent improvements that were not maintained at follow-up. Significant main effects of time for the other meta-cognition variables (all ps < .05) indicated improvements in subjective cognitive performance over time for both groups.

Conclusion: Meta-cognition generally improved over time regardless of treatment or improvements in objective cognition (there were none). Repeated objective testing alone may improve meta-cognition in OAWI. Other potential explanations and/or confounds include treatment expectations/anticipated sleep improvements and proprietary/non-standardized meta-cognition assessment. Better understanding of meta-cognition and how to improve it has important implications for older adults as subjective cognitive impairment has been associated with the prodromal phase of Alzheimer’s disease. Research on the impact of BBTi on subjective/objective cognition that controls for expectancies and uses a standardized meta-cognitive measure is needed.

Support (If Any): This work was supported by the National Institute on Aging (R21AG024459, PI: McCrae; T32AG020499, PI: Marsiske).

0385 DAYTIME IMPAIRMENT DURING SLEEP RESTRICTION THERAPY FOR INSOMNIA: RESULTS FROM A RANDOMISED-CONTROLLED TRIAL
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Introduction: Preliminary work suggests that Sleep Restriction Therapy (SRT) for insomnia may be associated with daytime symptom exacerbation (Kyle, 2011; Miller, 2013), however no study has assessed this possibility within the context of a rigorously-controlled trial. Here we profiled sleepiness and affect on a daily basis pre and post randomisation to either SRT or a specific factors component control arm called Bedtime Consistency Therapy (BCT).

Methods: Fifty-three participants (16 male, mean age = 41.13 ± 8.95) with insomnia disorder were randomised to SRT (n = 25) or BCT (n = 28). Treatment arms were matched for therapist time and number of sessions. During baseline (2 weeks) and treatment (4 weeks), participants completed daily assessments of sleepiness and positive and negative affect. Linear mixed-model analyses were conducted with fixed effects of time (baseline = week 1-2; early treatment = week 3-4; late treatment = week 5-6) and group (SRT vs. BCT). Random effects were run to account for between-subject variation.

Results: Significant time x group interaction effects were observed for all measurements (p < .005). In the SRT group, pairwise comparison between time points revealed a significant increase in both evening and morning sleepiness (from baseline to early and late treatment, p < .0001). Moreover, negative affect increased significantly from baseline to late treatment (p < .01), while positive affect decreased from baseline to early and late treatment (p < .0001). In contrast, the BCT group showed no change in evening sleepiness or positive affect, an increase in morning sleepiness (baseline vs early treatment, p < .05) and a decrease in negative affect (baseline vs early treatment, p < .05).

Conclusion: Our results show that the introduction of SRT is associated with increased sleepiness and negative affect, and reduced positive affect relative to a robust control arm. This work may have important implications for the clinical implementation of SRT.

Support (If Any): N/A

0386 STIMULUS CONTROL THERAPY VERSUS SLEEP HYGIENE EDUCATION IN OLDER ADULTS WITH INSOMNIA
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Introduction: Sleep problems are pervasive among the United States population with insomnia being the most common sleep complaint among adults and older adults. Between 20 and 40 percent of older adults have symptoms of insomnia, which impacts quality of life, inflates healthcare costs, and is associated with a greater risk of chronic disease, comorbid mood disorders, and premature mortality. While pharmacotherapy offers immediate relief from insomnia, it is associated with adverse side effects and risks. Behavioral interventions, such as cognitive-behavioral therapy for insomnia (CBT-I), have longer-term benefits and fewer side effects. However, the full CBT-I protocol is resource intensive and can be difficult to access.

Methods: The present study examined the ability of a brief Internet-based sleep intervention, stimulus control therapy (SCT; N = 26), to effectively reduce symptoms of insomnia and improve mood in a sample of 46 adults aged 60 years and older compared to a sleep hygiene psychoeducation-only group (N = 20). Participants were recruited from community sources and completed telephone screens. Eligible participants watched a 20-minute video (SCT or sleep hygiene) online and completed three surveys across a one-month period (baseline, 1-week, and 1-month) about mood and sleep.

Results: No significant group differences (p’s > .05) were observed. Interestingly, we observed decreases in both groups on sleepiness, fatigue, anxiety, depression, and sleep locus of control over time, as well as a group-time interaction for anxiety and stress. Among the SCT group, over 50% indicated adopting at least one of the recommended strategies. Among the control group, the most commonly reported strategy was limiting caffeine intake (60%) followed by 35% limiting alcohol.

Conclusion: Both sleep hygiene and SCT have equivalent efficacy and that minimal insomnia treatments may effectively treat comorbid insomnia and anxiety and depression in older adults. These data suggest that an online SCT intervention may be a sufficient first-line treatment option within the stepped care approach.

Support (If Any): NA

**0388**

WHY DO PATIENTS DROP-OUT FROM COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (CBT-I)? A QUALITATIVE INTERVIEW STUDY

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Introduction: Although CBT-I is the recommended treatment for insomnia, it can be challenging for patients. Poor adherence often limits treatment gains. Only half of patients consistently adhere to CBT-I treatment recommendations, and up to 40% prematurely drop out of treatment. Research has identified several factors related to adherence in patients with insomnia, including beliefs about the value of sleep treatment, medical and mental health comorbidities, and baseline symptom severity. Qualitative research is needed to provide CBT-I patient and provider perspectives to substantiate theories for treatment drop-out and to develop adherence promoting strategies. The current qualitative study sought to explore perspectives on adherence barriers (i.e., practical barriers, self-efficacy, maladaptive beliefs/cognitions, comorbidities and medication treatment side-effects like sleepiness,) and suggestions for facilitating treatment completion.

Methods: We conducted individual semi-structured interviews with 17 Veterans with chronic pain and insomnia who had recently participated in CBT-I, with 10 identified as completers in the medical record and 7 identified as prematurely discontinuing therapy. Thematic analysis was used to identify conceptual themes. After all coding was complete, the analysis team met to organize coded data into categories and to identify higher order themes.

Results: Of the 7 patients identified in the medical record as prematurely discontinuing CBT-I, all reported some degree of improvement in sleep and expressed appreciation of CBT-I. Reasons for discontinuing CBT-I varied: satisfaction with current sleep (n=3); assumed that they had successfully completed CBT-I (n=2), too busy to attend medical appointments (n=1); and surgery that interfered with treatment (n=1). Compared to patients who successfully
completed treatment, those who discontinued reported more barriers related to scheduling and transportation. Patients and providers differed in their perceptions of how treatment ended; due to lack of communication, providers may not realize that patients discontinue treatment due to satisfaction with sleep.

**Conclusion:** Efforts to increase CBT-I uptake and adherence should focus on increasing accessibility and feasibility. There may also be a need for improved communication between patients and providers regarding reasons for therapy termination.

**Support (If Any):** VA HSRD CDA 15-063

### 0389 WHEN SLEEP QUALITY IMPROVES, DO PERFORMANCE AND SATISFACTION IN OTHER LIFE ROLES CHANGE

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**Introduction:** Chronic insomnia is a prevalent condition negatively impacting the health and daily functioning of many Veterans. Occupational therapy is focused on helping individuals maximize performance and participation in their daily activities. Sleep is our largest occupation consuming around 1/3rd of our lives and sleep challenges create barriers to daily goals. Therefore, sleep is something occupational therapy should be concerned with and address to improve sleep itself and possibly other functional outcomes as well.

**Methods:** We recruited a convenience sample of 45 student Veterans to participate in occupational therapist-led Cognitive Behavioral Therapy for Insomnia (CBTI). We collected pre- and post-intervention data on sleep quality and daily functioning using the PROMIS Sleep scales and the Canadian Occupational Performance Measure (COPM), respectively. The COPM assesses one’s perceived performance and satisfaction across five pre-selected domains of daily functioning. We examined un-adjusted pre-post changes for both constructs using paired t-tests and we examined the association between sleep quality and daily functioning over time using multivariable linear mixed models to account for the correlation of repeated measures within participants. The results represent a preliminary analysis of the first 16 participants.

**Results:** The preliminary sample included 14 males and 2 females who were fully matriculated students at Colorado State University. Mean (standard deviation) age was 32.1 (6.6) years. Un-adjusted analyses demonstrated significant (p < .05) improvements in sleep quality, perceived performance in daily functioning, and satisfaction with daily functioning. Similarly, the multivariable regression analyses yielded significant associations between changes in sleep quality and both performance and satisfaction with daily functioning over time.

**Conclusion:** Perceived performance and satisfaction with daily functioning can be enhanced through effective interventions targeting improvements in sleep quality in student Veterans. Additional research is needed to evaluate the variability in the improvements in daily functioning and to determine whether these effects are maintained longer-term.

**Support (If Any):** The Restoring Effective Sleep Tranquility “REST” project is supported by the New Start for Student Veterans Program at Colorado State University.

### 0390 ADAPTED BEHAVIORAL SLEEP AND YOGA INTERVENTIONS FOR ADULTS IN LOW-INCOME AND RACIAL/ETHNIC MINORITY COMMUNITIES

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**Introduction:** Inadequate sleep is common among low-income and racial/ethnic minority communities. This may be related to health behaviors as well as psychological, social, and environmental demands. While sleep education and yoga interventions may be adapted to optimize sleep-related behaviors and reduce reactivity to contextual stressors, there is sparse research evaluating sleep interventions adapted for populations with higher risk of poor sleep and associated comorbidities.

**Methods:** We conducted a 10-week randomized controlled pilot study of behavioral interventions with content and delivery adapted for adults residing in low-income housing. Adults with reported sleep duration ≤6 hours/night (n=33) were randomized to group sleep education (SE) or SE plus yoga (SE+yoga). SE comprised of two, one-hour group educational sessions. Those randomized to SE+yoga then participated in weekly one-hour yoga classes for eight weeks. We assessed self-reported sleep duration, sleep-related impairment, sleep disturbance, sleep hygiene behaviors, and intervention acceptability.

**Results:** Participants were 45.9 years ±13.1; 90.9% were female; 42.4% identified as non-Hispanic Black and 39.4% as Hispanic, and 33.3% graduated college. Pre/post intervention improvements were observed in self-reported sleep duration (SE: 1.3±1.4 hours/night; SE+yoga: 0.8±0.9 hours/night; overall test-of-change p<0.001), PROMIS sleep-related impairment T-score (SE: -3.1±10.5; SE+yoga: -7.8±7.0; overall test-of-change p<0.001), PROMIS sleep disturbance T-score (SE: -8.6±16.4; SE+yoga: -8.9±9.8; p<0.01), and sleep hygiene index scores (SE: -2.5±5.5; SE+yoga: -2.9±5.5; p=0.01). No significant between-group differences were observed. Attendance was satisfactory (86.7% attended both SE groups; 66.7% attended at least 4 of 8 yoga classes). Quantitative data and post-intervention focus groups indicated high intervention acceptability: about 90% of participants rated SE sessions as helpful/very helpful; 92.3% agreed/strongly agreed that yoga class left them feeling relaxed/less stressed; and 70% reported yoga helped their sleep.

**Conclusion:** Our preliminary work suggest that adapted SE and yoga interventions are acceptable and may improve sleep behaviors, as well as sleep duration, sleep disturbance, and sleep-related impairment. Future work is needed to identify the potential additive effects of SH and yoga, and whether participant characteristics may enhance the efficacy of one or both interventions.

**Support (If Any):** NIH/NCI R34AT008923

### 0391 MINDFULNESS BASED STRESS REDUCTION AS A TREATMENT FOR CHRONIC INSOMNIA IN TRAUMATIC BRAIN INJURY PATIENTS

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**Introduction:** The Restoring Effective Sleep Tranquility (REST) project is supported by the New Start for Student Veterans Program at Colorado State University.
**Introduction:** The purpose of this trial is to evaluate the efficacy of MBSR as a nonpharmacological treatment in patients with mild TBI who are experiencing chronic insomnia. Chronic insomnia is experienced by over 70% of patients with traumatic brain injury (TBI), and limited evidence guides the therapy decisions of current usual care. Ineffective medications are often prescribed, yielding only dangerous side effects. Cognitive behavioral therapy for insomnia has been tested in small studies in TBI veterans, but often fails to address typical comorbidities such as PTSD and chronic pain. Mindfulness Based Stress Reduction (MBSR) -an internationally standardized protocol, has been shown to reduce insomnia and chronic pain in recent studies in civilians, and reduce PTSD symptoms in veterans with TBI. However, its effectiveness on treating chronic insomnia in TBI patients has not yet been evaluated.

**Methods:** A prospective, randomized trial with 1:1 randomization to usual care versus MBSR. The primary endpoint is a reduction of the Insomnia Severity Index (ISI) after weeks of MBSR group therapy. Several secondary endpoints have been identified, including ISI scores at six months (results pending), fatigue severity scale (FSS), perceived stress scale (PSS), and PHQ-9 scales, total sleep time and sleep efficiency as measured by actigraphy watch. Outcomes scores were compared with the Student’s T test.

**Results:** Subjects receiving MBSR (N=10, enrollment ongoing) had an average improved ISI by -5.1 (CI -1.4 to -7.3, p=0.047). In other outcomes, no statistically significant change in FSS, PSS, or PHQ-9 was noted. Objective measures show no statistical difference (sleep efficiency, total sleep time).

**Conclusion:** MBSR is an effective non-pharmacologic therapy that has the potential to become a preferred treatment for patients with mild to moderate TBI and symptoms of chronic insomnia. Strengths include the nonpharmacologic nature of the intervention. Limitations may include the resource intensive nature of the intervention.

**Support (If Any):** Uniformed Services University Award 60855 - 307513 - 11.01

**0392**

**“I’M ADVENTURING MORE”: EXPLORING THE MEANING OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (CBT-I) FOR PATIENTS WITH PAIN**

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**Introduction:** Insomnia is one of the most common, persistent, and distressing symptoms associated with chronic pain. Cognitive behavioral therapy for insomnia (CBT-I) is the first-line treatment for insomnia, but patient preferences and perspectives about CBT-I within the context of chronic pain are unknown. The current qualitative study sought to understand the experience of CBT-I among patients with chronic pain, including the connection of pain and insomnia, aspects of CBT-I that were appreciated or found to be difficult, and changes in sleep and pain functioning.

**Methods:** We conducted individual semi-structured interviews with 17 Veterans with chronic pain and insomnia who had recently participated in CBT-I and used thematic analysis to identify conceptual themes. After all coding was complete, the analysis team met to organize coded data into categories and to identify higher order themes.

**Results:** We identified several core themes regarding patients’ perceptions of CBT-I, including a perceived strong interrelationship of sleep and pain, that patients reported an ability to improve sleep in the face of pain, and improved sleep, activities, and socialization. Patients reported that prior to CBT-I, pain intensity precluded sleep and poor sleep resulted in higher pain levels. Despite this interrelationship, patients stated they could follow essential CBT-I components and rarely identified pain as a barrier to treatment adherence. Patients reported improved sleep when following CBT-I recommendations. Although most patients did not perceive less pain intensity, they reported a substantial improvement in functioning, including increased activity (“It helped me work through the pain and do the activities I want to do”) and improved socialization (“Before I was a recluse. Now I’m actually getting out and doing stuff”).

**Conclusion:** Patients valued CBT-I for improvements in sleep, quality of life and functioning. Findings support efforts to incorporate CBT-I into chronic pain treatment, including educating patients and providers about the ability to improve sleep in the face of ongoing pain.

**Support (If Any):** VA HSRD CDA 15-063

**0393**

**BASELINE PAIN SEVERITY AS A MODERATOR OF THE EFFECT OF CBTI ON SLEEP AND PAIN OUTCOMES IN PATIENTS WITH FIBROMYALGIA**

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**Introduction:** CBT is improves sleep and pain in patients with chronic pain, but significant pain effects are rarely found in individual trials - possibly due to floor effects as trials rarely screen for baseline pain intensity (bPI). The present study examines whether bPI moderates the effect of CBT-I on sleep and pain in adults with FM.

**Methods:** Adults (N=64, M =53.2, SD=13.7) with FM and chronic insomnia were randomized to 8-week CBT-I or waitlist control. Participants completed the McGill Pain Questionnaire (MPQ) and 14 daily diaries recording PI (0-none, 100-worst), SOL, WASO, TWT, and sleep quality (1-very good, 5-very poor) at baseline, post-treatment, and 6-month follow-up. Multiple regressions determined whether average bPI predicted changes in sleep (SOL, WASO, TWT, sleep quality) and pain (MPQ total score), controlling for age, sleep/pain medication, TST, and depression.

**Results:** bPI moderated the impact of CBT-I on SOL (t=2.42, p=.02) and TWT (t=2.02, p=.05). Specifically, moderate (53.32, SOL t=2.43, p=.02; TWT t=3.18, p<.001) and high (71.18, SOL t=3.68, p=.02) and TWT (t=2.02, p=.05). Specifically, moderate (53.32, SOL t=2.43, p=.02; TWT t=3.18, p<.001) and high (71.18, SOL t=3.68, p=.02) bPI were associated with improved SOL and TWT at post-treatment relative to baseline, whereas these associations were not observed for low bPI (35.80, SOL t=3.68, p=.001; TWT t=3.96, p=.001). bPI were associated with improved SOL and TWT at post-treatment relative to baseline, whereas these associations were not observed for low bPI (35.80, SOL t=3.68, p=.001; TWT t=3.96, p=.001). bPI trended toward significance for the MPQ (p=.07) and WASO (p=.11), but did not moderate changes in sleep quality. Baseline to follow-up results were similar.

**Conclusion:** FM patients with moderate to severe pain may be better candidates for CBT-I than those with less severe pain. Clinical trial researchers may wish to consider adopting pain severity criteria for determining eligibility for CBT trials. While our findings suggest a score of ~50/100 may identify patients likely to benefit from CBT-I, research is needed to determine the best screening
cutoff score and to identify better treatment options for chronic pain patients with less severe pain.

**Support (If Any):** NIAMS (R01AR055160 and R01AR005160-S1; McCrae, PJ). Data collected as part of clinical trial NCT02001077 Sleep and Pain Interventions (SPIN) at the University of Florida (McCrae, PJ).

### DO PATIENTS CHANGE TIB WHEN STARTING HYPNOTICS AND DOES THIS AFFECT OUTCOMES?

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**Introduction:** Given that the regulation of time in bed (TIB) is a key component of CBT-I, this naturally leads to the question, “do patients change TIB when starting hypnotics and does this affect outcomes?”

**Methods:** As part of a study on partial reinforcement, 108 subjects with Chronic Insomnia were monitored for two weeks prior to medication use and then for one month when prescribed 10mg/qs of zolpidem. Monitoring was accomplished with online daily sleep diaries. Subjects were typed based on whether they restricted (R-TIB > 30 min), maintained (M-TIB +/−30), or increased (I-TIB > 30 min) their TIB. These groups were then compared for differences in treatment response (% treatment responders).

**Results:** 14% restricted (R-TIB), 48% maintained (M-TIB), and 38% increased (I-TIB) TIB. Preliminary analyses suggest that treatment response did not vary by category (R-TIB [86%], M-TIB [67%], and I-TIB [78%]). As would be expected, the groups significantly differed with respect to TIB (-43 min, -1 min, +60 min for R-TIB, M-TIB, I-TIB respectively).

**Conclusion:** Subjects clearly vary TIB in response medication use. While such behavior does not appear to affect treatment outcome, it may affect the speed with which clinical responses occur. Additional efficacy outcome analyses and treatment response latencies analyses are on-going.

**Support (If Any):** R01AG041783; K24AG055602; R01AT003332

### DO CHRONIC INSOMIA PATIENT DEVELOP TOLERANCE TO SLEEPING PILLS?

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**Introduction:** Insomnia is a common sleep disorder with a prevalence of 10-30% in the population. Insomnia symptoms can have adverse consequences on emotional, mental and general health of patients. Although insomnia is a common disorder, only 1% of the adult population in Israel is treated with sleeping pills regularly. One of the reasons for this under-treatment is the concern of patients and clinicians of the development of tolerance to these medications. However, there is inconsistency in the literature regarding the development of tolerance to the sedative effect of sleeping pills in chronic insomnia patients. The primary aim of our study was to identify and characterize trends in the usage of chronic sleeping pills. The secondary aim was to assess tolerance, expressed as increase in hypnotic “treatment days per year” in chronic users.

**Methods:** A retrospective data study including all members of “Maccabi-Health-Services” above the age of 18 years (N=1.2million), collected between the years 2011-2014. An occasional user was defined as a person who purchased less than 180 sleeping pills per year, while a chronic user was defined as a person who purchased 180 and more sleeping pills per year.

**Results:** Only 20% of the Insomnia patients treated with sleeping pills (n=122500) were chronic users. Between the years 2011-2014, we observed a constant increase of 2.5% (n=3000) per year in the number of chronic users. Moreover, 11% of occasional users become chronic users, while 4% of the chronic users become occasional. The number of sleeping pills taken by chronic users was not different between the genders or between types of hypnotics (Benzodiazepines vs. Z-drugs). A positive correlation was found between age and number of sleeping pills among chronic users. We found non-significant increase in the average “therapy days per year” among chronic users. Between the years 2011-2014, among chronic users, only 44% increased “treatment days per year”, while 56% decreased or had no-change in the number of “treatment days per year”.

**Conclusion:** Our results suggest that chronic Insomnia patients do not develop tolerance to sleeping pills.

**Support (If Any):** No support

### A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIAL OF A NATURAL POLYPHENOL BLEND ON SLEEP AND DAYTIME FUNCTIONING IN ADULTS WITH SLEEP COMPLAINTS BUT NOT SLEEP DISORDERS

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**Introduction:** Sleep complaints, such as occasional sleeplessness and feeling unrefreshed, are common. Few safe, empirically-supported interventions for these complaints exist because most studies focus on disorders. This study examined effects of a natural ingredient on sleep-related outcomes in non-sleep-disordered adults.

**Methods:** N=100 adults with sleep complaints but not sleep disorders were randomized to receive either a proprietary polyphenol blend of a spearmint/green-tea extract, or placebo for 30 days, 30 minutes before bed. Participants completed sleep diaries (including morning ratings of “refreshed” [1-10 scale] and Karolinska Sleepiness Scale), wore a Fitbit sleep/activity monitor, completed Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI), and completed a JoggleResearch cognitive battery before and after the 30-day intervention. Preliminary analyses examined within-group change in sleep duration and morning refreshed/sleepiness, and between-group analyses examined change in ISI score and whether PSQI category (cutoff=5pts) changed during the study, adjusted for age, sex, and mood change.

**Results:** Preliminary per-protocol analysis (N=93, mean age=31, range=22-50y, 62% female) of within-group changes from baseline showed that objective sleep duration increased in the treatment (Δ=27.8min, 95%CI[9.5,46.0],p=0.0038) but not the control group (Δ=9.0min, 95%CI[-15.9,33.9],p=0.47), and subjective sleep duration increased in both the treatment (Δ=39.6min, 95%CI[9.7,69.6],p=0.01) and control (Δ=34.3min, 95%CI[8.4,60.2],p=0.01) groups. Daytime “refreshed” ratings were...
improved in both the treatment ($\Delta=1.4, 95\% CI[0.7,2.1], p=0.0003$) and control ($\Delta=1.0, 95\% CI[0.4,1.6], p=0.002$) groups, but reduction in sleepiness were seen only in the treatment group ($\Delta=0.8, 95\% CI[0.3,1.4], p=0.005$) and not the control group ($\Delta=0.4, 95\% CI[-0.1,1.1], p=0.13$). In between-group comparisons, the treatment group had greater improvements in ISI score ($\Delta diff=2.15$, $95\% CI[0.4,3.87], p=0.01$). Also, in examining PSQI category change, the treatment group was less likely than the control group to transition to poor sleep ($RRR=0.16, 95\% CI[0.04,0.63], p=0.009$). In cognitive measures, within-group improvements were seen in tests of processing speed, working memory, and executive function. Additional analyses (including cognitive details) are forthcoming.

**Conclusion:** Despite evident placebo effects, the treatment group overall demonstrated improvements in nighttime and daytime sleep-related variables, as well as cognitive function.

**Support (If Any):** Supported by Kemin Foods, LC

### 0397
**THE EXPERIENCES OF AUSTRALIAN NATUROPATHS IN THE CLINICAL MANAGEMENT OF PEOPLE LIVING WITH SLEEP DISORDERS**

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**Introduction:** Sleep disorders are quite common in Australian Society. It is well known that people with sleep disorders often self-treat with complementary medicines/dietary supplements, sourcing them through a range of outlets, i.e. health-food stores, Internet and from naturopaths/herbalists etc. Naturopaths are amongst the most commonly consulted complementary medicines practitioners in Australia, however there is no documented evidence on how they manage patients with sleep disorders. This study explores the perspectives of Australian naturopaths about their assessment, management and monitoring approaches for people with sleep disorders.

**Methods:** A purposive convenience sample of registered Australian naturopaths recruited through professional networks were invited to participate in semi-structured exploratory interviews. The interview guide was developed in consultation with relevant experts and a thorough review of current literature. Prior consent was taken to record the interviews that were later transcribed verbatim and thematically analysed.

**Results:** A total of 20 naturopathic practitioners representing different states of Australia were interviewed. A majority of participants were females in the age group between 30-50 years. Sleep health consults were common, but more often came about through the naturopaths’ history taking, rather than the patient themselves. Herbal remedies supported by sleep hygiene behaviours were the main mode of treatment and patients. Participants reported considering drug-herb interactions when prescribing herbal medicines. Inter-professional communication was seldom reciprocated and recognition of profession of naturopaths was poorly understood. Statutory regulation of naturopaths, allocation of more funds for research and focus on registration of naturopaths were identified as key steps in the direction of highlighting to the conventional practitioners their contribution to management of sleep patients which can in turn increase possibilities of integrated models of patient care.

**Conclusion:** Naturopaths engage in the treatment of sleep disorders yet face barriers in executing an integration of such approaches within the current health care system. Research is required to explore how to overcome these barriers with a view to developing integrated models in tertiary sleep clinics or primary care settings.

**Support (If Any):** NA

### 0398
**IMPROVEMENT IN SLEEP DURATION AND MAINTENANCE WITH ION POWERED CONTINUOUS RELEASE AND ABSORPTION MELATONIN IN A COHORT OF PATIENTS WITH CHRONIC SHORT SLEEP DURATION: RESULTS FROM A PATIENT-REPORTED OUTCOMES STUDY**

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**Introduction:** Numerous epidemiologic studies have demonstrated that short sleep duration has negative health consequences. Chronic sleep loss places a direct and indirect societal cost burden of more than $90 billion annually. Patients sleeping ≤ 4-5 hours should be regarded as high risk for all-cause mortality. Continuous Release and Absorption Melatonin (CRA-melatonin) with its Ion Powered Pump (IPP) delivery technology was hypothesized to provide the desired 7-hour pharmacokinetic (PK) profile for this population.

**Methods:** Patients who received a sample of CRA-melatonin (Remfresh) from their physicians were invited to complete a 13-question online survey. Questions included average hours of sleep before and after taking CRA-melatonin and number of middle of the night awakenings, as well as improvement in sleep onset, maintenance, and quality.

**Results:** 175 patients who self reported sleeping ≤ 4 h per night were analyzed. Prior to taking CRA-melatonin, over 90% of these patients indicated they suffered sleep disturbances nightly. After taking CRA-melatonin, the percentage of patients achieving an improvement in sleep duration was 96.6%, including more than half (52.0%) achieving a sleep duration of ≥ 6 h. 95.7% reported a major/moderate improvement in sleep maintenance. 99% reported a major/moderate improvement in sleep quality. This study is ongoing.

**Conclusion:** With CRA-melatonin and its 7-hour PK profile, the majority of patients (96.6%) previously experiencing chronic, short sleep duration of ≤ 4 h achieved an improvement in sleep duration, including (52.0%) who achieved a sleep duration of ≥ 6 h. The results provide real-world evidence that CRA-melatonin with its extended 7-hour PK plateau time may be a practical baseline therapy to improve sleep duration and other key sleep parameters in these high-risk patients for all-cause mortality.

**Support (If Any):** This study was supported by Physician’s Seal LLC.

### 0399
**OBSERVED HYPNOTIC EFFECTS WITH A CONTINUOUS-RELEASE ION POWERED PUMP MELATONIN DELIVERY SYSTEM: SELF-REPORTED PATIENT OUTCOMES STUDY RESULTS DEMONSTRATING IMPROVEMENT IN SLEEP DURATION AND QUALITY**

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Introduction: The rise and fall of endogenous plasma melatonin levels in humans is closely correlated with sleep propensity. Melatonin, with its hypnotic properties and benign safety profile, could be an effective sleep agent; however, clinical use of melatonin as a hypnotic is limited since no formulation has been shown to maintain critical blood levels for more than a few hours. A prolonged-release melatonin, marketed internationally for primary insomnia, demonstrated clinically meaningful improvements in sleep quality, morning alertness, and wake time after sleep onset, despite limited absorption 4 hours post dosing. Continuous Release and Absorption Melatonin (CRA-melatonin), with its Ion-Powered Pump delivery system, has shown an extended 7-hour pharmacokinetic (PK) plateau time, which may offer an alternative to prescription hypnotics to treat chronic sleep disturbances.

Methods: Patients receiving a sample of CRA-melatonin (Remfresh) from their physicians were invited to complete a 13-question online survey. Questions included hours of sleep before and after taking CRA-melatonin and number of middle of the night awakenings, as well as improvement in sleep maintenance and quality.

Results: 597 patient responses have been collected. 74.7% of patients suffered sleep disturbances nightly prior to taking CRA-melatonin. After taking CRA-melatonin, 79.7% of patients reported sleeping ≥ 6 h compared with 22.1% before taking CRA-melatonin. 95.1% of patients reported a major/moderate improvement in sleep maintenance. 98.3% of patients reported a major/moderate improvement in sleep quality. This study is ongoing.

Conclusion: The results of this second patient-reported outcomes (PRO) study have yielded data that closely replicate the findings of the first PRO study (REMDUR). This provides further real-world evidence of the correlative relationship between the 7-hour PK profile and clinically relevant hypnotic effects of CRA-melatonin, as demonstrated by improvements in sleep duration, maintenance, and quality.

Support (If Any): This study was supported by Physician’s Seal LLC.

0400 CANNABIS AND NATIONAL TRENDS OF SEDATIVE-HYPNOTIC MEDICATION USE IN THE UNITED STATES Christopher N. Kaufmann, PhD, MHS1, Benjamin Han, MD, MPH2, Atul Malhotra, MD1, Ramin Mojtabai, MD, PhD, MPH3, Adam P. Spira, PhD4, Lindsey Yourman, MD1, Alison A. Moore, MD, MPH5

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Introduction: Sedative-hypnotic (SDH) medications are often prescribed for treatment of insomnia despite concerns about their safety. There is anecdotal evidence to suggest cannabis, when medically used, may be efficacious for insomnia, although it’s unclear whether SDH users are now turning to cannabis for sleep, and if so, whether it is used as a substitute. We examine trends in SDH use from 2005-2014 stratified by cannabis user groups.

Methods: Data came from 2005-2014 waves of National Health and Nutrition Examination Survey. Participants self-reported cannabis use (never users, past users, and current users [within past year]) and medications currently using prescribed by a doctor. SDHs included benzodiazepines and other non-benzodiazepine hypnotics. We examined trends using logistic regression in order to model changes in the odds of prescribed SDH use over the entire study period (e.g., 2005-2014), and explored differences across cannabis user groups. Our sample was limited to those age 18 to 59 years as only these ages were queried about cannabis use.

Results: Overall, 6.0% of current, 5.8% of past, and 3.1% of never cannabis users reported SDH use (p<0.001). From 2005-2014 the odds of SDH use increased 84% (95% CI=1.05-3.20), with significant increases for current cannabis users (OR=4.49, 95% CI=1.59-12.71), a modest (albeit nonsignificant) increase for past users (OR=1.75, 95% CI=0.84-3.62), and no changes in never users.

Conclusion: Sedative-hypnotic use was high in current and past cannabis users and even increased across these groups in the study period. Results suggest cannabis may not be substituting for use of these medications. More research is needed to identify trends in SDH use after 2014 and in older age cohorts, examine trends based on indication for cannabis use (e.g., medicinally and/or recreationally) and determine the ways in which cannabis use may help or worsen insomnia symptoms.

Support (If Any): Dr. Han received support from NIDA (K23DA043651). Dr. Spira received grant support from NIA, and honorarium from Springer Nature Switzerland AG for Guest Editing a Special Issue of Current Sleep Medicine Reports. Dr. Moore received support from NIA (P30AG059299).

I. Insomnia

0401 INSOMNIA, DEPRESSION AND TRANSCRANIAL MAGNETIC STIMULATION - A 6 MONTH STUDY Debra J. Stultz, M.D.1, Russ Voltin, M.D.2, Dan Thistleton, M.D.3, Sarvana Osburn, B.S.4, Tyler Burns, MA, LPC, AADC, NCC5, Sylvia Pawlowska, D.O.6, Robin Walton, EdD, MSN, APRN-FNP7

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Introduction: While using Transcranial Magnetic Stimulation (TMS) in treatment-resistant depressed patients, our study evaluated both complaints of insomnia and depression throughout treatment and at 6 months follow-up.

Methods: 15 patients with resistant depression were treated using Brainsway TMS and were evaluated using the Patient Health Questionnaire-9 (PHQ-9), Beck Depression Inventory (BDI), Insomnia Severity Scale (ISI), and Pittsburgh Sleep Quality Index (PSQI) at initiation of treatment; end of treatment; and at 6 Months follow-up. The study consisted of 5 males and 10 females with an average age of 53. The average number of treatments given was 27. At the onset of treatment only 12 of the 15 had abnormal ISI scales and 13 of the 15 had abnormal PSQI scores.

Results: Results revealed that the decrease in the PHQ-9 scores from initial intake to 6 month follow-up were statistically significant using a paired sample t-test (t=4.26, 14 df, p<.001). The decrease in the BDI scores from the initial intake to 6 month follow-up were statistically significant using a paired sample t-test (t=6.55, 14 df, p<.001). If all 15 patients were included in the data, the decrease in the ISI scores from intake to 6 month follow-up were not
statistically significant using a paired sample t-test \( (t=2.19, 14 \text{ df}, p>.05) \). When analyzing only the ISI scores from patients that were initially abnormal, the decrease in the ISI scores were significant using a paired sample t-test \( (t=2.91, 11 \text{ df}, p<.05) \). The decrease in the PSQI scores including all 15 patients from intake to 6 month follow-up were not statistically significant using a paired sample t-test \( (t=1.60, 14 \text{ df}, p>.05) \), but once again when using only those that were initially abnormal the scores were significant using the paired sample t-test \( (t=3.10, 12 \text{ df}, p<.01) \).

**Conclusion:** Our studies demonstrated significant improvement in depression and in those with complaints of insomnia using TMS. As these symptoms are often bidirectional, improvement in both may help to prevent recurrence of depression as not all depression treatments improve insomnia.

**Support (If Any):** None

**0402**

**PRE-SLEEP PSYCHOPHYSIOLOGICAL DOWNREGULATION IN WOMEN WITH INSOMNIA SYMPTOMS**

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**Introduction:** Insomnia is a common complaint, being present in about a third of the adult population, with a greater prevalence in women. Insomnia is characterized by difficulties initiating and maintaining sleep, often attributed to an underlying state of psychological and physiological hyperarousal. Hyperarousal is particularly magnified in insomnia sufferers under specific circumstances, such as when trying to fall asleep. The current study explored the feasibility of lowering the state of hyperarousal before sleep using a novel approach of immersive audio-visual respiratory bio-feedback in women with insomnia symptoms.

**Methods:** Sixteen women (43.4±13.31 years) complaining of sleep difficulties (difficulty falling asleep and/or maintaining sleep) at least 3 times per week, for at least 1 month, with symptoms interfering with daytime functioning, participated in the study. Following an adaptation night, they had two randomized polysomnographic (PSG) nights: pre-sleep downregulation (use of immersive audio-visual respiratory bio-feedback across the falling asleep period) and control night (no pre-sleep manipulation). For the pre-sleep downregulation night, women were instructed to perform slow diaphragmatic breathing; they were wearing a customized sleeping mask which provided audio-visual feedback according to their breathing rate. On the control night, women were only instructed to follow typical bedtime routines.

**Results:** While performing immersive audio-visual respiratory bio-feedback, total heart rate variability (HRV) was increased and heart rate (HR) was reduced by 5bpm \((p<.01)\), compared to the control condition. Furthermore, HR remained lower throughout the night, and women had fewer awakenings \((p=0.010)\) and sleep stage transitions \((p=0.008)\). Women rated their subjective sleep quality and levels of stress upon awakening after each night. Perceived sleep quality did not differ \((\text{all } p's>.05)\) between nights, however women reported feeling significantly less stressed \((p=.028)\) following the pre-sleep downregulation night.

**Conclusion:** Immersive audio-visual respiratory bio-feedback was effective in lowering pre-sleep HR and increasing HRV, reflecting lower autonomic arousal, in women with insomnia symptoms. These preliminary data suggested that pre-sleep hyperarousal may be a potential target for improving sleep and autonomic functioning during sleep in insomnia.

**Support (If Any):** This study was funded by the National Institutes of Health (NIH), Grant HL103688 (FCB).

**0403**

**OLDER ADULTS WITH SLEEP ONSET INSOMNIA ARE MORE RESPONSIVE TO OPEN-LOOP AUDIO-VISUAL STIMULATION BASED DELTA INDUCTION THAN ARE THOSE WITH SLEEP MAINTENANCE INSOMNIA**

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**Introduction:** Previous findings reported from our pilot RCT treating chronic insomnia in older adults with osteoarthritis demonstrated that 30-minute baseline training of open-loop Audio and Visual Stimulation (AVIS) induced significant delta activity relative to an AVS control. Also, active AVS used for two weeks improved sleep in subjects with difficulties with sleep onset (SO) relative to those with sleep maintenance (SM). Here we further explore the hypothesis that subjects with SO difficulties respond differently to active AVS than those with SM difficulties by examining delta induction during baseline active AVS training and changes in the self-reported sleep measures following 2 weeks of AVS.

**Methods:** We studied 16 subjects (active AVS: \(n=9\), mean age 67.2; control AVS: \(n=7\), mean age 69.6) from our RCT for whom baseline QEEG data were available for baseline AVS training. Active AVS provided stimulation declining from 8Hz to 2Hz over 30 minutes, while control AVS idled below 0.5Hz. Subjects received baseline AVS training during which QEEG was recorded and then used AVS at home prior to bedtime nightly for 2 weeks. Self-reported sleep measures (Insomnia Severity Index (ISI), and sleep diary) were collected at baseline and at 2 weeks.

**Results:** Within baseline active AVS subjects, delta induction change in z-score over Cz was greater, albeit non-significantly, for SO \((n=3)\), \(2.7\pm1.04\) than SM \((n=6)\), \(1.62\pm0.86\). Both SO and SM control AVS subjects demonstrated minimal delta induction. In addition, within active AVS, SO subjects reported significant improvement in self-reported sleep measures (ISI \(-9.67\pm4.51, p=.01\); sleep diary latency \(-27\pm22.83, p=.01\)) compared to SM at 2 weeks. No significant sleep changes were reported within control AVS.

**Conclusion:** Sleep onset insomniacs are more responsive to AVS than are sleep maintenance insomniacs and appear to demonstrate differential sensitivity to active AVS even upon first exposure.

**Support (If Any):** Project supported by Research & Intramural Funding Program, School of Nursing, University of Washington

**0404**

**CONTROLLED APPLICATION OF ALTERNATE BILATERAL STIMULATION IMPROVES SLEEP: A PILOT STUDY.**

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**Introduction:** Alternate bilateral stimulation (ABS) has been studied extensively with respect to its use with eye movement...
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0405
RANDOMIZED CONTROLLED CLINICAL POLYSOMNOGRAPHY TRIAL OF SUVOREXANT FOR TREATING INSOMNIA IN PATIENTS WITH ALZHEIMER’S DISEASE

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Introduction: Sleep disturbance and insomnia are common in patients with Alzheimer’s disease (AD) but evidence for the efficacy of sleep medications in this population is limited. Suvorexant, a first-in-class orexin receptor antagonist that enables sleep to occur via competitive antagonism of wake-promoting orexins, is approved for treating insomnia in elderly and non-elderly adults. We conducted a clinical trial to evaluate its efficacy and safety for treating insomnia in patients with AD using sleep laboratory polysomnography (PSG) assessments.

Methods: This randomized, placebo-controlled trial consisted of a 3-week screening period followed by a double-blind 4-week treatment period (ClinicalTrials.gov: NCT02750306). Participants met diagnostic criteria for both AD and insomnia and had a qualified trial partner/caregiver. Participants were randomized to an initial dose of suvorexant 10mg, that could be increased to 20mg based on clinical response, or matching placebo. Assessments included overnight sleep laboratory PSG visits, a sleep diary completed by the trial partner, an activity/sleep watch worn by the patient, and exploratory measures of alternate bilateral stimulation may be effective in improving self-reported sleep metrics in people with insomnia symptoms.

Results: Self-reported sleep onset latency, wake after sleep onset and Insomnia Severity Index scores showed significant improvement. Sleep onset latency was reduced by 20% (3.8 minutes median), wake after sleep onset was reduced by 50% (15 minutes median), and the Insomnia Severity Index total score was reduced by 52% (8.5 points median).

Conclusion: This pilot study suggests that controlled application of alternate bilateral stimulation may be effective in improving self-reported sleep metrics in people with insomnia symptoms.

Support (If Any): This study was partially funded by a grant from the Massachusetts Life Sciences Center.

I. Insomnia

0406
NEURAL CORRELATES OF MOOD IMPROVEMENTS FOLLOWING RECOVERY FROM SLEEP DEPRIVATION IN PATIENTS WITH INSOMNIA AND GOOD SLEEPERS

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Introduction: Sleep deprivation improves mood in depressed individuals. We recently showed that partial or total sleep deprivation altered regional and global cerebral glucose metabolism during NREM sleep and reduced depressed mood in a sample including individuals with primary insomnia (PI; n=17) and good sleep controls (GS; n=19). This follow-up analysis in the same sample investigated associations between pre-post sleep deprivation mood changes and pre-post sleep deprivation changes in cerebral glucose metabolism during NREM sleep.

Methods: Participants had [18F]fluorodeoxyglucose positron emission tomography scans to measure cerebral glucose metabolism during two nights of NREM sleep: baseline, and recovery following one night of partial or total sleep deprivation. Relative regional cerebral metabolic rate for glucose (rCMRglc) values were extracted from regions of interest (ROIs) that showed lower relative rCMRglc during recovery sleep compared to baseline: left middle frontal, left parietal, and posterior cingulate cortices. Within ROIs, we examined average rCMRglc values across pre-post scans, and rCMRglc change values from pre-post sleep deprivation. Pre-post whole-brain glucose metabolism was also assessed. Depressed mood was assessed using a single item on the morning diary following each scan night. Associations between depressed mood and cerebral glucose metabolism (rCMRglc and whole-brain) were investigated within each group separately using structural modeling of dependent correlations.

Results: In GS, improvement in depressed mood following recovery sleep was associated with greater average rCMRglc in the posterior cingulate cortex and greater pre-post change in rCMRglc in the left parietal lobe (p<0.05 for all). In PI, pre-post sleep deprivation improvement in depressed mood was associated with higher average relative rCMRglc in the left middle frontal cortex (p<0.05) and, at a trend level, with greater reduction in whole-brain glucose metabolism pre-post sleep deprivation (p=0.052).

Conclusion: Improved mood may relate to greater reductions in relative glucose metabolism in the left parietal cortex in GS.
and reduced whole-brain glucose metabolism in PI during recovery NREM sleep. These findings may guide future studies on the mechanisms of mood improvement following sleep deprivation.

Support (If Any): HL65112, MH24652, MH019986, TR001857, HL082610, DA032557

0407
ACT-541468, A DUAL OREXIN RECEPTOR ANTAGONIST, FOR THE TREATMENT OF INSOMNIA DISORDER: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, 5-PERIOD, 5-TREATMENT CROSSOVER DOSE-RESPONSE PHASE 2 STUDY IN THE ELDERLY

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Introduction: Most hypnotic treatments for insomnia disorder negatively impact next-day functioning in the elderly. ACT-541468 is a potent and selective dual orexin receptor antagonist that has shown minimal residual next-day effects in Phase 2. We present data from a polysomnography (PSG) dose-response study of ACT-541468 in elderly subjects with insomnia disorder.

Methods: Eligible elderly (≥65 years) subjects with insomnia disorder (Diagnostic and Statistical Manual of Mental Disorders, 5th edition criteria) had wake after sleep onset (WASO) ≥30 min, order (Diagnostic and Statistical Manual of Mental Disorders, Eligible elderly (≥65 years) subjects with insomnia disorder.

Methods: A randomized, double-blind, placebo-controlled, 5-period, 5-treatment crossover dose-response phase 2 study in the elderly

ACT-541468 is a potent and selective dual orexin receptor antagonist that has shown minimal residual next-day effects in Phase 2. We present data from a polysomnography (PSG) dose-response study of ACT-541468 in elderly subjects with insomnia disorder.

Methods: Eligible elderly (≥65 years) subjects with insomnia disorder (Diagnostic and Statistical Manual of Mental Disorders, 5th edition criteria) had wake after sleep onset (WASO) ≥30 min, latency to persistent sleep (LPS) ≥30 min, total sleep time <6.5 h and were randomly allocated to 1 of 5 treatment sequences (Latin square design). Treatment (5 mg, 10 mg, 25 mg, 50 mg ACT-541468 and placebo) was administered on Days1&2 of each of the five treatment periods, followed by a 5-12-day washout. The main efficacy endpoints were the change from baseline (placebo run-in) in WASO (primary) and LPS (secondary) to Days1&2 (mean of PSG on Days1&2). The dose-response of ACT-541468 on WASO and LPS was evaluated using generalized MCP-Mod methodology. Self-reported next-day functioning (daytime alertness, morning sleepiness, daytime ability to function) was assessed by a visual analog scale.

Results: Of 149 subjects screened, 58 (67% female; median age 69 years [range 65-85]) were randomized. A dose-response relationship was demonstrated for WASO (p<0.0001) and LPS (p=0.025). Observed mean reductions from baseline to Days1&2 for ascending doses for WASO were: (placebo, −14.13), −18.43, −32.37, −44.20, and −61.11 min and for LPS were: (placebo, −33.88), −37.92, −44.61, −44.81, and −44.88 min. Self-reported next-day functioning was improved across all groups. The most frequent treatment-emergent adverse events were fatigue, nasopharyngitis, gait disturbance, and headache (all ≤7%), with no apparent relationship to dose (except fatigue [50 mg], 7%).

Conclusion: A significant dose-response was established for ACT-541468 in the reduction of WASO and LPS, with no dose-limiting safety events. No increase in next-day excessive sleepiness related to treatment was reported. Further long-term studies of ACT-541468 are warranted.

Support (If Any): None

0408
A BLINDED HYPNOTIC TAPERING APPROACH FOR HYPNOTIC DISCONTINUATION

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Introduction: Hypnotic users commonly make unsuccessful attempts to discontinue their hypnotics. This study tested a blinded tapering approach to reduce anxiety and help patients discontinue their hypnotics.

Methods: This study enrolled 78 (M age = 55.2 ± 12.8 yrs; 65.4% women) users of benzodiazepine and benzodiazepine receptor agonists. Enrollees completed baseline measures including the Insomnia Severity Index (ISI). They then completed 4 sessions of cognitive behavioral insomnia therapy (CBTI). Subsequently they were randomized to one of three 20-week, double-blinded tapering protocols wherein their medication dosage was either reduced by 25% or 10% every two weeks, or remained unchanged (CTRL). During tapering, all enrollees were seen biweekly by the study physician for support and guidance. At the end of the 20-week period the study blind was eliminated and those who completed one of the two blinded tapering protocols entered a 3-month follow-up period, whereas CTRL participants are offered an open label taper before completing the follow-up.

Results: Baseline ISI scores (ISI=18.07±5.58) showed that the total sample entered the trial with moderately severe insomnia complaints despite almost nightly hypnotic use. These scores declined into the mild range after CBTI (10.19±0.53) and tapering (9.62±0.63) and approached the normative range by follow-up (7.59±1.05). Of the 45 who completed one of the blinded tapering protocols to date, 39 (86.7%) totally discontinued their medication use by the end of the 20-week tapering phase whereas 12 (75%) in the CTRL group discontinued hypnotic use by the end of their open label tapering. At follow-up 22 of 30 (73.3%) who completed blinded tapering remained medication free whereas only 5 of 14 (35.7%) in the CTRL group who underwent open-label tapering remained medication free.

Conclusion: CBTI combined with blinded hypnotic tapering seems a promising treatment approach to help hypnotic users overcome their medication dependence and improve insomnia symptoms.

Support (If Any): National Institute of Drug Abuse, Grant # R34 DA04329-01

0409
EFFECTS OF TRAZODONE VS. COGNITIVE-BEHAVIORAL TREATMENT ON SLOW WAVE SLEEP IN CHRONIC INSOMNIA: A PILOT STUDY

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Introduction: Both trazodone and cognitive-behavioral treatment of insomnia (CBT-I) are widely used to treat patients with chronic
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I. Insomnia

Results: All patients demonstrated a significant improvement after CBT-I both at ISI (19.1±3.7 vs 10.3±4.9; p<.000) and at sleep variables (Sleep Latency: 38.1±28.6 vs 22.9±22.5; p<.005; Wake after Sleep Onset (WASO): 98.6±79.9 vs 51.7±52.1; p=.002; Sleep Efficiency: 67.2±19.1 vs 82±11.9; p=.000). The general linear model analysis with PSG data showed that only Slow Wave Sleep (SWS) % predicted the decrease of WASO subjectively reported at Sleep Diaries. In particular, patients by a higher SWS % were the ones showing a greater improvement at WASO after CBT-I (98.6±79.9 vs 51.7±52.2; p=.032).

Conclusion: Our study demonstrated that SWS % before treatment predict a better response to CBT-I. This result might support the hypothesis of a possible phenotype of insomnia characterized by % of SWS that could be the natural mediator of “process S” pressure that would result in a greater improvement of subjectively reported WASO and therefore in a better outcome after CBT-I.

Support (If Any): None

0410

SLOW WAVE SLEEP AND RESPONSE TO COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: Cognitive Behavioral Therapy for Insomnia (CBT-I) is recognized to be the first-choice treatment for chronic insomnia. Since the subjective evaluation of nocturnal sleep in mandatory for the diagnosis of insomnia, the efficacy of CBT-I has been mostly investigated with subjective measures. Only few studies examined the efficacy of CBT-I with an objective evaluation. However, polysomnography (PSG) could provide important information regarding objective sleep phenotypes and its influence on CBT-I response. Aim of our study was to evaluate if PSG variables before treatment could predict CBT-I outcomes.

Methods: 29 chronic insomnia patients (15 females and 14 males, mean age 40.8±12.0) underwent an ambulatory PSG recording before CBT-I treatment. Patients also reported subjective sleep by means of sleep diary during PSG evaluation and throughout the duration of CBT-I (9 weeks). PSG data were used as primary outcomes to evaluate possible different response to CBT-I. Moreover, we used a general linear model to assess if any PSG sleep measures could predict patients’ response to CBT-I in terms of Insomnia Severity Index (ISI) or subjective sleep diary variables.

Results: All patients demonstrated a significant improvement after CBT-I both at ISI (19.1±3.7 vs 10.3±4.9; p<.000) and at sleep variables (Sleep Latency: 38.1±28.6 vs 22.9±22.5; p<.005; Wake after Sleep Onset (WASO): 98.6±79.9 vs 51.7±52.1; p=.002; Sleep Efficiency: 67.2±19.1 vs 82±11.9; p=.000). The general linear model analysis with PSG data showed that only Slow Wave Sleep (SWS) % predicted the decrease of WASO subjectively reported at Sleep Diaries. In particular, patients by a higher SWS % were the ones showing a greater improvement at WASO after CBT-I (98.6±79.9 vs 51.7±52.2; p=.032).

Conclusion: Our study demonstrated that SWS % before treatment predict a better response to CBT-I. This result might support the hypothesis of a possible phenotype of insomnia characterized by % of SWS that could be the natural mediator of “process S” pressure that would result in a greater improvement of subjectively reported WASO and therefore in a better outcome after CBT-I.

Support (If Any): None

0411

TYPES OF STRESS, DEPRESSIVE SYMPTOMS, AND SLEEP QUALITY AMONG LATINA/O ADULTS

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Introduction: Acculturation stress, the psychosocial stress associated with changes engendered by the encounter of two divergent cultures, is associated with insomnia independent of chronic stress among Latinas/os. However, the associations of subtypes of acculturation stress (i.e., intrafamilial, extrafamilial), and sleep quality remain understudied. Our aims were to examine the independent associations of intrafamilial stress, extrafamilial stress, and perceived stress with different indicators of sleep quality, and test the moderating effects of depressive symptoms. We hypothesized that intrafamilial and extrafamilial stress would be more strongly associated with poor sleep quality than perceived stress.

Methods: Using cross-sectional data of healthy Latino adults(N=112) enrolled in the Latino Sleep and Health Study, we conducted separate age and gender adjusted linear regressions to examine the association of intrafamilial stress, extrafamilial stress, and perceived stress with insomnia symptoms and sleep quality. All independent variables were standardized. The moderating effect of depressive symptoms on these associations was tested using cross-products. Perceived stress was measured using Cohen’s Perceived Stress Scale. Intrafamilial and extrafamilial stress scores were calculated by summing the respective response items of Hispanic Stress Inventory. Depressive symptoms were measured using the Beck Depression Inventory. Insomnia symptoms and sleep quality were measured using the Insomnia Severity Index and Pittsburg Sleep Quality Index, respectively.

Results: Overall, Mage=41.10 (SD=15.13) and 65.18% were female. One SD increases in intrafamilial and extrafamilial stress were associated with 0.27 and 0.23 increases in insomnia symptoms, respectively (β=0.27;SE=0.12;p=0.02; β=0.23;SE=0.012;p=0.05). Perceived stress was not significantly associated with insomnia (β=0.12;SE=0.12;p=0.33). None of the stress types were significantly associated with sleep quality, but the association of intrafamilial stress with poor sleep quality (β=0.17;SE=0.09;p=0.07) was marginally significant. Depressive symptoms did not moderate these associations.

Conclusion: Intrafamilial acculturation stress was most strongly associated with insomnia symptoms, an indicator of sleep quality, associated with changes engendered by the encounter of two divergent cultures, is associated with insomnia independent of chronic stress among Latinas/os. However, the associations of subtypes of acculturation stress (i.e., intrafamilial, extrafamilial), and sleep quality remain understudied. Our aims were to examine the independent associations of intrafamilial stress, extrafamilial stress, and perceived stress with different indicators of sleep quality, and test the moderating effects of depressive symptoms. We hypothesized that intrafamilial and extrafamilial stress would be more strongly associated with poor sleep quality than perceived stress.

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Results: Overall, Mage=41.10 (SD=15.13) and 65.18% were female. One SD increases in intrafamilial and extrafamilial stress were associated with 0.27 and 0.23 increases in insomnia symptoms, respectively (β=0.27;SE=0.12;p=0.02; β=0.23;SE=0.012;p=0.05). Perceived stress was not significantly associated with insomnia (β=0.12;SE=0.12;p=0.33). None of the stress types were significantly associated with sleep quality, but the association of intrafamilial stress with poor sleep quality (β=0.17;SE=0.09;p=0.07) was marginally significant. Depressive symptoms did not moderate these associations.

Conclusion: Intrafamilial acculturation stress was most strongly associated with insomnia symptoms, an indicator of sleep quality,
while perceived stress was not associated with any indicator of sleep quality. If replicated, our results suggest that behavioral health treatments for insomnia may benefit from additional components that specially address the resolution of strained familial relationships resulting from adapting to U.S. culture.

Support (If Any): N/A

0412
THE ASSOCIATION BETWEEN PTSD SEVERITY AND INSOMNIA IS MEDIATED BY NIGHTMARES
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Introduction: Individuals with Post-Traumatic Stress Disorder (PTSD) are likely to experience nightmares and disturbed sleep. In fact, sleep disruption is often the most frequently reported symptom of PTSD. This population often re-experiences their traumatic events through nightmares. If left untreated, sleep disturbance can become a chronic issue and tends to be associated with poor recovery. Of the various sleep-related issues, nightmares can lead to a greater number of nocturnal awakenings and establish a conditioned fear response to sleep that further impacts emotional functioning. Here we examined whether nightmare severity mediates the relationship between PTSD severity and insomnia.

Methods: Fifty-eight adults (59.3% female; Mean age = 31.1 years, SD = 8.5) with a clinical diagnosis of PTSD were administered the Clinician-Administered PTSD Scale for DSM-5 as a measure of symptom severity. Individuals completed the Disturbing Dreams and Nightmare Severity Index (DDNSI) as a measure of nightmare severity and frequency and the Insomnia Severity Index (ISI) to assess participants’ degree of insomnia. A mediation analysis using Hayes’ PROCESS tool in SPSS was conducted to test the hypothesis that nightmare severity would mediate the relationship between PTSD severity and insomnia.

Results: Consistent with prior research, there was a significant positive relationship between PTSD severity and insomnia (b = .20). Moreover, nightmare severity fully mediated the positive relationship between PTSD severity and insomnia (b = .39, 95% CI [10, 68], F (2, 55) = 6.77, p = .0024).

Conclusion: As expected, the severity of PTSD symptoms was significantly correlated with insomnia symptoms. However, the relationship between PTSD severity and insomnia appears to be fully mediated by the severity of nightmares. In other words, greater severity of PTSD appears to lead to more severe nightmares, which in turn, lead to greater problems with insomnia. These findings suggest that interventions aimed toward reducing nightmare severity may be particularly efficacious in the treatment of PTSD.

Support (If Any): This project was supported by an USAMRMC grant to WDSK (W81XWH-14-1-0570).

0413
EFFECTS OF INTERPERSONAL PROCESSES ON INSOMNIA SEVERITY IN MILITARY PERSONNEL
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Introduction: Insomnia is prevalent among Service Members (SMs) and Veterans and affected by interpersonal processes. This project explored how attachment style and perceived social support (SS) influence insomnia in military personnel. Analyses focused on appraisal type SS because the perception of available others may attenuate feelings of loneliness and stress, which negatively impact sleep. We hypothesized greater SS would be associated with lower insomnia severity for people with lower and greater anxious attachment, but only for those with lower avoidant attachment. We also hypothesized SS would mediate the relationship between anxious, but not avoidant attachment, and insomnia severity.

Methods: Ninety-nine SMs and Veterans (aged 19-67) completed self-report measures of attachment style, SS, and insomnia severity. Linear regression evaluated the main and interaction effects of attachment style and SS on insomnia. PROCESS in SPSS was used to examine mediating effects of SS. Anxious and avoidant attachment were examined separately.

Results: Anxious attachment, avoidant attachment, and SS were independently associated with insomnia severity (β=.29, β=.29, β=.36; p<.01). Anxious attachment and SS better predicted insomnia severity than anxious attachment alone (ΔR²=11, ΔF=12.51, p=.001). Similar findings emerged for avoidant attachment and SS (ΔR²=.10, ΔF=11.72, p=.001). Findings were not significant after adjusting for age, childhood trauma, and current PTSD and mood disorders. The interaction of anxious attachment by SS and avoidant attachment by SS on insomnia severity were not significant. SS partially mediated the relationship between anxious attachment and insomnia severity (indirect effect=.074, CI=.008,.154), but did not mediate the relationship between avoidant attachment and insomnia severity.

Conclusion: Findings are consistent with literature linking lower anxious attachment or greater SS with better sleep among military personnel. Results show an association between avoidant attachment and subjectively reported insomnia severity, additive effects of anxious or avoidant attachment and SS on insomnia severity, and a mediating role of SS on the relationship between anxious attachment and insomnia severity. As SS is modifiable, enhancement of SS in treatment of insomnia may yield increased benefits for SMs and Veterans.

Support (If Any): DOD CDMRP & MOMRP (PR054993, PT073961, Log#11293006 (PI: Germain)

0414
MOOD AS A MEDIATOR OF MINDFULNESS AND INSOMNIA SYMPTOMS IN YOUNG ADULTS
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Introduction: Previous research suggests that there is an inverse relationship between insomnia severity and mindfulness, but this association may be influenced by mood and gender. The present study examined whether psychological distress mediates the relationship between insomnia severity and mindfulness after adjusting for gender.

Methods: We surveyed 2,159 young adults aged 18-35. Participants completed the Mindful Attention Awareness Scale, Kessler Distress Scale, and the Insomnia Severity Index. Regression analyses were used to investigate whether psychological distress mediates the effect of mindfulness on insomnia severity in young adults after adjusting for gender.
Results: The mean age of the sample was 22 years (SD=3.73) and 70.6% identified as female. Overall, insomnia severity was in the mild range (M=8.99, SD=5.61) with 55.4% reporting at least mild insomnia symptoms. Psychological distress was in the mild to moderate range (M=24.31; SD=8.51) with 28.7% of the sample being in the clinically significant range. Mindfulness was a significant predictor of psychological distress (β = -.322, SE = .010, p < .0001) and psychological distress was a significant predictor of insomnia severity (β = .395, SE = .011, p < .0001). Mindfulness was also a significant predictor of insomnia severity (β = -.16, SE = .007, p < .0001). The relationship between mindfulness and insomnia severity decreased after adjusting for psychological distress (β = -.047, SE = .008, p < .0001), consistent with partial mediation. Approximately 38.9% of insomnia severity was accounted for by the predictors (R² = .389). A Sobel test confirmed the significance of the mediation (Z = -1.996, SE = .0057, p < .0001). Mindfulness was associated with approximately .11 points higher insomnia severity scores as mediated by psychological distress. There was a significant difference in psychological distress scores between gender [F(1,1217) = 25.616, p < .0001], with females reporting greater levels of psychological distress (M = 14.79, SE = .21) than males (M = 12.72, SE = .36) but gender did not impact the relationship between insomnia, mood, and mindfulness.

Conclusion: Psychological distress partially accounts for the relationship between mindfulness and insomnia severity among young adults and this effect does not differ by gender. These results suggest that mindfulness training may have a positive impact on insomnia severity through a reduction in psychological distress.

Support (If Any): None

ASSOCIATIONS BETWEEN PAIN, DEPRESSION, STRESS, AND SUBSTANCE USE IN NURSES WITH AND WITHOUT INSOMNIA

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Introduction: Insomnia and pain have been shown to increase risk for development of depression and substance use disorders. Depression, substance use, stress, and pain are also strongly correlated with sleep impairment. No studies have examined associations between insomnia, pain, stress, substance use, and depression in a sample of nurses, who may experience these disturbances due to stressful work environments, intense physical demands, and rotating work schedules. Therefore, the present study examined if insomnia symptoms, pain symptoms, and perceived stress were associated with alcohol use and depressive symptoms in nurses, and if insomnia diagnosis moderated these associations.

Methods: Participants were 400 nurses (92% female; 78% white, mean age = 39.51 ± 11.13) recruited from two hospitals for a parent study, “Sleep and Vaccine Response in Nurses (SAV-RN)” (R01AI28359-01, PIs: Taylor & Kelly). Participants completed measures of depression, pain, insomnia, and stress. Linear regression was used to assess the associations between insomnia symptoms, stress, and pain with depressive symptoms and substance use. Insomnia diagnosis (based on diagnostic cutoffs from questionnaire data) was examined as a moderator of the associations between pain, stress, depressive symptoms, and substance use.

Results: Greater insomnia symptoms were associated with consuming fewer drinks per week (p = .04), and greater perceived stress was associated with consuming more drinks per week (p = .01). Greater insomnia symptoms, perceived stress, and pain were each associated with greater depressive symptoms (ps < .001). Insomnia diagnosis moderated the association between perceived stress and depressive symptoms (β = 0.11, p = .05), such that nurses with insomnia disorder had a stronger positive relationship between perceived stress and depressive symptoms.

Conclusion: Results suggest insomnia symptoms, stress, and pain were associated with greater mood disturbance. Greater stress was associated with greater substance use, which may reflect coping attempts. Nurses with insomnia may be particularly susceptible to increases in depressive symptoms under times of stress. Given that nurses are the first-line of care in hospital settings, it is essential to address these problems proactively and comprehensively.

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EXAMINING PHYSICAL ACTIVITY AS A POTENTIAL MODERATOR IN THE STRESS-HELP RELATIONSHIP

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Introduction: Prior research demonstrates a well-established relationship between stress and sleep. There is also evidence that physical activity may reduce psychological stress. We therefore examined whether physical activity moderates the stress-sleep relationship, hypothesizing that it may act as a buffer against the deleterious impact of stress on sleep.

Methods: Physical activity levels were obtained from 77 undergraduate students (86% female; 90% Hispanic; mean age 19.40 (2.07)) using a wrist-worn actigraph device. Participants were fitted with the actigraph on a Monday and returned for a follow-up session on the subsequent Friday. Participants also completed a survey containing standardized measures of self-perceived stress (PSS) and sleep quality (PSQI). Physical activity was calculated using the three-day time period, midnight Monday to midnight Thursday.

Results: A moderation analyses was conducted using Hayes’ PROCESS Macro V3.2 using 5,000 bootstrapped samples. Self-perceived stress (PSS) was correlated with poor sleep quality (PSQI; r(77) = .48, p < .001). However, physical activity (total Freedson bouts) did not significantly moderate this association (interaction: b = .0005 t(73) = .163, CI [-.006, .007]). Physical activity (Freedson) was not significantly correlated with self-perceived stress or sleep quality. A supplementary analysis revealed that total sedentary bouts was positively correlated with both stress (r = .22, p = .029) and poor sleep quality (r = .30, p = .004).

Conclusion: Our results did not support the hypothesis that physical activity moderates the stress-sleep relationship. However, it is important to note that none of our participants reached a “vigorous” level of activity during the three-day sampling period, based on the Freedson algorithm used. We were therefore not able to effectively test the impact of physical activity, given the restricted range of sedentary to moderate levels. This low-level of physical activity in college-age participants is concerning in its own right, but suggests that cross-sectional studies of this issue may need to use purposeful sampling of individuals engaged in low and high

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physical activity. Our supplemental analysis shows an interesting association between sedentary activity and stress/sleep which deserves further exploration.

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0417
INDIRECT EFFECT OF SLEEP ATTITUDES ON SLEEP DURATION AND QUALITY VIA AROUSAL BEHAVIORS
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Introduction: Sleep attitudes are psychological tendencies expressing favor or disfavor over activities or entities as compared to sleep. Previous literature has reported an indirect relationship between sleep attitudes and sleep hygiene for sleep outcomes, but has not looked at components of sleep hygiene (Arousal, Eating, and Sleep Environment) as potential indirect pathways.

Methods: Using Amazon’s Mechanical Turk, 173 adult participants (Mage = 32.97, SDage = 10.00; 69.36% minority, 58.38% male) self-reported sleep quality and duration, separately for weekdays and weekends, using modified questions from the Pittsburgh Sleep Quality Index (Buysse et al., 1989). Averages were calculated using weighted duration and quality (5*weeknight+2*weekend)/7). Participants also completed the Charlotte Attitudes Towards Sleep scale (Peach & Gaultney, 2017) and the Sleep Hygiene Practice Scale (Lin et al., 2009). Higher scores indicated more sleep hygiene problems, worse sleep quality, longer sleep duration, and more positive attitudes towards sleep. A path analysis examined whether sleep attitudes predicted sleep outcomes via an indirect route through one or more of the four components of sleep hygiene.

Results: Sleep attitudes significantly predicted all sleep hygiene behavior components, while arousal was the only component of sleep hygiene demonstrating direct associations with sleep outcomes. Sleep attitudes indirectly predicted both quality and duration via arousal behaviors. The pattern was most clear for sleep quality, longer sleep duration, and more positive attitudes towards sleep. A path analysis examined whether sleep attitudes predicted sleep outcomes via an indirect route through one or more of the four components of sleep hygiene.

Conclusion: Sleep attitudes indirectly predicted both quality and duration via arousal behaviors. The pattern was most clear for sleep quality, longer sleep duration, and more positive attitudes towards sleep. A moderation analysis was conducted using Hayes’ PROCESS Macro V3.2 using 5,000 bootstrapped samples after mean-centering predictor variables.

Support (If Any): N/A

0419
PREVALENCE AND SOCIODEMOGRAPHICS ASSOCIATED WITH TOTAL SLEEP TIME IN FRANCE AND INSOMNIA IN 12370 INDIVIDUALS, BAROMETRE SANTÉ PUBLIQUE FRANCE 2017.
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Introduction: Total sleep time (TST) on 24 hours, is now considered as a crucial point in epidemiological surveys devoted to metabolism and cardiovascular diseases, accident risk, psychiatric diseases and cancers. Better understanding those who sleeping less than 6 hours/24 hours and those with sleep debt or Sleep deprivation, would help us to prevent these Sleep disorders.

Methods: The Barometre Santé 2017 is an epidemiological telephone Survey made on a representative sample of the French Population, with 12370 subjects aged 18-75 years old. Questionnaires included more than 30 items on Sleep schedules and Sleep disorders according to ICSD-3.
DISASSEMBLING INSOMNIA SYMPTOMS AND THEIR ASSOCIATIONS WITH DEPRESSIVE SYMPTOMS IN A COMMUNITY SAMPLE: THE DIFFERENTIAL ROLE OF SLEEP SYMPTOMS, DAYTIME SYMPTOMS, AND PERCEPTION SYMPTOMS OF INSOMNIA
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Introduction: Insomnia and depression are closely related. However, few studies have investigated whether certain insomnia symptoms differentially relate to certain depressive symptoms. The present study aimed to examine the relationship between three types of insomnia symptoms (sleep symptoms, daytime symptoms, and perception symptoms) and specific symptoms of depression.

Methods: Participants were 1003 community-based adults aged 22-60 from the Philadelphia area who participated in the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study. Insomnia symptoms were represented by scores of sleep symptoms, daytime symptoms and perception symptoms, derived from the Insomnia Severity Index (ISI). Depression symptoms were assessed with the Patient Health Questionnaire 9 (PHQ-9).

Results: A Confirmatory Factor Analysis (CFA) supported the three-factor model based on ISI data. Binary logistic regressions examined independent associations between the three insomnia symptom types and individual depression symptoms. Sleep symptoms were more strongly associated with physiological aspects of depressive symptoms (appetite symptoms, psychomotor symptoms, and suicidal ideation; OR ranged from 1.12 to 1.20). The daytime symptoms, on the other hand, were significantly associated with almost all depressive symptoms, except for appetite. Moreover, daytime symptoms were exclusively related to cognitive symptoms of depression (e.g., trouble concentrating; OR=1.23, 95% CI: 1.16-1.46). The perception symptoms were independently associated with mood symptoms, tiredness, appetite, and judgment of oneself as a failure (OR ranged from 1.21 to 1.54), but not with psychomotor, cognitive and suicidal ideation symptoms.

Conclusion: Daytime symptoms and perception symptoms of insomnia were more strongly associated with a full range of depressive symptoms than sleep symptoms. The sleep symptoms were mainly associated with physiological symptoms of depression, implicating more biological mechanisms. Further research is needed regarding how types of insomnia symptoms differentially related to multiple health consequences.

Support (If Any): None
One-week sleep diary was used to assess sleep patterns, including the sleep onset latency, sleep efficiency, total sleep and number of awakenings after sleep. The Montreal Cognitive Assessment (MoCA) was used to measure the cognitive function. Risk factors were identified by using the multivariate linear regression with stepwise variable selection method.

**Results:** MoCA score was negatively correlated with age ($r = -3.2; P < 0.01$), sleep onset latency ($r = -3.2; P < 0.01$) while positive correlated with education level ($r = 0.50; P < 0.01$), sleep efficiency ($r = 0.26; P < 0.01$) and sleep duration ($r = 0.21; P = 0.02$). However, MoCA was not associated with the ISI total score ($r = -0.09; P = 0.30$). In linear regression model, MoCA score was only associated with sleep efficient (regression coefficient $= 2.70; P = 0.04$) after controlling for education level by using stepwise approach, which included age, sex, education level, and other parameters with significant correlation with MoCA.

**Conclusion:** Sleep quality as measured by sleep efficiency in sleep diary seems to be correlated with cognitive function in patients with insomnia disorder. However, severity of insomnia as measured by the ISI is not likely to be correlated with cognitive function in patients with insomnia disorder.

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**0423**

**SLEEP DEBT: ASSOCIATIONS WITH DIET QUALITY AND BEHAVIOR, NHANES 2009-2014**

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**Introduction:** Sleep deprivation has been associated with numerous chronic diseases, which may be due to the effect of sleep on diet quality. While scientists have found that probable insomnia and/or insomnia symptoms may have a negative effect on diet quality, there is a need to explore this association in a more diverse population.

**Methods:** Cross-sectional population based study using the National Health and Nutrition Examination Survey data from 2009-2014. This survey sample provides nationally representative data from non-institutionalized individuals in the United States. For this study, 16,454 non-institutionalized U.S. adults representing an estimated 697 million individuals nationwide were selected based on the validity of their dietary and sleep data. The exposure was self-reported sleep duration described as usual sleep hours at night on weekdays/workdays. The outcome measure was the Healthy Eating Index-2010, a measure of diet quality that assesses compliance to the U.S. dietary recommendations. The HEI maximum score is 100, a higher score indicates higher compliance.

**Results:** The average sleep among the study population was 6.9 hrs. Sleep hours were grouped into four categories. Sleep duration between 6 and 7.5 hrs per night served as the reference group. We examined the predictors of diet quality using a simple and multivariate regression and found that individuals that slept less than 4.5 hrs or less than 6 hrs, had 3.2 times and 2.81 times lower diet quality than the reference group. This effect was diminished, but significant after adjusting for age, gender, household-size, race/ethnicity, marital status, education, poverty income-ratio, physical activity, and thyroid disease, <4.5 hrs of sleep -1.71 (95%CI-3.23,-0.19) and 4.5-6 hrs of sleep -1.93 (95%CI-2.81,-1.05).

**Conclusion:** This diverse sample showed a possible association between sleep debt and diet quality after adjusting for confounders. It is possible that the association between sleep and mortality is due to the effect of sleep debt on diet quality. The reverse could be not ruled out due to the study design. However, this information may render insight into the effects of sleep deprivation and how it is associated to other comorbidities.

**Support (If Any):**

**0424**

**INSOMNIA IN ADULTS WITH AUTISM: RELATIONSHIP OF EMPLOYMENT, EDUCATION, AND TRAINING STATUS AND AUTISM IDENTITY**

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**Introduction:** Sleep problems, especially insomnia, are highly prevalent in adults with autism. Those not in employment, education, or training (NEET) may be at particular risk for insomnia given their limited structured activities. Additionally, adults with autism face stigma. Stigma and stereotyped threat (signals impacting physical and psychological outcomes) have been shown to detrimentally affect health and well-being in other populations. As part of a larger intervention study, we examined factors predictive of insomnia in this population, including internalized stigma.

**Methods:** Thirty-one (20 male & 11 female) individuals with ASD participated in a multi-component self-determination intervention and completed one week of actigraphy/sleep diaries and survey measures along with self-report of sleep problems. Regression analyses examined relationships between sleep latency and positive difference (believing that autism is a positive difference rather than a challenging disability) on the Autism Spectrum Identity Scale, a measure of internalized stigma.

**Results:** Self-report of sleep problems during interviews was inconsistent with actigraphy/sleep diaries; individuals either overreported or underreported insomnia during interviews. Half of the sample were NEET (n = 15). Approximately half of NEET and non-NEET individuals had insomnia (actigraphy sleep onset > 30 mins). For NEET status only, higher endorsement of positive difference was associated with shorter sleep latency on actigraphy ($R = 0.475; p = 0.032$).

**Conclusion:** Self-report of sleep problems during interviews may not accurately capture sleep latency in this population, and should be paired with objective measures, such as actigraphy. Positive autism identity may have a buffering effect on insomnia in adults with ASD who are in employment, education, or training. Treatment for insomnia in this population should include attention to the impact of socio-environmental factors.

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**0425**

**ACTIGRAPHY ASSESSMENT IN FIBROMYALGIA: A STANDARDIZED PROTOCOL TO REDUCE DISCREPANCIES BETWEEN SUBJECTIVE AND OBJECTIVE SLEEP**

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**Introduction:** Discrepancies between self-reported and actigraphy assessed sleep are common in patients with fibromyalgia (FM). This may partially be due to methods of actigraphy analysis, which
often use non-standardized accelerometry algorithms that do not accurately estimate rest intervals (i.e., bedtime/waketime interval), and lead to inaccurate computation of sleep variables. Here, we describe the MizZou Sleep Lab Actigraphy Protocol (MSLAP) as an alternative to automated rest interval detection (AUTO). Application of MSLAP relative to AUTO was carried out in a sample of patients with FM. For each method, magnitude of discrepancies between actigraphy/self-reported sleep were compared.

**Methods:** Fourty-seven adults with FM completed three days of actigraphy and sleep diaries measuring bedtime, waketime, SOL, sleep efficiency (SE), wake after sleep onset (WASO), and total sleep time (TST). For actigraphy analysis, rest intervals were determined using MSLAP and AUTO (in Philips Actiware V.6.0.8). MSLAP determines probable bedtimes/waketimes using a hierarchical procedure: 1) visually inspect activity/light signal, 2) identify trigger value where activity/light reaches zero (bedtime), or activity/light exceeds 100 or 1uW/cm² (waketime), 3) detect ten consecutive subsequent epochs meeting sub/supra-threshold criteria for activity/light. For MSLAP and AUTO, bedtime and waketime were recorded, and SOL, SE, WASO, and TST were computed using validated Actiware sleep scoring algorithms. Paired t-tests determined whether magnitude of subjective/objective sleep outcome discrepancies differed between MSLAP and AUTO.

**Results:** Bedtime objective/subjective discrepancies were lower (p<.001) for MSLAP (M=32.7 mins, SD=36.0) relative to AUTO (M=55.4 mins, SD=79.3). Wake time discrepancies were also lower (p<.001) for MSLAP (M=23.3 mins, SD=40.5) relative to AUTO (M=40.5 mins, SD=71.5). SOL discrepancies were lower (p=.04) for MSLAP (M=43.0 mins, SD=35.1) relative to AUTO (M=47.4 mins, SD=36.7). Subjective/objective discrepancies between MSLAP and AUTO did not differ for SE, WASO, or TST.

**Conclusion:** Compared to automated accelerometer rest interval detection algorithms, MSLAP may reduce discrepancies between self-reported and actigraphically assessed sleep in FM. Results promote the use of MSLAP in actigraphy analysis, which may help clinicians assess and treat sleep disorders in patients with chronic pain.

**Support (If Any):** NIAMS R01AR055160; R01AR005160-S1; PI, McCrae). Data collected at the University of Florida (Clinical Trial NCT02001077; PI, McCrae).

**0426**

**SLEEP PREDICTION ALGORITHM BASED ON DEEP LEARNING TECHNOLOGY**

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**Introduction:** Clinicians believe that maladaptive sleep-related factors such as inactivity during daytime, excessive time spent in bed, poor exposure to light, and high stress level contribute development of chronic insomnia. However, there’s paucity of evidences how exactly one’s behavior during daytime affect one’s sleep at that night. Traditional assessment methods, such as polysomnography, sleep diary, and actigraphy, cannot integrate sleep outcome with sleep-related factors by themselves. That is, prediction of sleep is wholly dependent to a researcher. We need to find the way which can integrate sleep-related factor and predict one’s sleep automatically. In this study, we tried to develop an algorithm that can predict sleep quality by using deep learning technology.

**Methods:** Sixty-nine healthy participants were enrolled to our study. We measured their sleep and sleep-related factors including daytime activity, exposure to light, and heart rate variability by using actigraphy and heart rate sensor (ActiGraph GT3X® and Polar H7®) for two weeks. The dependent variable of the analysis was sleep quality (sleep efficiency ≥90%). We used raw data for predicting sleep with deep learning technology, multi-input one-dimensional convolutional neural network (1D CNN). Additionally, we used traditional analysis and machine learning technology to aware which factors affect sleep quality. For this, we used sub-divided data into 3 part: wake-up to noon (P1), noon to 18:00 (P2), and 18:00 to bedtime (P3). We performed logistic regression analysis for traditional analysis, and random forest(RF) as machine learning technology.

**Results:** P1 vigorous activity, P1, P2, P3 exposure to light, and P1, P2, P3 exposure to outside light showed significant correlations with sleep quality in weighted logistic regression. The effect of other variables on sleep quality was below significance level. Logistic regression model’s accuracy rate was 79.2%, RF model’s was 83.6%, 1D CNN model’s was 87.2% without sleep diary information.

**Conclusion:** The algorithm made by 1D-CNN model can predict sleep quality accurately which is comparable to the traditional logistic regression and machine learning technology. This result can enable more objective and accurate sleep prediction by automation of integration and interpretation of the data.

**Support (If Any):**

**0427**

**REAL-TIME MONITORING OF SLEEP-WAKE STATUS AND THOUGHT CONTENT: ASSOCIATIONS WITH INSOMNIA SYMPTOM REDUCTION**

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**Introduction:** The current study piloted the Sleep Experiences and Assessment Application (SEAA), a smartphone application developed for cost-effective, naturalistic, event-level assessment of pre-sleep experiences. The SEAA delivers audible prompts immediately before sleep and throughout the sleep period, which users respond to by verbally recording their wake status and thought content in the moment. The current study aimed to investigate effects of SEAA usage on subjective sleep experiences among individuals with and without insomnia.

**Methods:** Data were obtained from a 3-week daily investigation of 19 community participants (mean age = 21.74 [SD = 5.21], range: 18-40], 37% male, 58% White; 63% with Insomnia Disorder). Daily online sleep diaries were administered for 3 weeks to assess
subjective sleep behaviors and experiences. Participants utilized the SEAA each night during week 2 of the study. The Insomnia Severity Index (ISI) was administered at baseline and follow-up after three weeks.

Results: Mixed ANOVA analyses were conducted with alpha set at .10 due to the exploratory nature and small sample size of this pilot study. Results demonstrated large, significant group by time interaction effects on global insomnia severity ($F(1,15)=4.21, p = .058$, $\eta^2_p=.22$) and average daily sleep efficiency ($F(1,15)=3.95, p = .07$, $\eta^2_p=.21$). Specifically, compared to the non-insomnia group, the insomnia group endorsed a greater reduction in ISI scores from baseline to follow-up and a greater improvement in daily average sleep efficiency from Week 1 to Week 3. Qualitative feedback at follow-up showed that individuals with insomnia reported: (a) a better subjective estimate of sleep onset latency and number of nighttime awakenings; (b) becoming more aware of pre-sleep thought content that inhibits sleep.

Conclusion: These preliminary findings suggest that real time monitoring of pre-sleep thoughts and sleep status using the SEAA may be associated with improved sleep among individuals with insomnia. Observed insomnia symptom reduction may be explained by improved estimation of sleep patterns and increased awareness of maladaptive pre-sleep thought content. Findings highlight the potential benefits of real-time monitoring of the pre-sleep experiences using the SEAA.

Support (If Any): Syracuse University Internal Grant awarded to Les A. Gellis.

0428
TESTING A NOVEL SMARTPHONE APPLICATION TO EVALUATE PRE-SLEEP EXPERIENCES AND SLEEP PATTERNS: FEASIBILITY AND ANALYSIS OF PRE-SLEEP THOUGHT CONTENT
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Introduction: Little is known about real-time pre-sleep experiences in the natural environment and there is a need for cost-effective and efficient methods to evaluate pre-sleep experiences and sleep patterns in the natural setting. This study tested a novel smartphone application, the Sleep Experience and Assessment Application (SEAA), which emits auditory tones throughout the night, and, in response to the tones, participants are asked to verbally report their wake status and thought content, if awake. Feasibility of the instrument and analyses of participants’ real time pre-sleep thought content were evaluated.

Methods: 19 individuals (mean age = 21.74 years [SD = 5.21, range: 18 - 40]; 37% male, 58% White; 63% with Insomnia Disorder) completed the SEAA for one week (mean nights = 6.2 [SD = 1.4]) and provided feedback about the usage of the application, the difficulty of using the device, and comfort level of reporting their sleep status and thought content at follow-up. Participants rated all items on a scale of 1 to 10, with 10 being most positive.

Results: Participants reported that the SEAA was easy to use ($M=9.1$, SD=1.6), were comfortable reporting their thought content ($M=7.2$, SD = 2.7) and sleep status ($M=8.3$, SD = 1.9), was unlikely to disturb their sleep ($M =7.9$, SD = 2.7), and was moderately useful ($M=4.9$, SD = 3.2). Independent sample $t$-tests revealed no differences in ratings between those with and without insomnia (mean differences = 0.27 to 1.75; $p$’s = .18 to .78). The SEAA was also able to collect and record diverse categories of pre-sleep thought (e.g., Rehearsing/Planning, Problem Solving; Sleep and its Consequences).

Conclusion: These preliminary findings suggest that the SEAA may be easy to use and individuals report relative comfort with reporting real-time sleep patterns and thought content without sleep disruption. These results of positive subjective experiences in usage of the application suggests that this method may prove feasible in evaluating real-time pre-sleep experiences and sleep patterns of those with and without Insomnia.

Support (If Any): Syracuse University Internal Grant.
0430

RESPIRATORY SAFETY OF LEMBOREXANT IN HEALTHY ADULT AND ELDERLY SUBJECTS

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Introduction: Lemborexant (LEM) is a dual-orexin-receptor antagonist under development for the treatment of insomnia. As concerns regarding current sleep-promoting drugs include central respiratory depression (benzodiazepines) and limited safety evidence in vulnerable individuals such as the elderly (nonbenzodiazepine receptor agonists), it is important to assess respiratory safety of LEM. The study’s primary objective was to determine whether a single dose of LEM decreased peripheral oxygen saturation (SpO2) during total sleep time (TST) in healthy adult and elderly subjects versus placebo (PBO). Secondary objectives included change in apnea-hypopnea index (AHI) and whether SpO2 during TST decreased below defined thresholds.

Methods: This study was a multicenter, single-dose, randomized, double-blind, PBO-controlled, 3-period crossover in healthy (screening AHI <5) adult (age <65y) and elderly (age ≥65y) subjects. Subjects were randomized to three treatment periods in which they received a single dose of LEM 10mg (LEM10), LEM 25mg (LEM25), or PBO in three randomized sequences separated by ≥14d washout. Following administration of study drug five minutes before lights out, subjects underwent polysomnography (PSG). LEM25 is a supratherapeutic dose; in LEM clinical development, LEM10 is the maximum dose.

Results: Seventeen subjects were randomized: 12 (70.6%) female, 9 (52.9%) White, mean age 48.5y; 58.8% <65y and 41.2% ≥65y. Mean baseline SpO2 (95.4%) and AHI (2.06) were comparable between treatment sequences. For both LEM doses, there was no significant difference in SpO2 (LS mean difference versus placebo [95%CI]) (LEM10: -0.36 [-0.78, -0.07]; LEM25: 0.29; [-0.72, -0.14]) or AHI (LEM10: 0.52 [-1.72, -2.76]; LEM25: -1.16 [-3.40, -1.08]) during TST versus PBO. The difference between LEM25 and PBO was significant for TST SpO2 <90% (P=0.03), but not for the 85% or 80% thresholds; this was driven by a subject who exhibited obstructive sleep apnea on all treatments, including PBO. Excluding this subject, the difference was not significant. The proportion of subjects with ≥1 incident of SpO2 <90% for ≥30 seconds during TST was similar for each dose.

Conclusion: LEM demonstrated respiratory safety in healthy adult and elderly subjects, as objectively measured by SpO2 and AHI during TST.

Support (If Any): Eisai Inc., Purdue Pharma L.P.

0431

BEDTIME SOCIAL TECHNOLOGY USE (PARTNER AND SELF) RELATED TO DAYTIME SLEEPINESS AND SLEEP

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Introduction: One third of Americans report bedpartner sleep problems negatively impact their sleep. Previously we found one third of participants reported passive bedpartner social technology use related to disrupted sleep and increased sleepiness. We examined the relationship of both passive and active bedpartner social technology use and one’s own passive and active social technology use with daytime sleepiness and sleep. Active social technology use was defined as initiating use during bed time, passive social technology use was defined as the potential for sleep interruption by social technology without user action.

Methods: 199 university students (age: M=20.5 years, SD=6.45) recruited from introductory psychology courses were given extra credit for participation. Participants completed demographic information, the Epworth Sleepiness Scale (ESS), the Pittsburg Sleep Quality Index, questions regarding associated features of inadequate sleep hygiene, and the Sleep Hygiene Index. Four additional questions assessed frequency of active and passive social technology use and being aware of bedpartner active and passive social technology use during sleep time. For self and bedpartner, active and passive technology use were analyzed separately and combined.

Results: Self: 60.3% and 62.3% of students reported frequently or always using active and passive bedtime social technology, respectively. More frequent use was significantly related to greater daytime sleepiness (ESS) (r(196)=.142, p<.05), sleep disturbance (r(190)=.189, p<.05), and associated features of inadequate sleep hygiene (daytime sleepiness (r(196)=.176, p<.05), mood disturbance (r(197)=.174, p<.05), avolition (r(196)=.149, p<.05), and reduced cognition (r(197)=.177, p<.05). Bedpartner: 20.7% and 26.1% of students reported frequently or always noticing their partner’s active and passive use, respectively. Awareness of bedpartner active or passive social technology use was not significantly related to any sleep/sleepiness variables.

Conclusion: Participants were frequent users of bedtime social technology which was related to daytime sleepiness, disrupted sleep, and related complaints. Less than a third of participants were aware of partner active and passive bedtime social technology and surprisingly no sleep related associations were found. Future research should separate participants with no bedpartner from those who are unaware of their bedpartner’s social technology use.

Support (If Any): none
Results: Middle-aged (46.5±15.7yrs), overweight (34.0±8.4kg/m²), age, BMI, cardiovascular disease, and type 2 DM. Symptom measures: Stanford Sleepiness Scale, α necrosis factor-β (TNF-α), and IL-6. Cytokine plasma concentrations were measured, and Spearman’s partial rank-order correlation adjusted for Lee Fatigue Scale. Analysis: Descriptive statistics, Mann-Whitney test, and Spearman’s partial rank-order correlation adjusted for age, BMI, cardiovascular disease, and type 2 DM.

Results: Middle-aged (46.5±15.7yrs), overweight (34.0±8.4kg/m²), men (41.8%) and women with/without OSA (AHI, 9.7 [IQR 7.7-15.1]) v.1.8 [0.7-2.6]; p<0.001, respectively). In OSA, no change in sleepiness E-to-M (E, 3.4±1.3 v. M, 3.54±1.4, p=0.629); marginal change in sleepiness E-to-M in non-OSA (E, 4.0±0.8 v. M, 3.2±1.1; p=0.055); similar fatigue results (OSA: E, 4.7±2.2 v. M, 4.2±1.9; p=0.702; Non-OSA: E, 5.6±2.1 v. M, 4.7±2.0; p=0.076). No significant differences in any symptom or diurnal variation of symptoms existed between groups. TNF-α (D) was present in both groups (OSA≤0.001; Non-OSA≤0.01). No group differences in any cytokine (D) were identified. In OSA, IL-6 (E) was correlated with sleepiness (E) (r=0.706, p<0.001) and energy (r=-0.685, p<0.001); whereas, IL-8 (M) and TNF-α (M) were correlated with fatigue (M) (r=0.582, p=0.021; r=0.453, p=0.05, respectively). IL-8 (D) was correlated with fatigue (M) (r=0.543, p=0.048) and energy (D) (r=-0.535, p=0.032). In non-OSA, IL-6 (E) and sleepiness (E) showed the opposite trend (r=-0.454, p=0.066) of OSA; no significant relationship between IL-8 and morning symptoms.

Conclusion: In OSA, IL-6 may be a biological marker of sleepiness and IL-8 may be a biological marker of fatigue. Diurnal variation of cytokines may provide mechanistic insights for symptoms commonly expressed in OSA and symptomatic response to treatment. Larger, controlled studies are needed, including treatment trials, to better discern molecular signature of OSA and symptom expression.

Support (If Any): American Nurses Foundation and Sigma Theta Tau International (Yang, PI).

0434 BRUXISM AND SLEEP DISORDER
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Introduction: Sleep bruxism (SB) is reported by 8% of the adult population and is mainly associated with rhythmic masticatory muscle activity (RMMA) characterized by repetitive jaw muscle contractions (3 bursts or more at a frequency of 1 Hz). The purpose of this study was to evaluate the nature of sleep bruxism and to discuss its consequences.

Methods: We prospectively studied 22 patients who were referred to the clinical sleep apnea laboratory for study. They underwent standard nocturnal polysomnographic examination; in addition, masticatory activity was measured with a massester electromyogram. Patients slept in the supine and lateral decubitus positions.

Results: Nocturnal clenching was higher in patients with higher respiratory disturbance index. 16 among 22 patients were included in the criteria of obstructive sleep apnea; average respiratory disturbance index (RDI) was 12.7 280 clenches demonstrated in all patients.

Conclusion: We conclude that there is an association between sleep related breathing disorder and bruxisms that sleep position affects the incidence of both sleep disordered breathing and bruxisms, and that analysis of apneas and hypopneas and clenching events in both supine and lateral decubitus sleeping positions may be helpful.

Support (If Any): Seoul Sleep Center
THREE GROUPS

**Introduction:** The phenomena of periodic cycles of vascular engorgement on the nasal cavity mucosa that alternate between right and left sides are termed the “nasal cycle.” It has been reported that the reversal of cyclic phase during sleep(RCS) tended to be associated with REM sleep and postural changes by Kimura et al. In addition, they also reported that RCS never occurred in slow-wave sleep. In this study, we evaluated the relationship between nasal cycles during sleep and obstructive sleep apnea(OSA).

**Methods:** We utilized the portable rhinoflowmeter measuring airflow independently through each nostril on 79 subjects with OSA aged 26 to 74 years diagnosed by polysomnography.

**Results:** Thirty-nine of 79 (49.4%) subjects presented RCS. RCS occurred in stageW(56.7%), stage1(14.4%), stage2(11.3%), stage3(0%), and stage REM(17.5%). Forty-nine of 97 (50.5%) reversals occurred associated with postural changes.

**Conclusion:** According to the study done by Kimura et al, RCS tended to be associated with REM sleep(68.8%) and postural changes(18.8%) in healthy subjects. In OSA subjects, it was 17.5%, 50.5% each. So, RCS that was associated with postural changes was increased and REM sleep was decreased in OSA subjects. As AHI rose, RCS slightly became hard to occur. It was considered that OSA patients present entirely different nasal cavity physiology from healthy subjects.

**Support (If Any):** Non

**0435**

**THE RELATIONSHIP BETWEEN NASAL CYCLES DURING SLEEP AND OSA**

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**Introduction:** Patients with simple snoring (SS) often complain of poor sleep quality despite normal apnea-hypopnea index (AHI). We aimed to identify the difference of sleep electroencephalography (EEG) spectral power between patients with SS and obstructive sleep apnea (OSA).

**Methods:** Power spectral analysis was performed using SpectralTrainFig which was developed by the National Sleep Research Resource. We compared the absolute power values in standard frequency bands of the EEG spectra during the first Non-Rapid Eye Movement (NREM) sleep period between SS (n = 42) and OSA (n = 129) groups after controlling age and sex.

**Results:** The absolute spectral power in beta (15-20 Hz, F = 7.64, p = 0.006, p corrected = 0.036) and delta (1-4 Hz, F = 10.54, p = 0.001, p corrected = 0.006) bands during NREM sleep was higher in OSA group than in SS group. The AHI was positively associated with absolute beta power in the OSA group (r = 0.251, p = 0.004, p corrected = 0.027) and total participants (SS + OSA; r = 0.340, p < 0.001, p corrected < 0.001).

**Conclusion:** Higher beta power in OSA group and positive correlation between beta power and AHI were as expected, since OSA is considered as more severe sleep disorder than SS. However, higher delta power in OSA than in SS is somewhat unexpected. The lower delta power in SS group is presumed to be the cause of subjective sleep quality deficits in these patients.

**Support (If Any):** This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF-2011-0013991).

**0437**

**DIFFERENCES OF ELECTROENCEPHALOGRAM ACTIVITY DURING NONRAPID EYE MOVEMENT SLEEP BETWEEN OBJECTIVE AND SUBJECTIVE DAYTIME SLEEPINESS IN SLEEP APNEA PATIENTS**

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**Introduction:** Objective and subjective measures of excessive daytime sleepiness (EDS) appear to be related to different underlying mechanisms and clinical outcomes in sleep apnea patients (OSA). Delta electroencephalogram (EEG) power, an index of slow wave sleep, appears to be associated with physiological sleep propensity while high-frequency EEG activity (i.e., beta EEG power) is an index of cortical hyperarousal. We examined whether the patterns of relative EEG power differ in OSA patients with objective vs. subjective EDS.

**Methods:** We studied 43 OSA patients (55.80±6.27, 51.2% male) who underwent 8-hour in-lab polysomnography for 4 consecutive nights. We examined delta (0.39-3.91 Hz), low-beta (15.23-25.00 Hz) and high-beta (25.39-35.16 Hz) relative power at central EEG derivations during nonrapid eye movement (NREM) sleep. The mean values of 2nd and 3rd nights of EEG relative power were used. Objective EDS was defined as mean multiple sleep latency test values ≤ 8 minutes, while subjective EDS was defined as Epworth scale score > 10.

**Results:** After adjusting for age, gender and apnea-hypopnea index (AHI), OSA with objective EDS had significantly higher relative delta power during NREM sleep compared to OSA without objective EDS (82.5±2.69 vs. 76.0±1±43, p=0.045), while OSA with subjective EDS had significantly higher relative low-beta (1.95±0.15 vs. 1.37±0.15, p = 0.010) and marginally significantly higher high-beta power (0.56±0.05 vs. 0.44±0.05, p=0.072) during NREM sleep compared to OSA without subjective EDS. Furthermore, OSA patients with objective EDS had significantly higher relative delta power (81.02±2.23 vs. 74.66±1.78, p=0.046) and lower relative low-beta power (1.38±0.24 vs. 2.08±0.19, p=0.043) during NREM sleep compared to those with subjective, but not objective EDS, after adjusting for age, gender and AHI.

**Conclusion:** Our findings suggest that OSA with objective EDS is associated with higher levels of physiological sleep propensity which may be associated with impaired arousal mechanisms whereas subjective complaint of daytime sleepiness/fatigue is associated with cortical arousal during NREM.

**Support (If Any):** NIH RO1 HL64415
B. Clinical Sleep Science and Practice

0438
UPPER AIRWAY ANATOMICAL DIFFERENCES BETWEEN CHINESE AND CAUCASIAN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: This study aimed to evaluate upper airway soft tissues and craniofacial structures differences between Chinese and Caucasian patients with obstructive sleep apnea (OSA).

Methods: Airway sizes, soft tissue volumes and craniofacial structures and craniofacial structures differences between Chinese and Icelandic, Reykjavik, Iceland.

When compared to Caucasian patients, Chinese patients had bigger soft palates which likely contributes to the smaller airway dimensions quantified using three-dimensional magnetic resonance imaging (MRI) were compared between Caucasians (N=134) and Chinese (N=67) patients with moderate-severe OSA (AHI≥15 events/hour) matched for age and gender. Analyses were performed using mixed effects models.

Results: When compared to Caucasian patients, Chinese OSA patients had similar age (49.61±9.78 vs. 49.62±9.72 years, p=0.8702), lower BMI (28.0±3.5 vs. 33.46±5.67 kg/m², p<0.0001) and no significant difference in AHI (45.68±21.54 vs. 41.3±15.78 events/hour, p=0.0959); smaller RP airway mean cross-sectional area (80.78±37.82 vs 147.3±62.8 mm², p<0.0001) which may be contributed by bigger soft palate (11240±3422 vs 9801±2267 mm³, p<0.0001), but smaller combined soft tissues (176849±27366 vs 205002±33818 mm³, p<0.0001); bigger ANB angle (5.26±3.13 vs 2.93±2.66, p<0.0001), different shaped mandibular including shorter mandibular corpus length (78.56±4.82 vs 94.41±6.60 mm, p<0.0001) but longer mandibular ramus length (66.40±5.75 vs 45.36±6.51mm, p<0.0001), and wider (width first molar 48.7±2.79vs 45.21±3.02 mm, p<0.0001) and shallower (unit depth 44.47±4.11 vs 47.57±3.96 mm, p<0.0001) maxillary. These findings remained after controlling age, AHI, height or age, AHI, BMI.

Conclusion: When compared to Caucasian patients, Chinese patients had bigger soft palates which likely contributes to the smaller airway dimensions.

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0439
VENTILATORY RESPONSE TO EXERCISE TESTING IS PRESERVED IN PATIENTS WITH OBESITY HYPOVENTILATION SYNDROME
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Introduction: A decreased ventilatory response to hypoxia and hypercapnia is a common finding in patients with obesity hypoventilation syndrome (OHS). We aimed to test the hypothesis that exercise ventilatory response is also damaged in OHS patients.

Methods: Eleven patients with OHS, twenty-three obese patients with moderate-to-severe OSA and twenty obesity subjects without OSA performed incremental cycle exercise. Oxygen consumption (VO2), ventilation (VE), ventilatory equivalents for oxygen (VE/VO2) and carbon dioxide (VE/VCO2), as well as slope of VE/VO2 and VE/VCO2 were measured.

Results: The VO2 response to exercise was comparable among the three groups. The slope, the nadir as well as end-exercise of VE/VO2 and VE/VCO2 were not significantly different among the three groups.

Conclusion: Ventilatory response to exercise testing is preserved in patients with OHS. This may reflect different ventilatory regulation mechanisms during sleep and exercise for patients with OHS.

Support (If Any):

II. Sleep-Related Breathing Disorders

0440
A MODEL TO EVALUATE THE CONTRIBUTION OF PATHOPHYSIOLOGICAL PHENOTYPES TO OSA SEVERITY AND DEVELOP SIMPLIFIED APPROACHES TO ESTIMATE THE KEY PHENOTYPIC TRAITS THAT CONTRIBUTE TO OSA
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Introduction: This study aimed to determine if a predictive model could be used to accurately classify obstructive sleep apnea (OSA) severity level (i.e. mild=AHI<15, moderate=AHI 15-30 and severe=AHI>30 events/h) using gold standard physiological measurements of the 4 pathophysiological phenotypes that contribute to OSA (Aim 1). We also investigated whether the 4 pathophysiological phenotypes can be estimated from standard anthropometric, demographic and polysomnographic variables (Aim 2).

Methods: Anthropometric, demographic and polysomnography parameters from a standard diagnostic study (off CPAP) were collected in 52 CPAP-treated OSA patients. The 4 key OSA phenotypes: 1) upper-airway collapsibility (Pcrit), 2) arousal threshold, 3) loop gain and 4) pharyngeal muscle responsiveness were also quantified in these individuals using gold-standard upper airway physiology methodology on a separate night. Principal component analyses and machine learning techniques were used to address the study objectives.

Results: Principal component analyses using the 4 OSA phenotypes showed linear separability with the first two components. This enabled development of a model to classify obstructive sleep apnea severity defined according to total AHI with up to 93% accuracy (95% sensitivity, 90% specificity) from the phenotypes. In addition, using polysomnographically-derived parameters plus anthropometric and demographic variables, the model was able to predict physiologically-determined Pcrit with 80%, arousal threshold with 83%, loop gain with 57% and muscle responsiveness with 67% accuracy respectively.

Conclusion: These findings indicate that OSA phenotypes are important contributors to polysomnographically defined OSA severity levels. In addition, these findings highlight the potential for routine sleep study and clinical data to estimate OSA phenotypes, which may be helpful as part of a clinical decision support system to inform targeted treatment for OSA.
We have previously reported that subjective excessive daytime sleepiness (EDS) is associated with poor sustained attention in patients with sleep apnea (OSA) patients. In this study we examined whether high-frequency oscillation in the electroencephalogram (EEG) activity during sleep mediates the association between subjective EDS and sustained attention in OSA.

**Methods:** We studied 43 OSA patients (55.80±6.27, 51.2% male) who underwent 8-hour in-lab polysomnography for 4 consecutive nights. We examined low-beta (15.23-25.00 Hz) and high-beta (25.39-35.16 Hz) relative power at central EEG derivations during nonrapid eye movement sleep (NREM). The mean values of 2nd and 3rd nights of relative EEG power were used. Epworth scale score (ESS) was used to assess subjective EDS whereas PVT was used to assess sustained attention levels.

**Results:** After adjusting for age, gender and AHI, higher values of ESS were significantly associated with increased relative low-beta power during NREM sleep (standardized β=0.38, p=0.014). Furthermore, increased relative low-beta power during NREM was significantly associated with lower values of median of 1/RTs while adjusting for age, gender and apnea-hypopnea index (standardized β=-0.42, p=0.007). Mediation analysis revealed that 30.6% of the association between ESS and median of 1/RTs was mediated by relative EEG low-beta power during NREM sleep (β=-0.42, p=0.007).

**Conclusion:** Our findings suggest that increased high-frequency EEG activity during NREM sleep mediates the association between subjective EDS and poor sustained attention in patients with OSA. Cortical hyperarousal maybe one of the underlying mechanisms of the association between subjective complaint of sleepiness/fatigue and poor sustained attention in OSA.

**Support (If Any):** NIH ROI 1HL64415

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**SLEEP BRUXISM PROTECTS THE AIRWAY**

**Introduction:** Sleep bruxism (SB) presents a perplexing process with a controversial etiology. Many claim SB results from malocclusion and occlusal interferences, however, many patients do not display these features. A relationship between SB and OSA has been claimed but most studies have not provided an etiological link to an underlying mechanism. We have previous reported that SB provides airway protection via mandibular stabilization, protecting the upper-airway, in patients with a propensity for upper-airway obstruction. The present study investigates this hypothesis, noting an inverse association between SB and upper-airway obstruction in patients with extensive SB by history and exam.

**Methods:** PSG studies were selected in patients with SB and in whom nasal esophageal pressure monitoring (Pes) was performed and EMG collected from temporalis, masseter and submental regions bilaterally utilizing various referencing methods. All stage-N2 epochs were evaluated and tabulated for presence of SB and airway obstruction (based on elevated Pes levels). All N2-Epochs were then categorized as follows: Inverse Pes/Brux pattern (INV) then subdivided into Inverse with Brux (IB) or Inverse with Obstruction (IO) groups, and Non-Inverse Pes/Brux pattern (NONI) subdivided into Both present (NB) or Neither present (NN).

**Results:** There was an average of 239 epochs per study (+/- 27) of stage N2 sleep, 74% (+/- 14) of the epochs demonstrating INV. Only 67% of the patients demonstrated a predominantly IB pattern. In those patients, 64% of the INV showed IB with 36% showing IO. In 33% of the patients this bruxing predominance of IB epochs were not identified.

**Conclusion:** An inverse relationship between SB and upper-airway obstruction exists in many, but not all, SB patients. Characterizing this relationship is problematic, with limited objective airway monitoring methods. The Pes assists in overcoming this difficulty. Standard EMG montage is insensitive and better monitoring methods were used in our study, including temporalis muscle and mastoid references. Clinically we recognized that treatment of mild OSA improves TMD symptoms in those affected. Characterizing the etiology of SB will bring validity and acceptance in treating the airways of these patients even without a classic OSA presentation.

**Support (If Any):** NIH RO1 HL64415

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**AROUSAL DURATION IS A TRAIT IN SLEEP APNEA**

**Introduction:** Several features of the polysomnogram in patients with obstructive sleep apnea have strong trait-like characteristics. They include upper airway collapsibility, arousal threshold, loop gain, the upper airway negative pressure response, REM vs. NREM dominance of apnea, sleep depth post-arousal, and sleep fragmentation propensity. Arousal counts dominate clinical practice but arousal duration may have information on sleep quality and trait sleep fragmentation propensity.

**Methods:** Split night polysomnograms performed at the Beth Israel Deaconess Medical Center affiliated sleep laboratories were scored for arousal duration, besides standard scoring metrics. Arousal duration for this analysis was defined at the time to the first slow oscillation (not time to any feature of sleep). This included the first K-complex post arousal or a slow wave with at least the following characteristics: 0.5 Hz and 50 microvolts amplitude. Statistical analysis compared the diagnostic and treatment (CPAP) components. Intra-class coefficients were generated for several measures.

**Results:** The population characteristics included age: 51 +/- 12.2, 113 male, and BMI 34.6 +/- 3.5. Total sleep time for diagnostic and titration components was 126 +/- 51.6 and 225.6 +/- 105.6 minutes; sleep efficiency 71.7 +/- 17.2 and 74 +/- 18 , respectively.

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**SLEEP, Volume 42, Abstract Supplement, 2019**
Introduction: Obstructive sleep apnea (OSA) is a frequent cause of morbidity associated with hospitalization. Recently, we reviewed experience with an inpatient sleep screening program, finding a high proportion of OSA. It is well known that hospital and general medical histories often do not include sleep related histories. We explored the factors in the recorded histories associated with having an inpatient screening test.

Methods: Charts of 61 hospitalized adult patient who had undergone inpatient OSA screening (Morpheus®) were reviewed. We hypothesized that patients in whom OSA screening was performed would have a high proportion of specific OSA related history recorded in the chart.

Results: The following symptoms/medical conditions associated with OSA were found on chart review of 61 patients as follows: snoring; 80%; excessive sleepiness; 73%; witnessed apneas; 63%; observed nocturnal desaturations; 38%; and observed hypercapnia. The following did predict OSA: past history of OSA (p=.014), a positive sleep screening: having at least one sleep symptom/sign recorded, and a history of snoring was a borderline predictor (p=.053).

Conclusion: Documentation of sleep apnea related history is generally poor in hospitalized patients, even those who had sleep apnea screening. Standardized screening tools are rarely used for inpatients. The reasons for OSA screening are not always clear. Protocols for hospitalized patients for screening for OSA should be standardized.

Support (If Any): None

0446
SCREENING FOR OBSTRUCTIVE SLEEP APNEA IN THE YOUNG ADULT POPULATION
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Introduction: Existing obstructive sleep apnea (OSA) screens have been validated to detect moderate-to-severe OSA. Severe disease comorbidity focuses screens on a sensitive detection of moderate-to-severe OSA for urgent treatment. For the young adult population with predominantly mild-to-moderate OSA, we propose a screening strategy focused on the specific detection of all OSA to conserve healthcare costs. We applied the Berlin, STOPBANG, Four Variable and NAME2 as well as pre-test probability (PTP) for symptoms of hypertension, elevated neck circumference and snoring in a cohort of sleep center patients 18-39 years of age with predominantly mild-to-moderate OSA.

Methods: Using data collected at the initial clinic encounter we calculated PTP for four PTP tools and four presenting symptoms. All patients had in lab polysomnography scored using the 2007 AASM criteria. We calculated sensitivity, specificity, positive predictive value (PPV), area under receiver-operator characteristic curves (AUROC) and the diagnostic odds ratios (DOR).

Results: There were 141 patients who had data available for analysis. The mean age and BMI were 30.8 ± 6.2 and 28.9 ± 5.6 respectively, and the mean Epworth Sleepiness Sore (ESS) was 12.0 ± 5.3. The mean AHI was 8.1 ± 14.4, and 56 patients (40%) had an AHI ≥ 5 and were considered positive for OSA. Of those with OSA, 63% had mild-to-moderate disease. For the
B. Clinical Sleep Science and Practice

Berlin, STOPBANG (positive at ≥ 3), Four Variable (positive at ≥ 9) and NAMES2 PTP tools, sensitivities ranged from 85.2-94.6%, specificities from 23.5-32.9%, PPV from 44.2-46.4%, AUROC from 0.59-0.61 and DOR from 2.6-5.4. The combined symptom set of snoring, hypertension by self-report on STOPBANG and elevated neck circumference (> 17 inches for men, ≥ 16 inches for women) resulted in 13% sensitivity, 99% specificity, 88% PPV, AUROC of 0.557 and DOR of 12.

Conclusion: In the young adult population with predominantly mild-to-moderate OSA, existing PTP tools perform with poor specificity, positive predictive value and diagnostic odds ratio. The combined symptom set of snoring, hypertension and elevated neck circumference, suggests high specificity and an improved DOR for OSA in the young adult population.

Support (If Any):

0447
ASSESSING THE PERFORMANCE OF BILLING CODES TO IDENTIFY PATIENTS WITH CENTRAL SLEEP APNEA FROM THE ELECTRONIC MEDICAL RECORD
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Introduction: Research on central sleep apnea (CSA) has often relied on International Classification of Disease (ICD) billing codes. However, the accuracy of this approach has not been evaluated. We aimed to assess the validity of an ICD code approach for identifying patients with CSA.

Methods: We evaluated the validity of CSA ICD codes in a sleep and cardiovascular disease cohort of 5,181 patients aged ≥18 years. Patients were selected into this cohort if they underwent an in-lab diagnostic sleep study in one of six University of Pittsburgh Medical Center sleep laboratories between 01/2004 and 12/2017 and either right heart catheterization or echocardiography. ICD diagnosis of CSA was based on ICD-9 codes 327.21, 327.27 and 786.04 or ICD-10 codes R66.3, G47.31, and G47.37. Medical records including all sleep study reports as well as inpatient and outpatient clinical notes were extracted and reviewed by two physicians in all 101 patients with a CSA ICD code and a random sample of 135 patients without a CSA ICD code in order to verify CSA status.

Results: Among the 101 patients with a CSA ICD billing code, a CSA diagnosis was confirmed in 62 patients for a positive predictive value of 61.4%. Among the 135 patients without a CSA ICD billing code, a CSA diagnosis was excluded in 131 patients for a negative predictive value of 97.0%. After accounting for sampling probabilities, the sensitivity and specificity of CSA based on presence of a CSA ICD billing code were 29.2% and 99.2% respectively.

Conclusion: The sensitivity and specificity of CSA based on presence of a CSA ICD billing code was 29.2% and 99.2% respectively. Among the 135 patients without a CSA ICD code, a CSA diagnosis was excluded in 131 patients for a negative predictive value of 97.0%

Support (If Any):

0448
GUPTA SCORE OF THE OROPHARYNGEAL AIRWAY TO PREDICT THE SEVERITY OF OBSTRUCTIVE SLEEP APNEA - AN ORIGINAL RESEARCH STUDY.
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Introduction: Estimating the severity of obstructive sleep apnea using a clinical score of the oropharyngeal airway which is more accurate than the Modified Mallampati Classification.

Methods: Retrospective review of consecutive adult patients presenting to a community-based sleep clinic for evaluation over a period of one year. Each patient underwent a diagnostic polysomnogram in an AASM accredited sleep center. Patient demographic data including age, neck size, BMI, gender, Epworth sleepiness scale along with the Modified Mallampati Class (MMC) was recorded at the initial visit and compared to the apnea-hypopnea index (AHI) reported on the polysomnogram. Initially a standard MMC was noted on clinical exam. Immediately thereafter, the patient was asked to take a single breath in through the nasal route only. The change in MMC (if any) was recorded as a corrected score. This was named the Gupta Score (GS).

Results: A total of 198 patients (108 male) undergoing diagnostic polysomnogram were included. Age 19-86, BMI 18-72.8, Neck size 12.5”-22”, Epworth 0-23, and AHI 0-122 events/hour. 97 patients were diagnosed with obstructive sleep apnea (OSA). Data demonstrated that patients fell into the following MMC classifications. MMC I=19 patients with mean AHI=25.98, MMC II=65 patients with mean AHI=36.43, MMC III=17 patients with mean AHI=46 and MMC IV=2 patients with mean AHI=41.2. Data from the Gupta Score were as follows. GS I=1 patient with mean AHI=5.8, GS II=10 patients with mean AHI=19.39, GS III=65 patients with mean AHI=36.45, GS IV=27 patients with mean AHI=43.23.

Conclusion: Modified Mallampati classification is not a useful tool in clinical assessment to predict severity of obstructive sleep apnea. The Gupta Score increases the probability of diagnosing a patient with obstructive sleep apnea and its severity as indicated by this study. Incorporating the Gupta score in the routine clinical exam across various medical specialties may result in a greater number of patients being diagnosed and treated for obstructive sleep apnea.

Support (If Any): None.

0449
COMPARING DEEP FEATURE REPRESENTATIONS TO IMPROVE ROBUSTNESS TO SUBJECT VARIATION IN SORNE DETECTION
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Introduction: Snoring is an indicator of obstructive sleep apnea (OSA), which contributes to cardiovascular disease and mortality. To better study snoring, audio-based snore detection methods using different feature representations have been proposed. However, there is a gap in (1) baseline comparisons of different deep learning features, and (2) analysis of the robustness of snore detection in the presence of subject variation. Through an ablation study, we quantified the effect of features. As a measure of robustness to subject variation, we employed a leave-one-subject-out scheme.

Methods: We used 1D raw signals or 2D Mel-frequency-cepstrum-coefficients (MFCC) of the signals as inputs to fully connected, convolutional, long-short-term-memory (LSTM) cell-based recurrent, very deep networks (VGG) or combinations of them. The classifiers were support-vector-machines (SVM) or neural networks. The ablation study consists of seven modular combinations of the elements mentioned above. For training, we used 8,207 snore and non-snore 5s- segments from the snore channel of polysomnography (PSG) data obtained from 19 subjects. A leave-one-subject-out
scheme, in which each subject is tested using the training data from other subjects, is used to simulate subject variation. We then measure the variation in performance (F1-score) over different subjects using the standard deviation (SD).

**Results:** Features learned from 2D convolutional, LSTM, and very deep network (VGG) significantly improve the classification accuracy and robustness of snore detection. Applying these findings, we developed a 2D convolutional LSTM network model that combines spectral and temporal features, resulting in the highest accuracy (mean F1-score = 0.8812) and the second-best robustness. Very deep convolutional networks (VGG-SVM) have the most robust performance (SD of F1-score = 0.0568).

**Conclusion:** We provide a baseline comparison to understand the effect of feature representation on snore classification. Besides accuracy, we introduce robustness as another performance metric. Methods with the best accuracy do not necessarily give the best robustness. Features extracted from 2D-convolutional and LSTM network results in the best accuracy, but those from very deep convolutional networks (VGG) have the best robustness.

**Support (If Any):** Supported by Philips Respironics.

### 0450

**A RETROSPECTIVE ANALYSIS OF 124 PATIENTS WITH OBSTRUCTIVE SLEEP APNEA BY DRUG-INDUCED SLEEP COMPUTED TOMOGRAPHY**

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**Introduction:** To explore the guiding significance of anesthetic-induced sleep in the clinical diagnosis of obstructive sleep apnea syndrome (OSAS).

**Methods:** A total of 124 patients with OSAS aged between 18 and 66 years old, who were performed operation in our hospital from October 2016 to July 2018, were enrolled in this study. The upper airway was scanned by computed tomography (CT) while they were awake and during the sleep apnea. Sleep was induced by dexmedetomidine under electrocardiograph and oxymoglobin saturation monitoring. Data including cross-sectional area and length of the posterior region of the soft palate, the posterior region of the tongue, and the posterior region of the epiglottis were then collected.

**Results:** Of 124 patients, none of them were suffering emergency or dangerous complications during sleep in CT room. 122 patients occurred occlusion or stenosis in upper airway. Among all of those, there were 119 stenosis occurring in oropharynx, accompanied by 5 cases of stenosis or occlusion retroglossal area. Meanwhile, none was found stenosis behind epiglottis. Moreover, we also found 38 (30.67%) cases of deviation of nasal septum with retropalatal problems. Only 2 patients had no changes in upper respiratory tract before and during the sleep. A about 61.33% patients had multi-level obstructions and the most common obstructive site was oropharynx (90.67%), including only retropalatal area stenosis 66 (53.33%) and accompanied tonsillar hypertrophy 46 (37.33%).

**Conclusion:** The drug-induced sleep computed tomography (DI-SCT) examination is a safe and non-invasive method for diagnosing the obstructive sites in OSAS patients. The DI-SCT is good for diagnosing multiple obstructions, which occur mostly on severe OSAS patients. The oropharyngeal obstruction usually compares with nasal stenosis, which can be detected by DI-SCT.

**Support (If Any):**
**B. Clinical Sleep Science and Practice**

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**Introduction:** Moderate-to-severe obstructive sleep apnea (OSA) afflicts more than 6% of US adults and bears a significant risk of long-term cardiovascular morbidity and mortality if untreated. Since 80% of such cases are undiagnosed, a simple reproducible physical examination screening method would prove useful. The most utilized exam features currently - BMI, neck circumference measurement, and Friedman palate score - are of limited diagnostic utility, as they focus on obesity, rather than on pathologic craniofacial anatomy. Our group previously has reported that the SCPTC maneuver has high predictability in identifying patients with moderate-to-severe OSA. This exam feature (http://csmaclinic/chinpress.htm) can be incorporated into routine physical exams performed by physicians, dentists, and other healthcare professionals to improve identifying patients with OSA.

**Methods:** All steps are performed with the patient supine. (1) The patient is instructed to close the mouth, put the teeth into a normal occlusion, and breathe through the nose for several respiratory cycles. This establishes the baseline condition. (2) The patient is instructed to relax the jaw, tongue, and muscles in the back of the throat while the examiner guides the mandible posteriorly (chin press) and holds it in place. The patient then performs several respiratory cycles. Obstruction is compared to the baseline condition and scored as 0 (no change), 1+ (increased resistance without airway collapse), or 2+ (collapse observed during the respiratory cycle, either on inhalation or exhalation). (3) Step 2 is repeated, but this time the patient first is instructed to touch the hard palate with the tip of the tongue and then curl it back as posteriorly as possible.

**Results:** Patients with SCPTC scores of ≥ 3 had an odds ratio of 2.7 (CI 1.478-4.930, p = 0.001) of moderate-to-severe OSA, with sensitivity of 72%.

**Conclusion:** SCPTC is an easy, reproducible objective physical exam finding that can be used to screen adults for moderate-to-severe OSA.

**Support (If Any):** N/A

**0453**

**COMPARING THREE HOME SLEEP APNEA TESTING DEVICES TO POLYSOMNOGRAPHY: ASSESSING RESPIRATORY, SLEEP-WAKE, AND BODY POSITION DATA**

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**Introduction:** We previously compared 3 Home Sleep Apnea Test (HSAT) devices with PSG for evaluating obstructive sleep apnea (OSA). This study is an update with increased patient sample size comparing various metrics including respiratory and sleep-wake data.

**Methods:** Patients were eligible if referred for suspected OSA and HSAT-appropriate. Participants wore three HSAT devices simultaneously for three nights: 1) Device N (Nox T-3; Nox Medical); Device A (ARES; SleepMed, Inc); Device W (WatchPAT, Itamar Medical). Nights 1 (N1) and 2 (N2) were performed at home; Night 3 (N3) was performed simultaneously with PSG. Comparison of respiratory, oximetry, sleep-wake and position metrics were performed for N3. Other analyses based on N1 and N2 are reported separately.

**Results:** 88 (44 women; 47±12 years) patients enrolled; 83 completed N3 testing with PSG.

- **Respiratory:** REI4% vs AH14% showed excellent agreements (reported as R, P value; BlandAltman mean difference, 2SD): “A” (0.96, p<0.01; -2.4, 19.9), “N” (0.97, p<0.01; 0.3, 15.7), “W” (0.91, p<0.01; -1.2, 28.3). RDI showed good correlations but HSAT trended lower than PSG: “A” (0.90, p<0.01; -11.0, 35.0), “W” (0.86, p<0.01; -13.3, 39.3). “N” does not report RDI. REI13% vs AHI1(AASM) also showed excellent agreements: “A” (0.97, p<0.01; -4.6, 19.2), “N” (0.97, p<0.01; -4.0, 17.1). “W” REI13% was not analyzed due to data loss.

- **Oximetry:** Correlation was good for ODI, T90%, and Min Sat (R-ODI, R-T90%, R-Min Sat): “A” (does not report ODI, 0.75, 0.60); “N” (0.99, 0.84, 0.57); “W” (0.93, 0.82, 0.64). All correlations had p<0.01.

- **Sleep:** “W” performed the best although overall correlations (R-TST, R-sleep efficiency, R-%REM) were weaker than respiratory comparisons: “A” (0.58, 0.61, 0.12); “N” (0.48, 0.19, does not report REM); “W” (0.64, 0.68, 0.54). All except 0.19 and 0.12 were statistically significant.

**Conclusion:** HSAT demonstrates good agreement with PSG, particularly for respiratory and oximetry data, further strengthening our conclusion that HSAT is reliable for evaluation of OSA.

**Support (If Any):** N/A

**II. Sleep-Related Breathing Disorders**

**0454**

**COMPARISON OF HOME SLEEP APNEA TESTING AND IN-LABORATORY POLYSOMNOGRAPHY AT A SINGLE ACADEMIC OUTPATIENT SLEEP CENTER**

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**Introduction:** Home sleep apnea testing (HSAT) is increasingly used to screen for and diagnose obstructive sleep apnea (OSA). While this approach has many advantages (patient convenience, access, potential cost-effectiveness), in-laboratory attended polysomnography (PSG) remains the gold standard for diagnosing sleep disordered breathing. Particularly in cases of borderline HSAT results (such as with respiratory event index (REI) between 5.0 and 10.0), recognizing the limitations of HSAT, including false positive rates and grading of OSA severity, better informs sleep providers’ ability to correctly interpret results and recommend appropriate treatment options.

**Methods:** At risk patients for sleep disordered breathing, who had an ambulatory (type II) home sleep study with a REI between 5.0 and 10.0, followed by an in-laboratory diagnostic polysomnogram were identified retrospectively at a single academic outpatient sleep center. The REI from the home sleep study was then compared to the RDI (respiratory disturbance index) from the polysomnogram. Patient demographics were also analyzed to ascertain characteristics that may increase likelihood of inaccurate HSAT results.
Results: Of 31 patients who were identified as having a REI between 5 and 10 respiratory events per hour, followed by an in-laboratory polysomnogram, 21 (68%) were confirmed to have OSA (6 mild; 10 moderate; 5 severe). Ten patients did not have OSA, representing a potential false negative rate of 32%. Additionally, male sex and BMI ≥30 kg/m², were associated with higher positive predictive values (0.71 and 0.75) compared to female sex and BMI < 30 kg/m² (0.6 and 0.64).

Conclusion: HSAT offers patients who are at risk for OSA several potential benefits compared to traditional PSG. However, HSAT resulting in a REI between 5.0 and 10.0, can be falsely positive in up to 32% of patients leading to incorrect diagnosis and costly, unnecessary treatments. Therefore, a dedicated in-laboratory attended PSG in patients with a borderline REI of 5.0 to 10.0 respiratory events per hour is strongly recommended.

Support (If Any): Not applicable.

0455 COMPARING THREE HOME SLEEP APNEA TESTING DEVICES TO POLYSOMNOGRAPHY: EVALUATING DIAGNOSTIC PERFORMANCE IN POOR SLEEPERS

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Introduction: We previously demonstrated excellent diagnostic performance between 3 HSAT devices compared to PSG for the evaluation of obstructive sleep apnea (OSA). However, HSAT relies on estimated sleep time and thus reliability in patients with poor sleep is unclear. This study specifically evaluates HSAT diagnostic performance for OSA in poor sleepers and those with likely insomnia.

Methods: Patients were eligible if referred to Kaiser Permanente Sleep Center (Fontana, CA) for suspected OSA and HSAT-appropriate. Participants wore 3 HSAT devices simultaneously with PSG: Device N (Nox T-3; Nox Medical); Device A (ARES; SleepMed, Inc); Device W (WatchPAT, Itamar Medical). We identified 2 subgroups with poor sleep or with likely insomnia: 1) PSG with Sleep Efficiency (SE) ≤ 70%, 2) Patients reporting ≤ 5 hours of sleep on questionnaire. Diagnostic performances were compared.

Results: "SE ≤ 70% Cohort": 11 patients (7 women, 4 men; 53±14 years) underwent successful testing. REI4% vs AH14% showed excellent agreement (reported as R, P value; BlandAltman mean difference, 2SD): “A” (0.92, p<0.01; -4.7, 28.4), “N” (0.84, p<0.01; 1.1, 25.9), “W” (0.88, p<0.01; -1.1, 25.1). % of patients with OSA(REI≤5)/ moderate-severe OSA(REI≥15) were “A” 75/50%, “N” 82/45%, “W” 100/56% and generally demonstrated higher diagnostic yields than PSG 82/45%.

"≤ 5 Hours of Sleep Cohort": 17 patients (8 women, 9 men; 48±12.2 years) underwent successful testing. REI4% vs AH14% showed excellent agreement (reported as R, P value; Bland Altman mean difference, 2SD): “A” (0.95, p<0.01; -11.0, 25.1), “N” (0.96, p<0.01; -5.8, 16.6), “W” (0.91, p<0.01; -2.2, 24.7). % of patients with OSA/moderate-severe OSA were “A” 92/62%, “N” 80/60%, “W” 92/62% versus PSG 82/65%.

Conclusion: HSAT diagnostic performance in poor sleepers or those with likely insomnia is excellent when compared directly to PSG. HSAT does not under-diagnosing OSA despite relying on estimated sleep time to calculate respiratory indices.

Support (If Any): N/A

0456 FALSE NEGATIVE HOME SLEEP APNEA TESTING- AN IMPORTANT CONCEPT TO PREVENT MISDIAGNOSIS IN PATIENTS WITH UNDERLYING SLEEP APNEA

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Introduction: The current gold standard for a definitive diagnosis of OSA is an overnight Polysomnography (PSG). One of the limitations of the study is the lack of Electroencephalographic (EEG) data. This prevents the inclusion of RERAs in the diagnosis of Sleep Apnea. The results of this preliminary analysis serves as the foundation to elucidate whether subtle changes in breathing patterns recorded during a sleep study are reflected in changes in cortical activity.

Methods: 0 Patients in this study were those that underwent HSAT from February of 2017 till September of 2018. The studies read by a single Sleep expert were selected for this study. Only those patients whose REI in their HSAT less than 5 were included in this study. All these patients had multiple airflow fluctuations in their HSAT that raised the suspicion for the presence of RERAs. Those patients with REI of less than 5 and did not have airflow fluctuations were excluded from the study. Of the 111 patients selected, only 43 patients underwent subsequent polysomnogram at the time of the study. Of the 43 patients, 29 of them were eventually diagnosed with sleep apnea while 14 patients did not end up with the diagnosis of sleep apnea.

Results: Patients who underwent HSAT from February of 2017 till September of 2018 were chosen. Only those patients whose Respiratory Event Index less than 5 were included in the study. A total of 111 patients met the inclusion criteria A total of 43 patients underwent a subsequent overnight polysomnogram in the sleep center. 68 patients did not have subsequent PSG in the sleep center. Of them 29 patients were positive with RDI greater than 5 and 14 patients were negative with RDI less than 5.

Conclusion: This study highlights the importance of analyzing the airflow and thoraco-abdominal waveforms during the HSAT interpretation to predict the possibility of underlying sleep related breathing disorder.

Support (If Any): n/a

0457 AN EFFECTIVE MODE TO PREDICT SEVERITY OF OBSTRUCTIVE SLEEP APNEA: DYNAMIC CHANGE OF AEROSPACE DETECTED BY SUBMENTAL ULTRASONOGRAPHY

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National Taiwan University Hospital, Taipei, Taiwan, 3Institute of Industrial Engineering, National Taiwan University, Taipei, Taiwan, 4Department of Research and Development, AmCad BioMed Corporation, Taipei, Taiwan, 5AmCad BioMed Corporation, Taipei, Taiwan.

Introduction: We previously reported that manually-operated submental ultrasonography (US) could be used to identify patients with severe obstructive sleep apnea (OSA). The present study aimed to test the accuracy of machine-held submental US to identify patients with different severities.

Methods: 13 healthy volunteers [apnea-hypopnea index (AHI)<5/ hr] and 51 OSA patients (AHI>5/hr) were enrolled. The pharynx was scanned for 4 seconds through hypoid bone to mandibular plane with 5-MHz convex transducers while the participants were awake and at supine position with total 84 frames of US-images obtained. Transverse diameter of pharyngeal airspace was measured for three times for tidal breathing and Müller’s Maneuver (MM). The dynamic change was defined as percentage of pharyngeal diameters shortening from the diameters upon expiration (MM). The dynamic change was defined as percentage of pharyngeal diameters shortening from the diameters upon expiration during tidal breathing to that during MM. The dynamic change was compared between OSA of different severity while multivariate logistic regression was applied to identify independent predictors. Thereafter, these independent predictors were used to estimate the probability of OSA of different severity, which was tested using the area under the receiver operating characteristic (AUROC) curve.

Results: Among 64 participants, 68.9% male, the median age was 46 y/o [interquartile range (IQR), 17.5] and body mass index (BMI) was 26.8 Kg/m² (6.7). The AHI was 0.4/hr (0.5) and 22/hr (31.6) in volunteers and OSA patients, respectively. The age (r=0.485, p<0.001), BMI (r=0.628, p<0.001), median pharyngeal diameter at MM (r=0.387, p=0.0016) and median dynamic change (r=0.622, p<0.001) were correlated with AHI. The Stepwise logistic analysis identified the median dynamic change as independent predictor for no-mild [odds ratio (OR), 1.148], moderate (1.070) and severe (1.037) OSA. The AUROC of BMI and median diameters for identifying the no-mild, moderate, severe OSA was 0.893, 0.849, 0.667, respectively.

Conclusion: Using BMI and median dynamic change of pharyngeal diameter as the indicators, the machine-held submental US could be applied to identify patients with OSA of different severity with good accuracy.

Support (If Any): AmCad BioMed Corporation, Ultrasound Images from Lung and Airway Collection and Development [106-S-C12] from Chin-Ling Center in Taiwan

Introduction: Sleep-disordered breathing (SDB) is highly prevalent among patients with spinal cord injury or disease (SCI/D). In-laboratory polysomnography (PSG) is difficult for these patients due to functional limitations and the physical construction of most sleep laboratories. Our objective was to assess whether simulated limited-channel home sleep studies could accurately diagnose SDB in Veterans patients with SCI/D.

Methods: Within a larger study, 20 Veterans with SCI/D completed one night of in-laboratory PSG. Limited-channel home sleep studies were simulated by extracting in-laboratory PSG channels to include solely the following information: nasal pressure, thermistor, thoracic and abdominal belts, and oxygen saturation. The full PSGs and limited-channel recordings were put in random order and were staged and scored by a single sleep physician.

Results: Mean age of patients was 59.50 ± 12.25 years; 85% were male, and the average BMI was 26.55 ± 4.82. The mean Apnea-Hypopnea Index (AHI) was 34.59 ± 25.23. Eighteen patients (90%) had SDB defined as AHI ≥5/hour. Simulated limited-channel home sleep studies accurately predicted SDB in 17 out of 18 patients (95%). Both negative PSG studies also yielded negative limited-channel home sleep studies.

Conclusion: In patients with SCI/D, limited-channel home sleep studies may be a viable alternative to in-laboratory PSG. Home sleep apnea testing (HSAT) may increase access to diagnostic testing; however, our study did not address the limitations of conducting limited channel studies in the home environment under unmonitored conditions. Our findings support the diagnostic accuracy of limited-channel studies in SCI/D patients. Further research on the usability of HSAT devices in this patient population is needed.

Support (If Any): VA Rehabilitation Research and Development Service (RX002116; PI Badr) and NIH/NHLBI (K24HL143055; PI: Martin)

0459 DIAGNOSTIC PERFORMANCE OF SYMPTOMLESS OBSTRUCTIVE SLEEP APNEA PREDICTION TOOLS IN CLINICAL AND COMMUNITY-BASED SAMPLES

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Introduction: Most prediction tools for obstructive sleep apnea (OSA) include patient-reported symptoms. However, symptoms may not be available in electronic medical records for widespread identification of OSA. Thus, we developed OSA predictions without patient reported symptoms using logistic regression


**B. Clinical Sleep Science and Practice**

((LOG) or artificial neural network (ANN) and validated their performance in an international clinical sample and in a community-based sample.

**Methods:** Retrospective data on 17,448 subjects who underwent polysomnography in five international sleep centers within the Sleep Apnea Global Interdisciplinary Consortium were allocated into training (n=10,469) and validation sets (n=6,979). Two models to predict the presence of OSA (Apnea Hypopnea Index ≥15 events/hour) were developed from the training set based on probabilities derived from LOG and ANN using age, gender, BMI, and ethnicity. Model performance was evaluated using the area under the curve (AUC), positive (PPV) and negative predictive values (NPV), sensitivity and specificity, and positive (+LR) and negative likelihood ratios (-LR). The predictive models were validated in the clinical sample and in the Sleep Heart Health Study (SHHS) community-based sample (n=5,761).

**Results:** In the clinical sample validation group, the LOG model had sensitivity=0.65, specificity=0.51, PPV=0.60, NPV=0.56, +LR=1.32, -LR=0.69, and AUC=0.61. The corresponding ANN values were sensitivity=0.74, specificity=0.51, PPV=0.63, NPV=0.64, +LR=1.51, -LR=0.50 and AUC=0.68. The ANN performed significantly better than LOG (p<0.05), except for specificity (p=0.90). In the SHHS validation set, diagnostic characteristics of LOG were sensitivity=0.81, specificity=0.36, PPV=0.25, NPV=0.87, +LR=1.26, -LR=0.53 and AUC=0.63. The corresponding ANN values were sensitivity=0.90, specificity=0.36, PPV=0.28, NPV=0.93, +LR=1.41, -LR=0.27 and AUC=0.72. Again, all ANN characteristics were significantly better than LOG (p<0.05), except for specificity (p=0.74).

**Conclusion:** Compared to LOG, ANN without patient reported symptoms provides improved diagnostic performance for OSA prediction in both clinical and community-based samples. The AUC of the ANN tool was higher than the one previously reported for a tool that includes symptom responses in the same SHHS cohort (STOP-BANG questionnaire). This suggests that the symptomless ANN prediction may also have utility in identifying OSA risk but future studies in other samples are warranted.

**Support (If Any):**

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**0460 DETECTING RESPIRATORY EVENTS BY RESPIRATORY EFFORT DERIVED FROM 3D TIME-OF-FLIGHT CAMERA AND SPO2**

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**Introduction:** To calculate the Apnea-Hypopnea Index (AHI), the detection of apneas and hypopneas is performed using multiple sensors of a polysomnography (PSG) such as nasal airflow and respiratory inductance plethysmography (RIP). This setup is uncomfortable and labor intensive. Therefore, we used a contactless 3D time-of-flight (TOF) camera to monitor the respiratory effort.

Using this respiratory effort and SpO2, we developed an algorithm to detect apnea and hypopnea events without the need of airflow sensors and RIP belts.

**Methods:** 3D Video-PSG was performed for 53 patients with suspected sleep apnea syndrome at Advanced Sleep Research GmbH, Berlin and Johannes Kepler University Clinic, Linz, as approved by the relevant ethical committees. The respiratory effort signal (Effort3D) was derived from the camera’s depth information over the upper body region. An Effort3D-SpO2 algorithm for detecting apnea and hypopnea events was developed wherein an event is a segment of at least 10 seconds with a substantial decrease in Effort3D and an associated 4% desaturation in SpO2. The 3DSpO2-AHI was calculated from the number of detected events and the total sleep time (TST), obtained from the PSG’s hypnogram. The intraclass correlation coefficient (ICC) with its 95% confidence interval (CI) was used to measure reliability with manually scored m-AHI according to the American Academy of Sleep Medicine (AASM) scoring manual and automatically calculated PSG-AHI from the PSG.

**Results:** The ICC for 3DSpO2-AHI versus m-AHI is 0.97 (CI: 0.95-0.98) and the median absolute difference is 4. On the other hand, the ICC for 3DSpO2-AHI and PSG-AHI is 0.91 (0.85-0.95) and the median absolute difference is 4. Between m-AHI and PSG-AHI, the ICC is 0.93 (0.88 - 0.96), and the median absolute difference is 4.

**Conclusion:** The respiratory effort derived from 3D TOF camera together with SpO2 is a promising option in detecting respiratory events as it has shown excellent reliability scores, comparable to automated-PSG and manual scoring. The contactless 3D TOF camera and SpO2 is a more comfortable alternative for overnight recordings.

**Support (If Any):** Austrian Research Promotion Agency (FFG), project ID 859622.

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**0461 PATTERNS OF TONGUE THICKNESS CHANGES IN OBSTRUCTIVE SLEEP APNEA PATIENTS: A WHOLE-NIGHT SIMULTANEOUS ULTRASOUND AND POLYSOMNOGRAPHIC STUDY**

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**Introduction:** Tongue deformation may play a critical role in the development of obstructive sleep apnea (OSA). We combined an ultrasound system with polysomnography (PSG) to simultaneously record changes in tongue thickness during a whole night’s sleep.

**Methods:** Our ultrasound system included a custom-designed curvilinear transducer. The center frequency of the probe was 3 MHz, and it had 16 channels. We placed the probe in the submental midline sagittal plane. We designed a dedicated ultrasound device to automatically detect maximum tongue thickness at a recording rate of 1 Hz. The device synchronizes with the PSG and transmits the measured data to a computer for storage. The system receives an A-line signal from each channel, determines the depth of the air-mucosal interface as the tongue thickness, and then registers the maximum tongue thickness and its channel number. We generated a “SonoPSG” report for each patient, reporting on the mean or median maximum tongue thickness and the distribution.
of the registered channels in various sleep stages as well as during various respiratory events.

**Results:** In total, the study comprised 50 patients, including 15 without OSA, 7 with mild, 14 with moderate and 14 with severe OSA. We calculated the mean maximum tongue thickness during eupnea and respiratory events according to OSA severity. A mixed-model ANOVA demonstrated a significant difference between the groups. The distribution of the registered channels in eupnea and other respiratory events showed that when eupnea and snoring occurred, most registered channels were located in the second quartile of the tongue. However, when hypopnea or apnea occurred, most registered channels shifted posteriorly toward the third quartile of the tongue.

**Conclusion:** With our novel ultrasound system, quantified tongue thickness results can be recorded during the whole night and synchronized with PSG. Future applications of our ultrasound system will involve an individualized treatment plan for each OSA patient, to verify treatment results, especially for those procedures targeting the tongue, and to investigate the pathophysiology of OSA.

**Support (If Any):** None

**0462**

**USE OF A TRANSFORMED ECG SIGNAL TO DETECT RESPIRATORY EFFORT DURING APNEA**

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**Introduction:** Apneas can be incorrectly classified as central using respiratory inductance plethysmography (RIP) effort belts. Use of chest wall EMG to detect respiratory effort (inspiratory EMG bursts) during apnea can provide complementary information about effort and improve apnea classification. However, not all sleep centers use chest wall EMG and the signal does not always exhibit inspiratory bursts. The purpose of this study was to evaluate the ability of a transformed electrocardiographic signal (TECG) recorded using standard ECG electrode placement to detect inspiratory bursts from the underlying surface chest wall electromyographic (EMG) activity and the utility of the transformed signal for apnea classification compared to uncalibrated RIP belts.

**Methods:** Part 1: 250 consecutive adult studies without regard to respiratory events were retrospectively reviewed. The ECG signal was transformed with high pass filtering and viewed with increased sensitivity and channel clipping (TECG-FC) to determine the fraction of studies with inspiratory burst visualization as compared to chest wall EMG (right thorax). Part 2: 445 consecutive studies were reviewed to select 40 with ≥ 10 obstructive and ≥ 10 mixed or central apneas (clinical scoring). Five obstructive and 5 central or mixed apneas were randomly selected from each study. A blinded scorer classified the apneas using either RIP or a transformed ECG signal (TECG-FB) using high pass filtering and QRS blanking. The agreement between the two classifications was determined by kappa analysis.

**Results:** Part 1: Inspiratory burst visualization was noted in the TECG-FC and chest wall EMG signals in 83% and 71% of the studies (p < 0.05). Part 2: The percentage agreement between RIP and TECG-FB classification was 89.5%, the kappa statistic was 0.83 (95% CI 0.79 to 0.87) and interclass correlation was 0.83 showing good agreement. Using RIP bands 116 apneas were classified as central. Of these 18 (15.5%) were classified as obstructive or mixed by the transformed ECG signals.

**Conclusion:** A transformed ECG signal can exhibit inspiratory bursts in a high proportion of patients and is potentially useful for detecting respiratory effort and apnea classification.

**Support (If Any):** None

**0463**

**VALIDATION OF A HOME SLEEP APNEA TESTING DEVICE FOR THE DIAGNOSIS OF SLEEP DISORDERED-breathing based on AASM 2012 Guidelines**

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**Introduction:** Home sleep apnea testing (HSAT) is a scalable, cost-effective way of diagnosing sleep disordered breathing (SDB) that can help address the volumes of undiagnosed patients due to limited availability of in-laboratory polysomnography (PSG) facilities. The American Academy of Sleep Medicine (AASM) in 2012 defined a hypopnea as a ≥ 30% drop in nasal air flow to pre-event baseline associated with either a ≥ 3% oxygen desaturation or an arousal. Most HSAT devices do not fully cover all aspects of the scoring rules and only score hypopneas associated with desaturations. The study aim was to evaluate the sensitivity and specificity (compared to PSG) of a new HSAT algorithm using hypopnea scoring using the AASM 2012 guidelines.

**Methods:** This was a dual-center, single-night study with simultaneous PSG and HSAT performed in 46 subjects referred to sleep laboratory for investigation of SDB. PSG studies were manually scored by a single expert sleep study scorer. The ApneaLink Air HSAT device (ResMed) uses an autoscoring algorithm that employs flow shape information and machine learning techniques to detect hypopnea associated with arousal. Studies were considered evaluable if the HSAT evaluation time was ≥ 4 hours.

**Results:** Subjects were predominantly male (65%), aged 56 ± 13 years, BMI 36 ± 8 kg/m². Apnea-hypopnea Index (AHI, events/hr) categories per PSG reports were: 5 normal (AHI < 5), 9 mild SDB (AHI 5-14), 12 moderate SDB (AHI15-30) and 17 severe SDB (AHI≥30). Per PSG, there were 2,683 obstructive, 52 mixed, and 363 central apneas, and 5,324 hypopneas. Three subjects were excluded from the analysis due to low HSAT evaluation time. Sensitivity for the HSAT algorithm was 92% and specificity was 80% for ruling in OSA. We calculated the mean maximum tongue thickness duration associated with either a ≥3% oxygen desaturation or an arousal. The American Academy of Sleep Medicine (AASM) in 2012 defined a hypopnea as a ≥ 30% drop in nasal air flow to pre-event baseline associated with either a ≥ 3% oxygen desaturation or an arousal. Most HSAT devices do not fully cover all aspects of the scoring rules and only score hypopneas associated with desaturations. The study aim was to evaluate the sensitivity and specificity (compared to PSG) of a new HSAT algorithm using hypopnea scoring using the AASM 2012 guidelines.

**Conclusion:** The results from this study suggest that the new HSAT algorithm is suitable to screen for SDB based on AASM 2012 guidelines.

**Support (If Any):** None

**0464**

**OUTCOMES OF HOME SLEEP APNEA TESTING STRATIFIED BY SPECIALIZATION OF THE REFERRING PHYSICIAN**

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**Introduction:** The American Academy of Sleep Medicine (AASM) recommends that home sleep apnea testing (HSAT) be ordered by
a board-certified sleep physician after an initial patient evaluation. The University of California Los Angeles (UCLA) sleep laboratory accepts HSAT referrals from physicians both with and without subspecialty training in sleep medicine. The aim of this study was to compare the diagnostic yield of HSATs ordered by sleep specialists against those ordered by physicians without formal training in sleep medicine.

Methods: All HSAT referrals to the UCLA sleep laboratory between 2013 and 2018 were retrospectively reviewed. Studies were excluded if they were ordered for evaluation of a therapeutic device for obstructive sleep apnea. Studies with AHI ≥ 5 were labelled as diagnostic. Studies were labelled as non-diagnostic if there was an AHI < 5, or if the interpreting physician deemed the study as technically inadequate after review of the raw data. Studies were separated into two groups based on the specialization of the ordering provider (i.e. sleep vs non-sleep providers).

Sleep providers were defined as board-certified or board-eligible in sleep medicine. We performed a χ² test to evaluate for a statistically significant difference in the rate of non-diagnostic studies between these groups.

Results: Of the 2225 tests reviewed (65% males, 35% females), 49.9% (1110/2225) were referred by sleep providers and 50.1% (1115/2225) were referred by non-sleep providers. The mean (±SD) age was 55.15 years for both groups. The mean (±SD) body mass index was 29.2±7.3 kg/m² for patients referred by sleep providers and 28.7±6.5 kg/m² for those referred by non-sleep providers. The non-diagnostic rate for studies ordered by sleep specialists was 18.7% (208/1110) compared to 25.6% (285/1115) for those ordered by other providers: χ² (1, N= 2225) = 15.01, p < 0.001.

Conclusion: HSATs ordered by physicians without formal training in sleep medicine were statistically more likely to be non-diagnostic than those ordered by sleep specialists. These results lend support to current AASM guidelines on HSAT utilization.

Support (If Any): ASPIRE Fellowship

0466 CONSEQUENCES OF DIFFERING HYPOPNEA SCORING GUIDELINES ON MILD OSA DIAGNOSIS

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Introduction: Treatment of obstructive sleep apnea (OSA) improves patient symptoms and decreases the risk for various comorbid conditions. However, OSA diagnosis is complicated by multiple criteria for scoring of obstructive hypopneas. Increasingly, more stringent Medicare criteria (AHI ≥ 5) are being adopted, potentially decreasing the number of patients diagnosed and treated for OSA. Therefore, comparison to the recommended American Academy of Sleep Medicine criteria (AHI ≥ 4) is warranted.

Methods: AHI ≥ 4 defines hypopnea as nasal pressure signal drop of ≥ 30% from baseline over ≥ 10 seconds with ≥ 4% oxygen desaturation. In contrast, AHI ≥ 5 requires a nasal pressure signal drop of ≥ 30% from baseline over ≥ 10 seconds, with either ≥ 3% oxygen desaturation or associated arousal. We retrospectively enrolled 121 patients diagnosed with mild OSA (5 ≤ AHI ≤ 15) by polysomnogram (PSG) using AHI ≥ 4. Inclusion criteria included ≥ 18 years, CPAP treatment with acceptable adherence (usage ≥ 4 hours for ≥ 70% of nights), and clinical follow-up. Baseline PSGs were rescoring using AHI ≥ 4. Patient charts were reviewed for changes in Epworth Sleepiness Scale (ESS).

Results: Mean AHI ≥ 4 was 10.28 ± 2.60 events/hour. When PSGs were rescoring using AHI ≥ 5, a significant decrease in AHI was observed (mean AHI 4.70 ± 2.67 events/hour, p < 0.0001). Fifty-seven percent (69/121) of patients would have lost OSA diagnosis if AHI ≥ 4 standards were applied. Improvement in ESS with CPAP treatment was noted in 66% of patients overall and in 61% of patients who would have lost diagnoses had AHI ≥ 4 been used.

Support (If Any): ASPIRE Fellowship Grant
**B. Clinical Sleep Science and Practice**

**Conclusion:** The majority of our patients would have lost their OSA diagnosis had AHI$_{v-A}$ been applied. Given the improvement in ESS in CPAP-adherent patients, this loss of OSA diagnosis would have resulted in a missed opportunity for treatment. Future work that focuses on the benefits of treating mild OSA is needed and may justify the use of AHI$_{v-A}$.

**Support (If Any):** CTSA award UL1TR002243 from National Center for Advancing Translational Sciences

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**0467**

**A COMBINATION INDEX OF LOW FREQUENCY CARDIO-PULMONARY-COUPLING AND OXYGEN DESATURATION HAS A STRONG CORRELATION WITH THE APNEA HYPOPNEA INDEX**

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**Introduction:** Deriving an AHI from limited measurements enables simple sleep apnea diagnosis. Cardiopulmonary coupling (CPC) is an ECG-based analysis incorporating cyclic variation in heart rate (CVHR) typical of apnea, and ECG-derived respiration, to generate sleep apnea metrics. Elevated Low Frequency Coupling (e-LFC) is a CPC pattern that has been associated with fragmented sleep. Narrow spectral band e-LFC (e-LFC-NB) associates with sustained central apnea, classic periodic breathing, and high loop gain obstructive sleep apnea OSA). Broad spectral band e-LFC (e-LFC-BB) associates with OSA.

**Methods:** We combined e-LFC with oxygen desaturations to generate a SleepImage-AHI (SAHI) index and examined its correlation with the conventional 3%/arousal AHI using polysomnograms in 38 subjects. CPC analysis was done on the ECG from the PSG, generating a narrow-band index (NBI) and broad-band index (BBI). The PSG pulse oximeter trace was processed to calculate the Oxygen Desaturation Index (ODI) defined as events lasting 10 seconds or longer of 3% or more within each CPC LFC periods. The SAHI-Adult = (NBI + ODI), and the SAHI-Pediatric = (BBI + NBI + ODI), per hour of sleep. Pearson coefficient was calculated to estimate correlation between SAHI and 3% AHI, and Bland-Altman (BA) for agreement between the two methods.

**Results:** There were 20 adults age 42-90 (median: 69.5, SD 14.5). There were 18 children age 5-10 years. Females were 52.6%. Pearson coefficient was 0.7649. One adult PSG had short cycle non-hypoxic periodic breathing events without desaturations which were not scored leading to AHI of 13.1 vs. SAHI of 76.2. Removal of this outlier study resulted in a correlation coefficient 0.92. The BA analysis mean difference = -2.28 (CI -6.25 to 1.70) for the whole set and -0.637 (CI -2.87 to 1.59) with the outlier removed, 0.599 (CI -1.23 to 2.43) for the pediatric, -4.87 (CI -12.38 to 2.64) for adults with, and -0.637 (CI -2.87 to 1.59) with the outlier remove, 0.599 (CI -1.23 to 2.43) for the whole set and outlier study resulted in a correlation coefficient 0.92. The BA analysis mean difference = -2.28 (CI -6.25 to 1.70) for the whole set and -0.637 (CI -2.87 to 1.59) with the outlier removed, 0.599 (CI -1.23 to 2.43) for the pediatric, -4.87 (CI -12.38 to 2.64) for adults with, and -0.637 (CI -2.87 to 1.59) with the outlier remove, 0.599 (CI -1.23 to 2.43) for the whole set and outlier study resulted in a correlation coefficient 0.92.

**Conclusion:** Patients with REM only OSA are not diagnosed as obstructive sleep apnea in most centers. However, our study shows that these patients have a similar degree of daytime sleepiness. In addition, they had a similar incidence of cardiovascular and metabolic comorbidities. Therefore, diagnosing these patients as having obstructive sleep apnea and initiating treatment would be potentially useful in reducing their daytime sleepiness as well as comorbidities.

**Support (If Any):** none

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**0468**

**REM-ONLY SLEEP APNEA: AN UNDERRECOGNIZED DISORDER**

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**Introduction:** Obstructive events in obstructive sleep apnea (OSA) can be worse during rapid-eye movement (REM) sleep. Previous studies have shown that there is a graded relationship between the degree of severity of obstructive events during REM sleep and hypertension. as well as between the REM apnea hypopnea index (AHI) and degree of insulin resistance. However, these studies looked at patients who have a traditional diagnosis of OSA i.e. overall AHI more than or equal to 5 per hour with an elevated REM-AHI in addition. Few studies have examined the characteristics of patients who have only an elevated REM AHI but an overall AHI less than 5 per hour.

**Methods:** This was a retrospective review of all adult polysomnograms (PSGs) conducted between July 2017 and December 2017 at the Michael E. DeBakey VA Medical Center (MEDVAMC) Sleep Lab. Based on PSG data, patients were split into groups: strict REM-only OSA (overall AHI < 5 and REM AHI >= 5), all OSA (overall AHI >= 5) and normal. Demographic and clinical characteristics of the patients were reviewed. Descriptive and statistical analyses of the study parameters were performed.

**Results:** There were 420 patients in the sample after exclusions, 43 of whom had REM-Only OSA, with an observed prevalence of 10.2%. The results showed that patients with REM-only OSA were similar to the patients traditionally diagnosed with OSA. They had similar age distributions, and symptomatically had similar Epworth sleepiness scale scores. Both had similar incidences of co-morbidities though hypertension was seen more commonly in patients with traditional OSA. Polysomnographically, the group with REM-only OSA had a higher sleep efficiency and total sleep time and a similar sleep onset latency to traditional OSA group.

**Conclusion:** Patients with REM only OSA are not diagnosed as obstructive sleep apnea in most centers. However, our study shows that these patients have a similar degree of daytime sleepiness. In addition, they had a similar incidence of cardiovascular and metabolic comorbidities. Therefore, diagnosing these patients as having obstructive sleep apnea and initiating treatment would be potentially useful in reducing their daytime sleepiness as well as comorbidities.

**Support (If Any):** none

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**0469**

**RESPIRATORY CYCLE-RELATED EEG CHANGES (RCREC) PREDICT ALL-CAUSE MORTALITY IN THE SLEEP HEART HEALTH STUDY (SHHS)**

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**Introduction:** Sleep-disordered breathing (SDB) is among the most prevalent sleep disturbances in adults and is associated with an increased risk of death. This analysis focused on data from a large cohort of adults to assess whether an SDB biomarker based on quantitative analysis of sleep EEG, namely Respiratory Cycle-Related EEG Changes (RCREC), may in comparison to the standard apnea-hypopnea index (AHI) improve prediction of all-cause mortality. The RCREC are thought to represent breath-to-breath, inspiratory microarousals associated with increased work of breathing.

**Methods:** Data were obtained from the Sleep Heart Health Study (SHHS), a multicenter longitudinal study focused on SDB

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**II. Sleep-Related Breathing Disorders**
and cardiovascular health of middle-aged to older adults. The RCREC values were computed in delta (0.5-4.5 Hz), theta (4.5-8.5 Hz), alpha (8.5-12.5 Hz), sigma (12.5-15.5 Hz), beta (15.5-30.5 Hz), and gamma (30.5-49.0 Hz) frequency bands. Sequential Cox Proportional Hazard models, adjusted for body-mass index, age, race, smoking status, and sex, were used to assess association with all-cause mortality.

Results: Among adults with sufficient data quality (n=4427, mean age at baseline 62.8 ±10.9 (SD) years, 53% female), AHI and gamma RCREC separately showed associations with risk of mortality (adjusted OR 1.01 deaths per year per unit increase in AHI (p<0.04); 1.02 per year per 0.1 increase in gamma RCREC (p<0.0001). In a model that included AHI, gamma RCREC, and the above covariates, gamma RCREC retained significance (p<0.0001), AHI did not (p=0.14), and addition of AHI had not improved the overall model significance (Wilks' Theorem, p=0.15). The RCREC in other frequency bands were not similarly effective.

Conclusion: Gamma RCREC as a biomarker of SDB may, in comparison to the AHI, better predict all-cause mortality in the SHHS. The reason for clinical utility of gamma as opposed to other-frequency RCREC is not clear, though the reported prominence among insomniacs of gamma EEG power, thought to represent cortical hyperactivation, allows speculation that chronic repetitive nightly exposure could shorten life.


0470 PREVALENCE AND RISK FACTORS FOR CARDIOVASCULAR DISEASES ACCORDING TO PHENOTYPES OF OBSTRUCTIVE SLEEP APNEA SYNDROME: A RETROSPECTIVE COHORT STUDY

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Introduction: Obstructive sleep apnea syndrome is associated with the development of cardiovascular diseases caused by hypoxemia that occurs during sleep. The aim of this study was to classify phenotypes based on the polysomnographic findings and investigate the prevalence and risk factors for cardiovascular diseases according to the phenotypes.

Methods: This study targeted adult patients who underwent polysomnography because of suspicion of sleep disordered breathing at a university hospital from November 2008 to February 2018. Analysis was conducted by classifying phenotypes into the apnea-predominant, the hypopnea-predominant, and the simple snoring group based on the results of polysomnography. We collected and analyzed polysomnographic data and clinical features such as medical history and comorbidities through reviewing electronic medical records.

Results: A total of 860 adult patients underwent polysomnography for suspicion of sleep disordered breathing at a university hospital from November 2008 to February 2018. Analysis was conducted by classifying phenotypes into the apnea-predominant, the hypopnea-predominant, and the simple snoring group based on the results of polysomnography. We collected and analyzed polysomnographic data and clinical features such as medical history and comorbidities through reviewing electronic medical records.


0471 SLEEP RELATED BREATHING DISORDERS IN HEART TRANSPLANT PATIENTS

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Introduction: Sleep related breathing disorders (SRBD) in post-heart transplant patients has not been well-characterized. These patients are predisposed to weight gain and obesity due to long term immunosuppressive treatment. Obesity increases the risk for SRBD, which may negatively impact outcomes. Our aim was to better characterize SRDB in this patient population using comprehensive sleep evaluations and polysomnography (PSG) results post-transplant.

Methods: A retrospective analysis was performed on heart transplant recipients who presented to an academic sleep center between January 2011 through December 2017. We analyzed self-reported sleep complaints and PSG parameters.

Results: Ten patients were identified who received orthotopic heart transplant and obtained a sleep evaluation post-transplant. Six patients (5 male, 1 female) underwent a PSG. Mean age at the time of transplant was 52 ± 21.0 years. Mean BMI was 30.6 ± 5.6 kg/m2. The commonly reported symptoms were snoring, witnessed apneas, excessive daytime sleepiness (EDS), and non-restorative sleep. Mean apnea hypopnea index was 11.9 ± 6.3 per hour. Most events were obstructive. Obstructive apnea index was 3.6 ± 6.2 per hour, obstructive hypopnea index was 8.3 ± 4.5 per hour, and central apnea index was 0.7 ± 0.9 per hour. Mean oxygen saturation (SpO2) was 91.9% ± 1.9% and the minimum SpO2 was 81.6 ± 6.3%. Time spent with SpO2 at or below 88% was 14 ± 23 minutes. Periodic limb movement (PLM) index was 61.7 ± 32.9 per hour and the PLM arousal index was 6.42 ± 6.2 per hour.

Conclusion: In this case series, SRBD in post-heart transplant patients was mostly obstructive in nature. CPAP was the recommended treatment, but with low adherence. PSG should be considered in heart transplant patients with weight gain, symptoms of snoring, and self-reported non-restorative sleep or EDS. Future research should characterize SRBD pre- and post-heart transplant.

Support (If Any): None

0472 WITHDRAWN

0473 ALENDRONATE IS ASSOCIATED WITH A SIGNIFICANTLY HIGHER ODDS OF OBSTRUCTIVE SLEEP APNEA (OSA): RESULTS FROM THE US FDA ADVERSE EVENTS REPORTING SYSTEM (FAERS)

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Introduction: OSA is recognized as a heterogeneous disorder. The literature on the role of medications in OSA pathogenesis has tended to focus on central nervous depressants. We examined the association of Alendronate (a commonly used bisphosphonate that is FDA-approved for osteoporosis and Paget’s disease of the bone) and OSA. Alendronate was among one of the 5 most frequent medications documented as primary suspect (PS) for the adverse effect (AE) of OSA in the FAERS post-marketing individual safety reports (ISR). To our knowledge the association of Alendronate and OSA has not been previously reported.

Methods: We examined the FAERS database from January 1, 2004-June 30, 2017 (total ISR = 9,553,117) and examined ISRs where Alendronate was documented as PS for the AE of OSA. Medical Dictionary for Regulatory Activities (MedDRA) preferred term of ‘Sleep apnoea syndrome’ (MedDRA code 10040979) was used to select ISRs designating OSA as AE. Reporting odds ratios (ROR) with 95% confidence intervals (CI) were calculated to assess disproportionality signals for OSA both when Alendronate (i) was used for FDA-approved indications, and (ii) when used for any indication.

Results: Overall there were 626,321 ISR for Alendronate (mean+/−SD age: 61.20+/−11.06 years, age data on 437,493 ISR; 94.3% female, 5.7% male, gender data on 538,566 ISR). When used for FDA-approved indications (OSA-related ISR=625) versus all other medications for the same indications (OSA-related ISR=129), the disproportionality signal for OSA was 6.20 (95% CI: 5.13−7.49), z=18.86, p<0.0001. For Alendronate used for any indication (OSA-related ISR=917) versus all other medications for any indication (OSA-related ISR=10,998) the disproportionality signal for OSA was 3.74 (95% CI: 3.50−4.00), z=38.36, p<0.0001.

Conclusion: Alendronate was associated with a previously unreported higher odds of OSA both (i) when used for FDA-approved indications, and (ii) when used for any indication. Factors other than the primary FDA indications (that could theoretically affect chest wall function), such as possible direct irritation of portions of the upper airway by Alendronate and its pro-inflammatory actions, may be important.

Support (If Any): None

0474
OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH COPD AND FIBROTIC INTERSTITIAL LUNG DISEASE
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Introduction: Despite the clinical and prognostic significance of obstructive sleep apnea (OSA) on chronic respiratory diseases, the role of the interaction mechanism between upper and lower airway for OSA prevalence in respiratory disease has not been clarified. Few studies have compared the prevalence and severity of sleep apnea in COPD and fibrotic ILD.

Methods: 73 patients with COPD and 79 patients with fibrotic ILD were studied in this prospective study. A full overnight PSG in the hospital setting, pulmonary function testing, as well as other clinical evaluations were performed.

Results: OSA (AHI≥15/h) is more common (61% vs. 45%, P<0.001) and more severe (AHI 22.4±16.5/h vs. 16.8±13.2/h, P=0.02) in fibrotic ILD compared to COPD patients independent of age, BMI, and ODI score. There were no relationships between AHI and TLC or FVC among COPD and IPF patients. Oxygen desaturation index (ODI) was a good predictor of AHI in both COPD and ILD patients [area under curve (AUC), 0.78 and 0.89].

Conclusion: OSA is more common and more severe in patients with fibrotic ILD than COPD. ODI could be used as a screening tool for OSA among chronic respiratory diseases.

Support (If Any):
dependent, 2 were on non-invasive ventilation (NIV), and 4 were ventilator free.

**Conclusion:** The prevalence of OHS in critically ill patients in Taiwan was 0.6%. For moderate obese patients admitted to ICU for hypercapnic respiratory failure, OHS should be listed as one of the differential diagnosis and early starting of nocturnal NIV.

**Support (If Any):** National Taiwan University Hospital (NTUH 104-N2931, A105-128; 107-19)

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**0476**

**GENDER DIFFERENCE OF OBSTRUCTIVE SLEEP APNEA AMONG PATIENTS AWAITING BARIATRIC SURGERY**

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**Introduction:** Obstructive Sleep Apnea (OSA) is a sleep-related breathing disorder, with the incidence on the rise nowadays. Gender and obesity are among the predisposing factors for OSA. The aim of this study was to investigate gender difference of OSA among obese patients awaiting bariatric surgery and the possible influencing factors.

**Methods:** In this prospective study, standard overnight cardiopulmonary recording was conducted in 252 subjects scheduled for Bariatric Surgery. STOP-Bang, ESS questionnaires, pulmonary function, as well as endocrine hormone level testing were administered.

**Results:** OSA (AHI ≥ 5/h, AHI ≥ 15/h, AHI ≥ 30/h) was present in 80.6% (female 74.6%, male 92.8%, P < 0.001), 48.4% (female 37.9%, male 69.9%, P < 0.001) and 27.4% (female 17.2%, male 48.2%, P < 0.001). Compared to women, AHI, AI, HI, ODI as well as percentage time of SpO2 ≤ 90% were higher for men. Multiple regression analysis showed that age, BMI, STOP-Bang scores and prolactin level were associated with the prevalence of OSA.

**Conclusion:** OSA is more common and more severe in male patients than female patients scheduled for bariatric surgery. Age, BMI, STOP-Bang score and hormone levels are correlated with OSA incidence.

**Support (If Any):** This study was supported by ResMed Corp.

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**0477**

**AMERICAS PREVALENCE OF OSA IN ADULTS: ESTIMATION USING CURRENTLY AVAILABLE DATA**

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**Introduction:** Obstructive sleep apnea (OSA) is a major clinical problem due to its high prevalence and devastating complications. At present, the prevalence of adult OSA in the Americas (including North and South America) is unclear. Limited epidemiological studies have been done and the majority of the Americas’ population has not had a reliable estimate of disease burden. We sought to estimate the Americas’ prevalence of adult OSA using existing data from epidemiological studies.

**Methods:** We contacted authors of the important analyses following an exhaustive review of the literature. For countries where no measurement had been made, we used publicly available data to obtain estimates of age, gender, race and body mass index (BMI). We developed an algorithm to match countries without prevalence estimates with countries from which OSA epidemiological studies exist. The situation was complicated given the variable age of the existing studies, the differences in technology used (e.g., nasal pressure vs thermistor), the changing scoring criteria (e.g., AASM 1999 vs. 2007 vs. 2012) and other sources of variability.

**Results:** Among the 40 countries in the Americas there were age, gender, race and BMI data available for 38. We estimated an Americas’ adult OSA prevalence of approximately 170 million people (37.0%) based on the AASM 2012 criteria using a somewhat conservative approach to our estimates. Furthermore, we estimate 81 million adults in the Americas (17.7%) suffer from moderate to severe OSA based on an apnea hypopnea index ≥ 15/h. The nations with the greatest burden of OSA are the United States (54 million), Brazil (49 million), and Colombia (11 million).

**Conclusion:** This large burden of disease (170 million with OSA; 81 million with moderate to severe OSA in the Americas) has not been widely appreciated and speaks to the need to leverage new technology to diagnose and treat these patients. Further efforts with advocacy are also required for patients, providers and policy makers to develop strategies regarding how best to address.

**Support (If Any):** This study was supported by ResMed Corp.

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**0478**

**PREVALENCE AND INTERVENTION OF OSA IN CHINESE CIVIL SERVANTS UNDERGOING ANNUAL PHYSICAL EXAMINATION**

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**Introduction:** To investigate the prevalence of OSA among civil servants undergoing annual physical examination, active CPAP intervention was performed in diagnosed OSA patients, provide experience for OSA population control.

**Methods:** The method of cluster sampling is adopted, investigate a government official in guangdong province who underwent an annual health check-up between July and December 2017. The survey includes general information, clinical history, living habits (smoking, alcohol consumption, exercise frequency), sleep specific...
questionnaire, physical examination, OSA screening and diagnosis. Patients diagnosed with OSA were given free CPAP treatment.

**Results:** 1036 subjects (799 males and 237 females) completed the investigation and were included in the analysis. 22.0% (228/1036) were regarded as high-risk OSA (HR-OSA), 72 rejected home sleep test(HST), while 156 received, and 103 diagnosed as OSA. The prevalence of OSA in HR-OSA was 66.0% (103/156), of which mild, moderate, and severe was 40.2% (41/103), 33.3% (35/103), 26.5% (27/103) respectively. The prevalence of OSA was 9.9% (103/1036), 99.1% (226/228) patient in HR-OSA group have never been diagnosed. Free auto CPAP treatment was given to all OSA. Only 55.3% (57/103) patients received initial treatment. 29.8% (17/57) patients gave up in 1 week, the mainly reasons of rejecting further therapy were nose discomfort, insomnia and suffocating feeling.

**Conclusion:** There is a high risk of OSA and a high prevalence of OSA in the annual physical examination of civil servants. Most people have never been diagnosed with OSA, even with free CPAP treatment, the treatment rate was low and compliance was gradually reduced.

**Support (If Any):** 1.National Natural Science Foundation of China(NSFC81870077) 2.Public Welfare Research and Capacity Building of Guangdong Province(2016A020216030)

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**0479 BURN PIT EXPOSURE IN MILITARY PERSONNEL: IS THERE AN EFFECT ON SLEEP-DISORDERED BREATHING?**

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**Introduction:** Recent studies have suggested that exposure to elevated concentrations of respirable particulate matter (less than 10 µm) may increase the prevalence and severity of obstructive sleep apnea (OSA). Open-air burn pits as utilized by the U.S. military in recent operations until 2009 may have produced elevated concentrations of respirable particulate matter. Currently, it is unknown if burn pit exposure is a risk factor for OSA in military personnel. The purpose of this study was to determine if exposure to open-air burn pits during deployment was associated with increased severity of OSA.

**Methods:** As part of a comprehensive study of previously deployed military personnel with exertional dyspnea (n=145), all patients underwent pulmonary function testing, screening for burn pit exposure via the VA Burn Pit Registry Questionnaire, and if warranted by sleep questionnaires, in-lab polysomnography. We evaluated those for which all three tests were completed (100 patients). For analysis purposes, patients were classified into two groups, those with burn pit exposure (45 patients) and those without exposure (55 patients). Subgroup analyses were additionally performed on those who endorsed performing burn pit duties during deployment (25 patients) and those with greater than 12 hours of daily exposure (17 patients).

**Results:** The prevalence of OSA, as defined by an apnea-hypopnea index (AHI) > 5/hour, was similar in the exposed and unexposed groups (68.9% vs. 71.4%, p=0.83) with no difference in age (39.5 vs. 40.0 years, p=0.74) or BMI (29.9 vs. 30.4, p=0.48). The mean AHI was lower in the exposed group (12.8/hour vs. 19.7/hour, p = 0.04) and SpO2 nadir was similar between groups (87.2% vs. 86.2%, p=0.39). Subgroup analyses revealed similar findings in those who performed burn pit duty (prevalence=80.0%, p=0.58; AHI=14.8, p=0.16) and those with greater than 12 hours of daily exposure (prevalence=88.2%, p=0.33; AHI=18.0, p=0.62).

**Conclusion:** Exposure to open-air burn pits does not appear to increase the prevalence or severity of OSA in previously deployed military personnel. Given the high diagnostic rate of OSA, consideration should be given to screening military personnel for OSA.

**Support (If Any):**

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**0480 ECHOCARDIOGRAPHIC STUDY IN OBSE Patients With and Without Sleep Apnea, Hypoventilation Syndrome, or Both**

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**Introduction:** Hypoventilation syndrome (OHS), sleep apnea (OSA) or both are common in obese patients and can be complicated by several cardiovascular diseases. The purpose of this study is to evaluate echocardiographic parameters in obese patients with either OSA, OHS or both.

**Methods:** In this prospective study, consecutive obese asymptomatic patients were referred to the sleep disorders clinic between January 2002 to December 2015 and included (n=980). Demographic echocardiographic data, sleep parameters, arterial blood gases (ABGs) were recorded.

**Results:** Of 980 obese patients, 445 (45%) were obese (Group 1), 60 (6%) were obese with OHS (Group 2), 388 (40%) were obese with OSA (Group 3) and 87 (9%) were obese with both OHS and OSA (Group 4). Data analysis shows that the obese patients with sleep apnea and hypoventilation syndrome (group 4) have a higher BMI, waist and neck size comparatively to the other patient groups. The analysis also shows that group 3 and 4's average PCO2 is significantly different from the two other groups while there was no significant difference between the PCO2 within the two other groups. Regarding echocardiographic parameters, no significant difference was seen between the four groups concerning Left atrial volume (LA), the ratio of mitral valve early diastolic velocity E/E, E/Vp ratio and LV EF; while the Cardiac Output Index (COI) was lower for Group 4 patients. Patients with OSA and OHS show a higher IHA than patients with OSA alone.

**Conclusion:** The study shows that BMI, IHA and PCO2 are the highest amongst patients with both OSA and OHS.However, no significant difference was observed with echocardiographic parameters apart from the Cardiac Output Index (COI). One explanation is that these patients are asymptomatic.

**Support (If Any):**

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**0481 Higher Risk of OSA Is Associated with Poorer Affect Regulation Among the Severely Mentally Ill with a History of Aggression: Evidence from a Forensic Setting**

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Introduction: Obstructive sleep apnea (OSA) is a sleep-related breathing disorder with negative consequences on daytime functioning, including fatigue, irritability, and poorer memory. OSA is highly prevalent among individuals diagnosed with severe mental illnesses (SMI), likely due to an accumulation of risk factors (e.g., antipsychotics, obesity, smoking). Psychiatric patients in forensic settings display greater impulsivity and emotional dysregulation compared to non-forensic psychiatric patients. We hypothesized that forensic patients at higher risk of OSA will display greater impulsivity, aggression and emotional dysregulation than forensic patients at low risk of OSA.

Methods: Study participants were male (n=55) and female (n=10) forensic patients (mean age = 38.5 ±11.5). All were diagnosed with at least one SMI (e.g., schizophrenia, bipolar disorder). Participants completed the Sleep Disorders Questionnaire 2 - Sleep Apnea subscale (SDQ-2-SA) to estimate risk of OSA, followed by other self-report surveys, including: Pittsburgh Sleep Quality Inventory (PSQI), Epworth Sleepiness Scale (ESS), Buss-Perry Aggression Questionnaire (BPAQ), Barratt Impulsiveness Scale (BIS), Depression Anxiety and Stress Scale (DASS), Difficulties in Emotion Regulation Scale (DERS). Correlation analyses were run to examine the relationship between SDQ-2-SA scores and the scores from the surveys measuring different aspects of affect as well as sleep quality and sleepiness.

Results: Higher risk of OSA (as per the SDQ-2-SA) was positively correlated with poorer sleep (PSQI; r=0.34, p <0.01); higher aggression (BPAQ, r=0.25, p <0.01), higher impulsivity (BIS, r=0.35, p <0.01), higher depression and anxiety (DASS, r=0.42, p <0.001), and greater emotion dysregulation (DERS, r=0.36, p <0.01). Higher risk of OSA was not correlated with sleepiness.

Conclusion: While this remains to be replicated with objective PSG data, the present findings highlight that emotional dysregulation, impulsivity and aggression in forensic patients with various SMI may be worsened by OSA, a condition often undiagnosed and untreated among forensic patients. Future studies should investigate whether appropriate treatment in forensic patients with OSA may help improve emotional regulation, impulsivity and aggression, common features in many psychiatric disorders.

Support (If Any): UMRF

0482 DISTRIBUTION OF FAT IN PRE- AND POST-MENOPAUSAL FEMALES WITH SLEEP RELATED BREATHING DISORDER

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Introduction: Obstructive sleep apnea is the by far the most common sleep related breathing disorder (SRBD). It is associated with obesity and increased visceral adipose tissue. The aim of this investigation is to study fat distribution in pre- and post-menopausal females with SRBD.

Methods: This cross-sectional population-based study included national representative sample of NHANES 2005-2006. Adult females of ≥ 18 years of age were included (n=2,374). Demographic, questionnaire and examination data, and dual-energy X-ray absorptiometry measured fat mass were obtained. STOP questionnaire, with a score of 2 or more, has been validated to predict SRBD. Subject’s response to questions on snoring, snorts/ witnessed apneas, daytime sleepiness and hypertension (high blood pressure (BP) on ≥ 2 times, taking anti-hypertensive medications, or BP ≥ 140/90 mmHg) were used to stratify subjects with SRBD.

An age cut-off of 55 years was used as a surrogate for menopausal status.

Results: A total of 470 subjects were identified with SRBD. 155 subjects in age group ≥ 55 years and 315 subjects in age group < 55 years. Body mass index (BMI), waist circumference, total fat percentage, trunk fat percentage, and waist to hip fat ratio were significantly (p <0.001) higher in subjects with SRBD compared to subjects without SRBD. In subjects with SRBD, BMI, waist circumference, total fat percentage, trunk fat percentage were similar, in ≥ 55years and <55 years, at 31.6 ± 0.9 vs. 32.6 ± 0.9 kg/m², 103 ± 1.89 vs. 102 ± 1.2 cm, 43.1 ± 0.64 vs. 41.9 ± 0.54%, 42.4 ± 0.73 vs. 41.1 ± 0.61% (all p-values NS) respectively. Waist to hip fat ratio was significantly higher in females with SRBD compared to no SRBD: In <55 years group at 0.97 ± 0.0 vs. 0.86 ± 0.0% (p <0.001), and ≥ 55 years group at 0.96 ± 0.0% vs. 0.91 ± 0.0% (p <0.001).

Conclusion: Adult females with SRBD have significantly higher body fat compared to females without SRBD. Similar fat distribution was observed in pre- and post-menopausal females with SRBD.

Support (If Any): CDC for NHANES data.

0483 IMPACT OF OSA AND COMORBID CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) ON CLINICAL AND NEUROCOGNITIVE OUTCOMES

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Introduction: OSA coexisting with COPD, also known as “Overlap Syndrome” (OVS), occurs in 14% of the general adult population and is associated with grave consequences, including increased cardiovascular events, mortality and hospital admissions. However, the effect of OVS on neurocognitive function, exercise tolerance and quality of life (QoL) is not known. We hypothesized that OVS patients would suffer worse clinical outcomes than OSA alone.

Methods: We prospectively recruited eligible older patients (age 50 years or older) from sleep and pulmonary clinics with apnea-hypopnea index (AHI)≥15 and GOLD class 2-3, moderate to severe obstructive lung disease. Patients with OVS and OSA alone completed a battery of neurocognitive tests and sleep, dyspnea and QoL questionnaires. Exclusion criteria were acute, medical, psychiatric conditions, sedative, stimulant use, other. Trails A and B, Stroop, Digit symbol, HVLT-R, WASI II, WSM-IV, PASAT results were standardized for age and education level. Standardized scores on neurocognitive tests were compared to a normal expected value of 100.

Results: Health and cognitive data are presented for: OSA: n=46 males, age 65±8yr, BMI 35±7kg/m², AHI 59±32/hr, and OVS: n=22 (21 males) age 68±5yr, BMI 33±8kg/m², AHI 57±42/hr, GOLD class 2 and 3. Cognitive results are presented for 20 OSA and 18 OVS patients. Pittsburgh Sleep Quality of Life Index scores trended higher in OVS vs. OSA, total score 9.4±3.8 vs 8.8±2.4, p=ns. MMRC dyspnea scores were higher in OVS vs. OSA (1.3±0.8 vs 0.9±1.0, p=0.03). The 6-minute walk distance was reduced similarly compared to predicted normative distance (OVS vs. OSA:
B. Clinical Sleep Science and Practice

0484

INDIVIDUALS WITH OBSTRUCTIVE SLEEP APNEA HAVE HIGHER LIKELIHOOD OF MULTIPLE INVOLUNTARY, JOB LOSSES

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Introduction: Involuntary job loss can be related to both employer and personal factors. Irrespective of cause, it is likely to cause negative changes in daily activities and sleep patterns. Obstructive sleep apnea (OSA) can impair mental and physical performance and thus may be an etiologic factor leading to job loss. We hypothesized that people with OSA were more likely to have a history of multiple job loss (HMJL).

Methods: Participants with data regarding demographic and physical characteristics, employment history, and results from an out of center sleep test were selected from the ongoing, prospective Assessing Daily Activity Patterns through occupational Transitions (ADAPT) study. A propensity score analysis was performed to associate the association between the presence of OSA and having a HMJL. OSA was defined as an apnea hypopnea index (AHI) of > 15/hour (moderate-to-severe OSA). The propensity model used age (years), sex (male/female), race/ethnicity (white/non-white), whether a participant usually began their work shift between 7-9am (yes/no), whether they worked in a social environment (management, healthcare, or sales) or non-social (all other job categories), and payment type (hourly/salary) as predictors of OSA. Post matching, a logistic regression model was fitted on the matched data using HMJL as the response and OSA as the predictor.

Results: A total of 261 participants were used for the propensity score analysis. After propensity score matching a total of 39 matched pairs (N = 78) remained. From the logistic regression model on the matched data, the odds of having a HMJL for those with OSA was 2.86 (95% CI: [1.16 - 7.32]).

Conclusion: Individuals with moderate-to-severe OSA were more likely to have experienced multiple involuntary job losses. Body mass index (BMI) data were not collected and the inability to include BMI in the model is considered as a limitation, given the estimated relationship between BMI and job loss. Despite this limitation, these data provide valuable, proof of concept that moderate-to-severe OSA may confer significant long-term occupational and economic consequences that are uniquely associated with involuntary job loss.

Support (If Any): VA, RR&D:1 I21 RX002227

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OSA and 2) determine if the relationship between predictors and sleepiness and insomnia depended on age.

**Methods:** We performed a retrospective analysis of US veterans newly-diagnosed with OSA at the Miami VA in 2015. On diagnostic PSG night (76% attended studies), questionnaires were completed querying demographics, social characteristics, insomnia symptoms (Insomnia severity index [ISI]), sleepiness (Epworth sleepiness scale [ESS]) and self-reported sleep duration. Medical and psychiatric comorbidities were assessed with electronic medical record review. Linear regression modeling was used to explore the association of variables with 1) ESS and 2) ISI. Regression analyses were performed in two steps: 1) all variables were entered simultaneously testing for main effects, 2) the product of age and each variable found to have an association at a significance level of p < 0.10 with the primary outcome was entered separately to test for interaction.

**Results:** The sample consisted of 483 veterans (93% male, age 52 ± 13 yrs, 41% black, 34% Hispanic) diagnosed with OSA (AHI 36 ± 28 events/hr of sleep). Having a regular bed partner, higher weighted medical comorbidities, chronic pain diagnosis, and shorter sleep duration were associated with ESS. Age did not moderate the relationship between these variables and the ESS. Younger age, Hispanic ethnicity, higher educational level, shorter sleep duration, mood and pain diagnoses were each associated with the ISI. Furthermore, an age-sleep duration interaction term was associated with the ISI (b = -0.03; p=0.005). For all participants, there was an inverse relationship between sleep duration and ISI scores. However, for any sleep duration, older veterans reported a lower level of insomnia symptoms than younger veterans.

**Conclusion:** Older veterans with OSA may report less sleep complaints. Personalized screening methods for older individuals with OSA may be needed.

**Support (If Any):** None

**0487 PREVALENCE AND MORBIDITY OF SLEEPINESS IN AN ONLINE SLEEP APNEA PATIENT COHORT**

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**Introduction:** Excessive daytime sleepiness (EDS) is a common presenting symptom among sleep apnea (SA) patients. EDS is widely expected to improve with positive airway pressure (PAP) therapy, however, 12-29% of PAP-adherent patients report persistent sleepiness. Given the impact of EDS, we aim to understand the prevalence of EDS and associated quality-of-life (QOL) outcomes among a non-clinic-based sample of patients engaging in a SA online support, education, and research portal.

**Methods:** We conducted a cross-sectional survey among patients with SA through the Sleep Apnea Patient Centered Outcomes Network (MyApnea.Org). Survey measures included demographics, comorbidities, treatment, and QOL outcomes: work productivity and activity impairment (WPAI), physical and mental health (Short-Form Health Survey; SF-12v2), functional outcomes of sleep (FOSQ-10), insomnia (Women’s Health Initiative Insomnia Rating Scale; WHIIRS), depression (World Health Organization Well-Being Index; WHO-5), and drowsiness-related driving events. QOL outcomes were examined with descriptive statistics by EDS status (Epworth Sleepiness Score, ESS>and<10). We further examined differences by EDS using linear regression models adjusted for potential confounders. A sub-sample analysis was performed on those with self-reported PAP adherence averaging ≥6 hours/night.

**Results:** Of the respondents (n=292), 48.3% were female, 68.2% were ≥55 years, 91.4% were non-Hispanic/White, average body mass index was 32.8 kg/m² (standard deviation: 8.1), and 47% reported sleeping ≥6 hours/night on average. Sleepiness was identified as a precipitating factor for seeking initial treatment for 31% of respondents. Compared to those without EDS, those with EDS reported poorer QOL outcomes (WPAI, SF-12v2, FOSQ-10, WHIIRS, WHO-5, drowsiness-related driving events; all nominal p<0.01). Associations persisted after adjusting for demographics and comorbidities. In sub-sample analyses among 181 (85%) PAP-adherent patients, 29.8% reported residual EDS, and similar associations between EDS and QOL were observed.

**Conclusion:** Patients seeking online SA support experienced a high prevalence of EDS, despite high self-reported PAP adherence. EDS was associated with poorer QOL, including functionality, work, mood, and driving. EDS burden among SA patients despite PAP treatment may drive these individuals to seek online support for problems with sleepiness-related QOL, suggesting potential gaps in clinical care.

**Support (If Any):** Jazz Pharmaceuticals

**0488 POOR SLEEP AND DAYTIME SLEEPINESS INCREASE THE RISK OF HYPERTENSION ASSOCIATED WITH MILD-TO-MODERATE OBSTRUCTIVE SLEEP APNEA: AGE EFFECT**

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**Introduction:** Mild-to-moderate obstructive sleep apnea (OSA) affects 15-40% of the adult general population. However, it remains unclear when and how best to treat mild-to-moderate OSA. It has been shown that mild-to-moderate OSA in general random samples are associated with incident hypertension, particularly in the young and middle aged. In this study we examine whether symptoms modify the association between OSA and hypertension in patients with mild-to-moderate OSA.

**Methods:** A clinical sample of 188 adults (50.0 ± 14.65 years) with mild-to-moderate OSA (AHI between 5 and 29 events per hour) underwent 8-hour polysomnography, a clinical history and physical examination, including measures of blood pressure and body mass index (BMI). Poor sleep was measured with the Pittsburgh Sleep
Quality Index (PSQI) and daytime sleepiness was measured with the Epworth Sleepiness Scale (ESS). Hypertension was defined by physician diagnosis, past or present treatment, or blood pressure ≥140/90. All analyses were controlled for gender and BMI.

Results: The symptoms of poor sleep and daytime sleepiness were associated with significantly greater odds for hypertension (OR = 2.74, 95% CI = 1.13-6.61, p = 0.025). The association of these symptoms was stronger in those patients younger than 60 (OR = 4.05, 95% CI = 1.35-12.1, p = 0.012), while the association lost significance in those patients above 60 years old (OR = 1.04, 95% CI = 0.20-5.5, p = 0.96).

Conclusion: Our data suggest that poor sleep and daytime sleepiness improves the ability for clinicians to detect cases of mild-to-moderate OSA with increased cardiovascular risk. Importantly, the utility of these symptoms is strongest in young and middle aged adults. These results also suggest a different phenotype in older adults with mild-to-moderate OSA compared to young and middle aged adults.

Support (If Any): NA

0489
SUBJECTIVE SLEEPINESS AND PREVALENT HYPERTENSION IN ADULTS WITH TYPE 2 DIABETES MELLITUS AND OBSTRUCTIVE SLEEP APNEA
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Introduction: Subjective sleepiness is commonly seen in persons with type 2 diabetes mellitus (T2DM) and obstructive sleep apnea (OSA). Sleepiness is being increasingly recognized as a potential effect modifier on the association between OSA and cardiometabolic outcomes. However, much of the available evidence has focused on men. The objective of the current analyses was to characterize the association between subjective sleepiness and prevalent hypertension as a function of sex and obesity in a sample of persons with T2DM and moderate-to-severe OSA.

Methods: Adults with non-insulin requiring T2DM and undiagnosed moderate-to-severe OSA were recruited from the community. Demographic information, Epworth Sleepiness Scale (ESS) scores, prevalent hypertension data (defined as current antihypertensive medication), self-reported sleep duration, as well as a type III home sleep test were obtained. Moderate-to-severe OSA was defined as oxygen desaturation index of 3% (ODI3) of ≥15 events/hr. Sleepiness was defined as an ESS score ≥11. The association between subjective sleepiness and hypertension was examined using logistic regression analyses.

Results: The sample included 303 participants with 56% men. The mean ESS was 10.1 and 9.7 in women and men, respectively. Average self-reported sleep duration was similar in women and men: 6.15 versus 6.36 hours. Stratified analyses by sex demonstrated that subjective sleepiness was associated with prevalent hypertension only in men with a body mass index (BMI) < 35 kg/m². After adjusting for ODI3, sleep duration, race, and age the odds ratio (OR) of prevalent hypertension in men with an ESS ≥11 compared to men with an ESS <11 was 2.53 (95% CI: 1.07, 6.02). No association was observed in men with a BMI ≥35 kg/m² or in women of any BMI category.

Conclusion: The association between subjective sleepiness and hypertension in people with type 2 diabetes and moderate-to-severe OSA varies a function of BMI and sex. Differences in association should be considered for early identification of patients with T2DM at risk for co-existing hypertension - an additional risk factor for cardiovascular disease.

Support (If Any): NIH grant: HL118414

0490
INSOMNIA AMONG MILITARY MEMBERS WITH OSA
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Introduction: Obstructive sleep apnea is more prevalent in military members than civilian counterparts despite a younger and thinner population. CPAP adherence among military members is often suboptimal, raising concerns about how effectively this population is evaluated and treated with regards to OSA phenotype. The purpose of our study was to evaluate the prevalence of low arousal threshold (LAT) phenotype among military patients with OSA and describe the relationship with comorbid insomnia.

Methods: Retrospective review of consecutive service members found to have OSA following level one attended nocturnal polysomnography from 2012-2014 performed for clinical suspicion of sleep-disordered breathing. Low arousal threshold (LAT) was based on previously published non-invasive PSG criteria (AHI<30 events/hour, oxygen saturation nadir>82.5% and >58.3% of events are hypopneas). Clinic intake questionnaire including the Insomnia Severity Index (ISI) and the electronic medical record data were reviewed for all patients.

Results: 308 patients were evaluated (87.3% male, age 41.0±8.8, BMI 28.9±4.3 kg/m2, AHI 11.2±11.4 events/hour). The mean ISI score was 12.1±5.5, consistent with subthreshold insomnia, and 38.2% of patients met criteria for clinical insomnia (ISI>14). The majority of the cohort met criteria for LAT (n=278 (90.3%)). Patients with an LAT had a higher ISI score (12.0±5.0 vs 10.0±5.0, p=0.05), and the mean percentage of hypopneas varied significantly across ISI categories (p=0.02). Diagnoses of PTSD and TBI did not predict the occurrence of the LAT.

Conclusion: The majority of service members with OSA fulfill PSG criteria for LAT. Symptoms of insomnia are more prevalent among patients with an LAT, and the mean percentage of hypopneas is related to ISI categorization. Further research is needed to clarify the interactions between comorbid insomnia, the LAT, and OSA.

Support (If Any): N/A

0491
PREVALENCE AND PREDICTORS OF OBESITY HYPOVENTILATION SYNDROME IN THE BARIATRIC SURGERY POPULATION
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**Introduction:** Although obesity hypoventilation syndrome (OHS) is associated with increased morbidity and mortality post-bariatric surgery, there is limited characterization of OHS predictors in this population. We hypothesize that patients referred for bariatric surgery with OHS are more likely to have a greater severity of obstructive sleep apnea (OSA) and metabolic derangements compared to their eucapnic counterparts.

**Methods:** 1114 patients undergoing polysomnography (PSG) with end-tidal CO2 monitoring prior to bariatric surgery at Cleveland Clinic from September 2011 to September 2018 were included. OHS was defined by body mass index (BMI) ≥30kg/m² and either PSG-based end-tidal CO2 (EtCO2) ≥45mmHg or serum bicarbonate levels ≥27mEq/L. Univariable and multivariable logistic regression models (OR[95%CI]) were used to examine OHS predictors consisting of factors in domains of patient characteristics, polysomnography (cardiorespiratory and sleep architecture), laboratory and metabolic parameters.

**Results:** The analytic sample was comprised of 1114 patients: age 43.9±12.1 years, 11.6% male, BMI=47.8±8.6kg/m², and 62.7% Caucasian. OHS prevalence was 65.6%. Univariable logistic regression analyses revealed odds of OHS increased by 7% (1.07: 1.02,1.13) per 5-year increase in age; increased by 2% (1.02: 1.00,1.03) per 5-unit increase in stage shift; increased by 7% (1.07: 1.01,1.13) per 5% increase in sleep time SaO2<90%; decreased by 2% (0.98: 0.97,0.99) per unit increase in maximum heart rate during sleep; and increased by 17% (1.17: 1.04,1.31) per unit increase in hemoglobin A1c; the latter which persisted despite adjustment for age, sex, race, and BMI (1.13: 1.00,1.27). A 5% increase in odds of OHS per 10% increase in AHI decile was observed: (1.05: 1.00,1.09).

**Conclusion:** In this well-phenotyped clinic-based cohort, two-thirds of patients referred for bariatric surgery had OHS. Impaired long-term glucose control (even after adjustment for factors including obesity) was one of the strongest OHS predictors, as were alterations in sleep-related cardiopulmonary physiology and increasing age. These important findings can inform risk stratification for OHS in those undergoing bariatric surgery and set the stage for experimental studies to examine sleep-related respiratory and metabolic hypventilation contributions.

**Support (If Any):** Cleveland Clinic Neurological Institute Transformative Neuroscience Development Award

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**Methods:** We analyzed data from the Nulliparous Pregnancy Outcomes Study: Monitoring Mothers-to-be Sleep Disordered Breathing (nuMOM2b-SDB) study. SDB was measured objectively with a self-administered level 3 home sleep test in early (6-13 weeks gestation) and late (22-29 weeks gestation) pregnancy and defined as an Apnea Hypoxia Index ≥5. We defined early-onset SDB as SDB that was present since early pregnancy while late-onset SDB was defined as SDB that was only present at the time of the late pregnancy assessment. LGA and SGA were defined as birthweight >90th and <10th percentile for gestational age according to gender-specific reference values.

**Results:** SDB data were available for 3,263 participants in early pregnancy and 2,512 in late pregnancy. Early-onset SDB was present in 3.5% of participants, while late-onset SDB was found in 5.7% of participants. The overall frequency of LGA and SGA was 7.4% and 11.9% respectively. Early-onset SDB was associated with a higher mean birthweight (3313 vs. 3204 g, p=0.02) after adjusting for BMI, chronic hypertension, pre-gestational diabetes, and gestational age. In unadjusted models, early-onset SDB and was associated with LGA birthweight (OR 2.11, 95% CI 1.22 - 3.65). After adjusting for BMI, chronic hypertension, and pre-gestational diabetes, the odds ratio was attenuated and no longer statistically significant (aOR 1.02, 95% CI 0.56 -1.87). Late-onset SDB was not associated with increased birthweight or LGA. Neither early nor late-onset SDB were associated with SGA.

**Conclusion:** SDB in early pregnancy was associated with a higher mean birthweight. However, no association between SDB in pregnancy and LGA or SGA birthweight was observed.

**Support (If Any):**
between OSA and cancer risk (HR: 1.09; 95% CI: 0.95, 1.25). When examining cancer risk by site, OSA was associated with significantly increased risk for lung cancer (n=484; HR: 1.56; 95% CI: 1.09, 2.24) and possibly increased risk for kidney (n=83; HR: 1.70; 95% CI: 0.81, 3.58) and bladder cancer (n=137; HR: 1.76; 95% CI: 0.94, 3.29). There were no associations with other sites examined including breast, colon/rectum, uterus, ovary, pancreas, and melanoma.

Conclusion: We observed heterogeneous associations between OSA and site-specific cancer risk. The results need to be confirmed in other studies given the relatively small number of cases for bladder/kidney cancers and the focus on elderly women. Further investigation is required to understand the mechanisms underlying the associations with specific cancer sites, such as variations in the sensitivity of different tissue/cell types to hypoxia.

Support (If Any): NIH grants UMICA186107, P01CA87969, K01HL143034, R35HL135818

ASSOCIATIONS OF OBSTRUCTIVE SLEEP APNEA WITH RENAL FUNCTION DECLINE IN A COHORT OF VETERANS

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Introduction: Association of obstructive sleep apnea (OSA) with accelerated renal function decline was reported in several cohorts of patients with chronic kidney disease (CKD), in which diabetes is highly prevalent. However, in a community-based cohort with low prevalence of diabetes, sleep apnea was associated with slower renal function decline (Canales MT et al., SLEEP 2018). We aim to reconcile these discrepancies by analyzing a sleep clinic-based cohort.

Methods: We observed 1452 veterans (95% male, 80% white) who were referred to a veteran’s sleep medicine clinic and received polysomnography test. Estimated glomerular filtration rate at the baseline (eGFR0) and the end of observation (eGFR1, about five years later) were recorded. A multivariable regression analysis was conducted on the associations of eGFR1 with eGFR0, age, race (black, white, other), hypertension status, diabetes status, and the apnea-hypopnea index (AHI).

Results: The baseline prevalences of sleep apnea (AHI >5), diabetes, CKD (eGFR0 <60) were 67%, 36%, 21% respectively. The eGFR1 was positively correlated with eGFR0, and negatively correlated with age and with the diabetes status, all with strong significance (P <0.0001). Hypertension status was not correlated with eGFR1 (P =0.5). AHI was negatively correlated with eGFR1 only with marginal significance (P =0.02). When using the subgroup without OSA (AHI ≤5) as reference, even the subgroup with severe OSA (AHI >30) showed only slightly lower eGFR1 without significance (P =0.06).

Conclusion: The association of OSA with renal function decline is complex, and the diabetes status is a significant confounding factor. Here we showed that after corrections for age, race and the diabetes status, AHI was only weakly associated with accelerated decline of renal function. Our findings are consistent with the recent findings that mild-moderate OSA may be renally protective, whereas only very severe OSA may be renally impairing.

Support (If Any): Veterans Affairs Healthcare System
Methods: A single-site feasibility study was designed to prospectively evaluate logistics of screening and testing for OSA among COPD and HF before hospital discharge. STOP-Bang and Home Sleep Apnea Testing (HSAT) were used to evaluate patients’ OSA risks and diagnosis. Triaged patients’ diagnosis, response to automatic Positive Airway Pressure (APAP) therapy, compliance, and care utilization data were analyzed.

Results: In 6 months, 36 hospitalized patients were enrolled based on hospitalists’ evaluation, with a mean STOP-Bang score of 5.4 and 93.8% scoring ≥4. Patients’ mean age was 71.8 years, 44.4% were male and 91.7% had Medicare. 41.7% had type 2 diabetes, 86.1% were hypertensive and 30.1% had uncontrolled hypertension. Bedside HSAT was offered to all 36, with 31 (86.1%) successfully completed, 26 (83.9%) of completed HSAT) diagnosed with co-morbid OSA (AHI mean = 37.7), and 13 severe OSA. Of the 26, 69.2% were HF only, 19.2% COPD only while 11.5% had both. APAP was offered to all 26, with 15 (57.7%) successfully completed, 26 (83.9% of completed HSAT) diagnosed with OSA to moderate OSA; 11 studies (0.47%) increased from mild OSA to nil OSA (0.22 events/hour) compared to studies with moderate (0.38 events/hour), mild (0.24 events/hour) and nil OSA (0.02 events/hour). 21 studies (0.2%) changed severity of OSA based on the addition of WSW events; 1 study (0.03%) increased from nil OSA to mild OSA; 9 studies (0.33%) increased from mild OSA to moderate OSA; 11 studies (0.47%) increased from moderate OSA to severe OSA. Overall, WSW also had longer event duration and lower oxygen desaturation that events scored entirely in sleep.

Conclusion: Although WSW events are only responsible for a small portion of total respiratory events, they appear to have an important clinical impact on the patient. If WSW events are scored, it may alter the diagnosis and/or treatment recommendations. Also, as WSW events are, on average, longer in duration and have a lower oxygen desaturation, these events may present a different clinical picture to the Physician.

Support (If Any): Good Sam Foundation Heidner Foundation

0497 RESPIRATORY EVENTS THAT BEGIN AND END IN EPOCHS SCORED AS WAKE
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Introduction: According to the AASM Manual for the Scoring of Sleep and Associated Events (v2.5) respiratory events can be scored if the event begins or ends in an epoch of sleep. The rules do not take into account events that begin and end in epochs of wake, but span at least one epoch of sleep, or wake-sleep-wake (WSW) events. To determine the impact of these events being overlooked, further analysis was conducted.

Methods: 10481 previously scored studies performed at West Australian Sleep Disorders Research Institute were re-examined for the presence and frequency of WSW events. WSW events were then removed from the scored respiratory events to determine how many studies would have an altered OSA severity classification. Individual respiratory events were also examined and WSW events were compared to respiratory events scored entirely in sleep.

Results: Of the 10481 studies examined, 1141 (10.89%) studies were identified as having at least one WSW event. Overall, studies with severe OSA were more likely to have WSW events (26%) compared to studies with moderate (15%), mild (7%), and nil OSA (1%), and severe studies had more WSW events per hour (mean 0.72 events/hour) compared to studies with moderate (0.38 events/hour), mild (0.24 events/hour) and nil OSA (0.02 events/hour). 21 studies (0.2%) changed severity of OSA based on the addition of WSW events; 1 study (0.03%) increased from nil OSA to mild OSA; 9 studies (0.33%) increased from mild OSA to moderate OSA; 11 studies (0.47%) increased from moderate OSA to severe OSA. Overall, WSW also had longer event duration and lower oxygen desaturation that events scored entirely in sleep.

Conclusion: Although WSW events are only responsible for a small portion of total respiratory events, they appear to have an important clinical impact on the patient. If WSW events are scored, it may alter the diagnosis and/or treatment recommendations. Also, as WSW events are, on average, longer in duration and have a lower oxygen desaturation, these events may present a different clinical picture to the Physician.
followed AASM 2012 scoring criteria, using 3% or arousals for hypopneas.

**Results:** Among the 300 participants, 67 women (22.3%) had moderate-severe REM-OSA (mean REM-AHI 26.3± 9.5), despite having an overall AHI < 15 (mean total AHI 9.0 ± 3.2). In comparison, 233 women (77.7%) did not have significant REM-OSA (mean REM-AHI 5.7±3.9, mean overall AHI 3.9±3.2). The REM-OSA group was significantly older (53.8 ± 13.7 vs 49.0 ± 15.9 years, p=0.015), and had a trend toward greater BMI (36.7 ± 8.4 vs 34.3 ± 10.6 kg/m², p = 0.051).

**Conclusion:** Nearly a quarter of women who have mild OSA or are ruled out for OSA (based on total AHI) have significant REM-related disease. Given recent data showing adverse cardiovascular outcomes due to REM-OSA (independent of NREM-OSA), ignoring this metric when diagnosing disease or for insurance reimbursement, may result in under-treatment of at-risk women who have greater proclivity for sleep disordered breathing during REM sleep.

**Support (If Any):** None

### 0500
**DETERMINANTS OF DECREASED BLOOD PRESSURE ON CPAP**

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**Introduction:** The impact of CPAP on blood pressure (BP) is modest relative to anti-hypertensive medications. The role of CPAP adherence and effectiveness on BP change is not well defined. This study examines the short-term impact of CPAP therapy preceding blood pressure measurement in a single healthcare system by leveraging CPAP-EHR interface data.

**Methods:** 3100 sequential patients (68% male; age 54±13; BMI 37±8) were utilized for analysis. Included patients were at least 18 years of age, had AHI ≥ 15, were initially evaluated in 2015 or later, had BP measurements at initial and 6-month follow-up visits, and had daily CPAP-EHR interface data available for the 30-day window immediately preceding the 6-month BP measurement. Subgroup analyses were performed on patients with and without elevated initial BP (n= 1022 and 2078, respectively). Two-tailed t-test was used for BP comparisons between baseline and 6-month measures. Multiple linear regression was employed to determine impact of 1) preceding 30-day CPAP use (CPAPuse), 2) change from baseline AHI to 30-day average AHI in same window(AHIchg), 3) age, 4) baseline BMI, 5) number of anti-hypertensive medications, and 6) baseline BP on observed changes in blood pressure.

**Results:** In this population, patients used CPAP an average of 5.5±2.3 hours and had a residual AHI of 3.3±4.6 with an abandonment rate of 4.2% (CPAPuse < 20 minutes/day). Compared to baseline, the six month systolic, diastolic and mean BPs dropped 3.0, 2.9, and 2.9 mmHg respectively (p<0.001). Multiple linear regression analysis of initially normotensive patients showed average mean arterial pressure change of only 0.1±9.2 mmHg (p=0.65), while hypertensive patients dropped 8.65±10.0 mmHg (p<0.001). Multiple linear regression only explained 51% of the variance in 6-month BP change with most of that variance due to baseline BP. The CPAPuse coefficient was 0.23 ± 0.07 mmHg/hour of use and only accounted for approximately 1% of the total variance.

**Conclusion:** In patients with sleep apnea, blood pressure improved over time; however, only a small fraction of the blood improvement change was attributable to CPAP use. Further trials are needed to confirm effect sizes and cardiometabolic correlates.

**Support (If Any):** None
0501
USE OF THE AASM RECOMMENDED HYPOPNEA DEFINITION TO ASSOCIATION BETWEEN OBSTRUCTIVE SLEEP APNEA AND 2018 ACC/AHA BLOOD PRESSURE THRESHOLDS
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Introduction: The association between obstructive sleep apnea (OSA) and hypertension in prior studies has been determined using a definition of hypopnea requiring a 4% O2 desaturation. However, the AASM recommends using a 3% O2 desaturation or an arousal. This analysis assesses the relationship between OSA and hypertension utilizing the AASM recommended definition and the 2018 ACC/AHA blood pressure (BP) guidelines.

Methods: Data from 6113 participants from the baseline examination of the Sleep Heart Health Study were analyzed. The apnea hypopnea index (AHI) using home polysomnography and defined by a 3% O2 desaturation or an arousal was classified into 4 categories of OSA severity: <5, 5–<15, 15–<30 and ≥30/hour. Three definitions of dichotomous BP elevation were used: Elevated (>120/80 or use of hypertension medications [meds]), Stage 1 or Stage 2 (>130/80 or meds), Stage 2 (>140/90 or meds). The association between elevated BP and/or hypertension and OSA severity was assessed using logistic regression controlling for demographics and body mass index (BMI). Additional analyses utilized multiple linear regression to determine the relationship between natural log AHI, and systolic and diastolic BP controlling for the same covariates.

Results: For all definitions of BP elevation, increasing OSA severity was associated with greater likelihood of an elevated or hypertensive status in fully adjusted models: Elevated OR (95%CI): 1.30 (1.10–1.54), 1.41 (1.15–1.72) 1.69 (1.32–2.17); Stage 1: 1.27 (1.09–1.49), 1.36 (1.13–1.63), 1.58 (1.27–1.97); Stage 2: 1.07 (0.92–1.26), 1.22 (1.02–1.45), 1.38 (1.12–1.69) for AHI 5–<15, 15–<30 and ≥30/hour (<5/hour=reference). Linear regression found that OSA was associated with both systolic and diastolic blood pressure in fully adjusted models.

Conclusion: Use of the AASM recommended definition of hypopnea as a component of the AHI is associated with the presence of an elevated or hypertensive BP. This suggests that use of a 4% O2 desaturation requirement to identify patients with OSA is too stringent. Additional analyses will be required to assess whether using a 3% O2 or arousal criterion is predictive of incident hypertension.

Support (If Any): NHLBI

0502
WATCHPAT IS ACCURATE IN THE DIAGNOSIS OF SLEEP APNEA IN THE PRESENCE OF ATRIAL FIBRILLATION
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Introduction: The WatchPAT is a Home Sleep Testing device which has been shown to be accurate for diagnosing obstructive sleep apnea (SA). Studies so far excluded patients with arrhythmias as the potential effect on Peripheral Arterial Tone amplitude and rate changes had not been validated. We therefore sought to examine the accuracy of the WatchPAT in detecting SA in patients with atrial fibrillation (AF).

Methods: 101 patients (70 males) previously diagnosed with AF (permanent/persistent/paroxysmal/unknown type), aged 68.5±11.7 years, with suspected SA, underwent simultaneous recording of full night in-lab polysomnography (PSG) and WatchPAT (Itamar-Medical, Caesarea, Israel), in 10 medical centers. PSG scoring was performed blinded to the automatic scoring of the WatchPAT.

Results: Of the 101 patients, 46 patients had AF episodes during the study night: 38 had AF episodes throughout the entire night and 8 had AF episodes part of the night. The presence of AF episodes did not cause significant non-valid PAT signal. Using a threshold AHI ≥ 15, the sensitivity and specificity of the WatchPAT for all 101 patients were 0.88 and 0.63, respectively. Significant correlation was found between AHI assessed by PSG and by WatchPAT (r=0.8, p<0.01). This correlation remained significant also for the subgroup of 46 patients with AF episodes (r=0.8, p<0.01). The overall accuracy in sleep staging between WatchPAT and PSG based on an epoch-by-epoch comparison was 62% (compared to the previously reported 65% in the general population) with a Kappa agreement of 0.42 (compared to the previously reported 0.47 in general population).

Conclusion: These findings suggest that WatchPAT can accurately detect SDB events in patients with AF, and that AF should not be an exclusion criterion for using this device.

Support (If Any): The study was supported by an unrestricted grant from Itamar-Medical.

0503
REM PREDOMINANT OBSTRUCTIVE SLEEP APNEA AND HYPERTENSION: A CROSS-SECTIONAL STUDY IN CLINICAL SAMPLE
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Introduction: It has been reported that REM-predominant OSA had different clinical features and risks for cardiovascular disease than NREM OSA. However, studies investigating the REM OSA and NREM OSA have inconsistent results. This study aimed to investigate the clinical features of REM OSA and NREM OSA and their associations with hypertension in patients with OSA.

Methods: Clinical and polysomnographic information were extracted from a database prospectively collected from 6,875 referrals for suspected sleep apnea from January 2009 to December 2016. Patients with REM or NREM less than 15 min were excluded. REM OSA was defined as the ratio (apnea-hypopnea index at REM divided to that at NREM) more than 2 where NREM OSA was defined as the ratio less than 0.5. The data were compared between REM OSA and NREM OSA. The association between REM OSA/NREM OSA and hypertension was analyzed with logistic regression and presented as odds ratio (OR).

Results: Among 5308 patients with OSA, 1763 (33%) were REM OSA and 460 (9%) NREM OSA. The REM OSA were younger (P=0.006), more female (P<0.001), and had higher body mass index (P<0.001) while NREM OSA had higher neck circumference (P<0.001), higher percentage of active smoker (P=0.003), alcohol drinking (P=0.001), diabetes (P=0.014) and chronic kidney disease (P=0.37). The percentage of hypertension was similar between REM OSA and NREM OSA (24% vs 25%). For the polysomnographic features, NREM OSA had higher AH1 (either supine or non-supine), longer apneu duration, oxygen desaturation index and arousal index (all P<0.001). In REM OSA, the risk of hypertension increased with OR 1.46 and 2.41-fold for moderate and severe OSA, respectively, compared to mild OSA with the adjustment of age and gender. Such an association was not seen in NREM OSA.

Conclusion: The clinical and polysomnographic features of REM OSA were different from those of NREM OSA. REM OSA was associated with increased risk of hypertension while OSA was more severe.

Support (If Any): NA

0504
Mortality Risk Associated with Mild-to-Moderate Sleep Apnea is Modified by Age
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Introduction: Mild-to-moderate sleep apnea (OSA) is highly prevalent in the general population but its association with morbidity and mortality is not well-established. We examined the association between mild and moderate OSA and all-cause mortality in a large random general population sample.

Methods: The Penn State Adult Cohort, a random general population sample of 1741 men and women studied in the sleep laboratory with 8-hours polysomnography at baseline and followed-up for 19.2 ± 5.2 years for all-cause mortality. Mild OSA was defined as an apnea/hypopnea index (AHI) of 5 to 14.9 events/hour, while moderate OSA as an AHI of 15 to 29.9 events/hour. Cox proportional hazards regression was used to estimate all-cause mortality adjusted for race, sex, BMI, smoking, hypertension, diabetes, heart problems and stroke at baseline.

Results: All-cause mortality risk was significantly increased in the mild-to-moderate OSA group (HR = 1.28, 95% CI = 1.04-1.57, p=0.019). The risk of mortality was 1.4-fold (95% CI = 1.04-1.98, p = 0.027) in young and middle-aged adults (20-59y) with mild-to-moderate OSA, whereas it was negligible in older adults (>60y) with mild-to-moderate OSA (HR = 1.14, 95% CI = 0.87-1.49, p = 0.336).

Conclusion: Mild-to-moderate sleep apnea is associated with significant all-cause mortality risk but the strength of the association decreases markedly with age. These findings are in line with previous findings that the association of mild-to-moderate OSA with cardiometabolic risk is modified by age and suggests that OSA in older adults is a distinctly different phenotype than in the young and middle-aged.

Support (If Any): NA

0505
EMR and Clinic Based Approaches for Recruiting Peer Support for Sleep Apnea
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Introduction: Peer-support can improve adherence to therapy in various chronic medical conditions including adherence to continuous positive airway pressure (CPAP) therapy in patients with obstructive sleep apnea. Methodology to identify and recruit peers are generally not well described. We assessed the feasibility and yield of Electronic Medical Record (EMR) based approaches versus clinic-based approaches for identifying and recruiting peers with OSA who can help promote adherent behavior in research participants.

Methods: Peer-mentors were recruited from the sleep center by a stepped EMR-based approach combined with a clinic-based approach or direct referral of potential mentors by busy clinicians within these clinics.

Results: Over an 11-month period, 1,539 sleep clinic patients with upcoming appointments were screened in the combined
EMR- and clinic-based approaches. Forty-five percent (n=694) of 1,539 patients (51.8% women) were initially identified as potential peer-mentors. A more detailed EMR-review deemed 86.4% (n=600) of the patients as ineligible to be peer-mentors. Reasons for exclusion included: mental health conditions (26.2%); non-adherence to CPAP therapy based on device download (23%); complicated medical history (12.7%); recently diagnosed with OSA or undergoing diagnostic work-up (11.6%); residing outside city limits (11.8%); no OSA diagnosis (9.7%); shift-work or busy job interfering with mentoring responsibilities (2.6%); provider documented difficulty with CPAP adherence (1.7%); and oral appliance treatment (0.9%). Of the remaining 94 individuals, 11 consented to participating in the research study as peer-mentors when approached in the sleep clinic. EMR-based screening was more efficient in detecting screen-failures (93.8%) than clinic-based approach of detecting screen-failures (83%; \( \chi^2 = 0.0001 \)). Recruitment rate of the combined EMR- and clinic-based screening approach was 11 of 1,539 (0.01%) whereas direct referrals by busy clinicians had a recruitment rate of 100% (six of six referred patients consented for study participation as peer mentors; \( P = 0.0001 \)).

**Conclusion:** An EMR-based identification of potential peer-mentors for promoting adherent behavior in patients with OSA is feasible and can be combined with clinic-based approaches.

**Support (If Any):** HL138377

**0506**

**INPATIENT VERSUS OUTPATIENT PORTABLE MONITOR USE FOR OBSTRUCTIVE SLEEP APNEA SCREENING**

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**Introduction:** Obstructive sleep apnea (OSA) is highly prevalent disease associated with increased morbidity and mortality. In 2012, the American Academy of Sleep Medicine re-defined hypopneas to account for significant OSA symptoms. We hypothesized that the change leads to increased need to follow up titration polysomnographies (PSG) in patients with subsequent delays to treatment.

**Methods:** This is a retrospective, observational, cohort, single center study, aimed to compare the effect of using AHÍ3 (reduction in airflow ≥30% compared to baseline for ≥10 seconds accompanied by ≥3% desaturation or an arousal) vs. AHÍ4 (reduction in airflow ≥30% compared to baseline for ≥10 seconds accompanied by ≥4% oxygen desaturations) in newly diagnosed adults patients with OSA (AHÍ3 ≥ 5/hr). The AHÍ3a group included PSG from January to March 2018, and AHÍ4 group from March to June 2018. Age, AHÍ3a vs AHÍ4 on baseline-PSG or baseline portion of split-PSG, sleep study type (baseline vs split-PSG), and time to therapy initiation when available were included for analysis and compared using 2 sided t-test. Data reported as mean and standard deviations or number and percent.

**Results:** 587 patients were included, 276 in the AHÍ3a and 311 in the AHÍ4 group. There were no significant differences in age (53.67 ± 14.63 vs 53.48 ± 13.91, p = 0.80), AHÍ3a (36.9 ± 31.7 vs. 36.8 ± 33.4, p = 0.970) and AHÍ4 (25.94 ± 28.9 vs. 25.8 ± 31.6, p = 0.976) on baseline or baseline portion of the PSG. Significantly more patients in the AHÍ3a group had split-PSG compared to AHÍ4 group (82.6% vs. 59.8%, p < 0.0001). There was no significant difference in the time to therapy initiation between the two groups (70.01 vs 65.96 days, p = 0.64), however data was available for only 161 patients (27.4%).

**Conclusion:** Changing hypopnea definitions from the current AASM recommended definition using 3% desaturations to the alternative definition using the 4% oxygen desaturations, resulted in a higher proportion of baseline vs split-polysomnographies. More research is needed to determine the impact on the time from diagnosis to treatment.

**Support (If Any):** not applicable

**0507**

**TO SPLIT OR NOT TO SPLIT: THE IMPACT OF DIFFERENT HYPOPNEA DEFINITIONS USED DURING POLYSOMNOGRAPHY**

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**Introduction:** Obstructive sleep apnea (OSA) is highly prevalent disease associated with increased morbidity and mortality. In 2012, the American Academy of Sleep Medicine re-defined hypopneas to account for significant OSA symptoms. We hypothesized that the change leads to increased need to follow up titration polysomnographies (PSG) in patients with subsequent delays to treatment.

**Methods:** This is a retrospective, observational, cohort, single center study, aimed to compare the effect of using AHÍ3 (reduction in airflow ≥30% compared to baseline for ≥10 seconds accompanied by ≥3% desaturation or an arousal) vs. AHÍ4 (reduction in airflow ≥30% compared to baseline for ≥10 seconds accompanied by ≥4% oxygen desaturations) in newly diagnosed adults patients with OSA (AHÍ3 ≥ 5/hr). The AHÍ3a group included PSG from January to March 2018, and AHÍ4 group from March to June 2018. Age, AHÍ3a vs AHÍ4 on baseline-PSG or baseline portion of split-PSG, sleep study type (baseline vs split-PSG), and time to therapy initiation when available were included for analysis and compared using 2 sided t-test. Data reported as mean and standard deviations or number and percent.

**Results:** 587 patients were included, 276 in the AHÍ3a and 311 in the AHÍ4 group. There were no significant differences in age (53.67 ± 14.63 vs 53.48 ± 13.91, p = 0.80), AHÍ3a (36.9 ± 31.7 vs. 36.8 ± 33.4, p = 0.970) and AHÍ4 (25.94 ± 28.9 vs. 25.8 ± 31.6, p = 0.976) on baseline or baseline portion of the PSG. Significantly more patients in the AHÍ3a group had split-PSG compared to AHÍ4 group (82.6% vs. 59.8%, p < 0.0001). There was no significant difference in the time to therapy initiation between the two groups (70.01 vs 65.96 days, p = 0.64), however data was available for only 161 patients (27.4%).

**Conclusion:** Changing hypopnea definitions from the current AASM recommended definition using 3% desaturations to the alternative definition using the 4% oxygen desaturations, resulted in a higher proportion of baseline vs split-polysomnographies. More research is needed to determine the impact on the time from diagnosis to treatment.

**Support (If Any):** not applicable
**B. Clinical Sleep Science and Practice**

**Introduction:** This study was performed to assess the impact of use of PAP therapy for moderate or severe OSA on hospital-based care and costs in a large southeastern health system.

**Methods:** A retrospective cohort study was conducted among patients who had an in-laboratory sleep study with Atrium Health between Jan 1, 2014 and Dec 31, 2016. Patients were eligible if they: were at least 18 years old, were diagnosed with OSA, initiated PAP therapy, had an apnea-hypopnea index ≥ 15/hour and had a central apnea index ≤15/hour. Patients’ daily PAP usage data was obtained from Somnoware, a proprietary cloud-based management platform. Other data were obtained from the Atrium Health’s electronic data warehouse which contains patients’ clinical, billing, and scheduling data.

**Results:** The study consisted of 1098 patients, of which 60% (n=665) were on PAP >4 hours/night for ≥70% of the studied nights. After adjusting for significant covariates, association between PAP usage and acute care utilization was still evident in different measures of adherence. Increasing PAP usage was negatively associated with inpatient (IP) and overall acute care visits. For every 1 hour/night increase in PAP usage, there was 8% decrease in IP visits (RR=0.92, 95% CI:0.86-0.98) and 4% decrease in overall visits (RR=0.96, 95% CI:0.92-0.99). Increasing PAP usage was associated with less likelihood of having positive cost from IP (OR=0.93, 95% CI:0.86-1.00) and overall acute care visits (OR=0.94, 95% CI:0.89-1.00).

**Conclusion:** Broadly, use of PAP therapy above 4 hours per night over the 18m period was associated with a reduction in overall inpatient visits and costs. There was a linear response to hours of PAP usage to reduction in acute care visits. Using CMS criteria to PAP changed some of the subcategory associations, but generally led to similar conclusions of reduced visits and costs with patients using PAP >4h/70% (a slightly higher bar than averaging more than 4 hours/night). As patients and healthcare systems evaluate methods to reduce medical costs, treating OSA effectively should be considered part of the solution.

**Support (If Any):** NA

**0509**

**EFFECT OF CPAP USE ON READMISSION RATES IN HOSPITALIZED PATIENTS WITH CARDIOVASCULAR DISEASE AND SDB**

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**Introduction:** Sleep disordered breathing (SDB) is associated with cardiac-related morbidity and mortality. Hospitalized patients with heart disease are frequently readmitted. We hypothesized that hospitalized patients with cardiovascular disease and newly diagnosed SDB who used CPAP as an outpatient would show reduced cardiovascular endpoints were the change in Epworth sleepiness scale (ESS) and patient satisfaction.

**Results:** 117 patients were randomized (SPC+CSC n= 59, SPC n=58). The baseline characteristics SPC+CSC versus SPC (mean ± SD) for age (54.4 ± 10.7 versus 56.4 ± 13.6 yrs), diagnostic AHI (40.1 ± 23.4 versus 39.9 ± 24.7 #/hr), and ESS (11.4 ± 5.9 versus 10.6 ± 5.9) did not differ. At 3 months the % of participants with ≥70% of nights with ≥ 4 hrs of use (SPC+CSC 67.8 % versus SPC 46.6%, P=0.025) and average use among all nights (4.5 ± 2.4 versus 3.3 ± 2.6 hrs, P=0.022) were higher in the CSC arm. The residual AHI and improvement in ESS did not differ. The percentage of

**II. Sleep-Related Breathing Disorders**

**0510**

**EFFECT OF SLEEP COACHES USING CLOUD-BASED MONITORING ON PAP ADHERENCE**

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**Introduction:** Positive airway pressure (PAP) treatment for obstructive sleep apnea (OSA) in the VA Health Care System is challenging due to high demand/limited resources and delay in timely communication of PAP problems. The 4 PAP respiratory therapists (RTs) at the Gainesville VAMC provide durable medical equipment (DME) services for over 5000 patients, making timely response to new PAP-user issues difficult. The Patient Adherence Management System utilizes protocol-driven centralized sleep coaches (CSC) who monitor adherence via a wireless PAP data program and provide live telephone contact on Days 3, 7, 14, and 30 after PAP setup to identify issues and encourage adherence. PAP issues not resolved by CSC are escalated to the DME/sleep provider. We hypothesized the CSC system improves PAP adherence in treatment-naive patients.

**Methods:** A randomized prospective protocol comparing: Arm 1: standard PAP care (SIC) including PAP setup by PAP RT, wireless adherence monitoring, and a PAP help line. Arm 2: SPC + CSC. At PAP setup patients electing to participate signed an informed consent and were randomized to SPC or SPC+ CSC. The primary endpoint was 3-month adherence, and secondary endpoints were the change in Epworth sleepiness scale (ESS) and patient satisfaction.

**Results:** 117 patients were randomized (SIC+CSC n= 59, SPC n=58). The baseline characteristics SIC+CSC versus SPC (mean ± SD) for age (54.4 ± 10.7 versus 56.4 ± 13.6 yrs), diagnostic AHI (40.1 ± 23.4 versus 39.9 ± 24.7 #/hr), and ESS (11.4 ± 5.9 versus 10.6 ± 5.9) did not differ. At 3 months the % of participants with ≥70% of nights with ≥ 4 hrs of use (SPC+CSC 67.8 % versus SPC 46.6%, P=0.025) and average use among all nights (4.5 ± 2.4 versus 3.3 ± 2.6 hrs, P=0.022) were higher in the CSC arm. The residual AHI and improvement in ESS did not differ. The percentage of
patients satisfied/very satisfied with their therapy was higher in the SPC+CSC group (88.5% versus 67.3%, P=0.01)

**Conclusion:** Addition of the CSC system to standard care significantly improves PAP adherence at 3 months.

**Support (If Any):** Philips Respironics

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**0511**

**HEALTH BENEFITS TO PEERS PARTICIPATING IN A MENTORING PROGRAM FOR TREATMENT ADHERENCE IN PATIENTS WITH SLEEP APNEA**

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**Introduction:** Peer support aimed at improving treatment adherence can be effective in many chronic medical conditions including obstructive sleep apnea (OSA). Whether such peer-participation has any benefits to the well-being of peers who administer such peer support in unclear. We aimed to determine whether peers (who promote adherence to continuous positive airway pressure [CPAP] therapy in CPAP naïve patients with OSA) experienced any change in CPAP adherence, self-reported sleepiness, or health-related quality of life (HR-QOL). A secondary aim was to determine whether there was a “dose-effect” relationship between the number of CPAP naïve patients assigned to peer mentors and health benefits.

**Methods:** We administered questionnaires to peer mentors at baseline and two-years following participation in a randomized controlled trial of peer support aimed at promoting adherence to CPAP therapy in treatment naïve patients with OSA. CPAP adherence of the peer-mentor was downloaded at the start and end of study participation.

**Results:** Fifty four peer mentors participated in a trial that randomized 263 CPAP naïve patients with OSA to peer-support versus attention-control. Peers (aged 57.4 ± 12.0 years; 50% women) were predominantly white with 15% Hispanic ethnicity. Of the peer mentors who were assigned participants (n=23), CPAP adherence (usage > 4 hours/night) did not change from baseline (93.1 ± 12.1%) to end of study participation (90.9 ± 16.1% P=0.57); vigilance subgroup of the Functional Outcomes Sleep Questionnaire (FOSQ) improved from 3.5 ± 0.55 to 3.8 ± 0.33 (P=0.04); global FOSQ scores and Epworth sleepiness scores tended to improve 18.1 ± 2.2 to 18.7 ± 1.7 (P=0.13) and 6.4 ± 5.0 to 5.2 ± 3.7 (P=0.14), respectively. The number of assigned CPAP naïve patients to peer mentors was positively correlated with Global FOSQ score (beta= 0.42; P=0.011) and negatively correlated with Epworth sleepiness score (beta = -0.60; P=0.046).

**Conclusion:** Peer-mentors experienced health benefits to sleepiness and health-related quality of life by participating in a peer-support program with a dose-effect relationship based upon number of assigned mentees.

**Support (If Any):** IHS-1306-02505 and HL138377

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**0512**

**DOES PATIENT AND FAMILY ENGAGEMENT IMPROVE POSITIVE AIRWAY PRESSURE USE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA? A RANDOMIZED CONTROLLED TRIAL**

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**Introduction:** Despite clear Positive Airway Pressure (PAP) benefits, nearly 25% of users discontinue PAP within 2 weeks and 50% do so within 1 year. We sought to assess the impact of patient and family engagement in improving PAP adherence in OSA patients.

**Methods:** Pilot randomized controlled trial (RCT), patients aged &#8805;18 years with a new diagnosis of OSA, who qualified for PAP treatment, and living with a partner/parent, were randomized to Intervention group (ITG) (n=28) and Attention Control Group (ACG) (n=32). Both groups participated in a 60-90 minutes group visit (1-3 subjects with their partner/visit). Intervention group visit included four-structured sessions: interactive education, peer coaching, hands-on experience and semi-structured one-on-two motivational interview. ACG patients with their partner were educated on physical activity only. Objective PAP adherence data were obtained at 3-and-6 months. Correlated data models were used to compare temporal changes in the mean daily usage (MDU) and proportion of PAP adherence (PAP use &#8805; 4 hours/night on 70% of nights) during the three-time intervals between the two groups.

**Results:** ACG had a consistent decrease in MDU (hours/day) from baseline to 3 months (d= -2.2 and 6.6 for 3- and 6-months (d= -1.7 and 2.3, p=0.07), unlike unique ITG counterparts whose mean remained relatively constant (p=0.76). There was no difference in the change in proportion of PAP adherence (p=0.84) and in the intention to use (ITU) PAP at 3-and-6 months (p=0.15). There was an unstable spike in the ACG in the ITU at 3 months (p=0.03) unlike ITG whose rates remained constant throughout (p=0.64).

**Conclusion:** This is the largest and longest RCT of patient and partner intervention to improve PAP use. Our intervention kept the patients motivated to continue to use their PAP at the same rate as baseline whereas PAP adherence declined with time in patients undergoing standard education and counseling. Our findings suggest that additional intervention is needed to improve the PAP use in OSA.

**Support (If Any):** Funded by the Sparrow Health System/Michigan State University Center for Innovation and Research.

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**B. Clinical Sleep Science and Practice**

**II. Sleep-Related Breathing Disorders**

**0512**

**DOES PATIENT AND FAMILY ENGAGEMENT IMPROVE POSITIVE AIRWAY PRESSURE USE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA? A RANDOMIZED CONTROLLED TRIAL**

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**Support (If Any):** Funded by the Sparrow Health System/Michigan State University Center for Innovation and Research.
0513
VARIABILITY IN CPAP ADHERENCE: A NATIONAL PERSPECTIVE
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Introduction: The effectiveness of continuous positive airway pressure (CPAP) in the treatment of obstructive sleep apnea (OSA) has been limited by adherence. The American Academy of Sleep Medicine (AASM) and other stakeholders have proposed CPAP adherence rates be used as a measure of quality of care. However, the creation of such quality metrics requires an understanding of sources of non-provider variability for appropriate risk adjustment. We sought to use nationally representative data to describe CPAP adherence rates in general clinical practice as well as sources of variability.

Methods: Telemonitoring data were obtained from a therapy database maintained by a CPAP manufacturer. All new patients initiated on CPAP therapy between 11/2015 and 08/2018 who had at least one usage session were eligible. Analyses were restricted to patients with age 18-90 years, non-missing sex, and zip code within the United States. Adherence was defined based on Medicare criteria.

Results: A total of 714,270 patients met inclusion criteria. Overall, 90-day adherence was 72.5%. Age, sex, and state of residence were all significantly associated with adherence rates (p<0.05). Younger age was associated with lower adherence rates such that adherence ranged from 54.8% in those aged 18-30 to 79.1% in those aged 61-70. Women had slightly lower adherence rates than men (71.4% vs. 73.3%). In age and sex-adjusted analyses, adherence rates were lowest in the Northeast and Southwest and highest in the Upper Midwest and Mountain West. Adherence rates ranged from 50.8% in the District of Columbia and 60.5% in New York up to 81.2% in Idaho and 81.9% in South Dakota.

Conclusion: CPAP adherence rates vary substantially by both age and geography. More subtle differences exist by sex. Whether the sources of variability are due to patient factors such as disease severity and socioeconomic status, provider factors, environmental factors, or selection biases in who is diagnosed with OSA and treated with CPAP remains to be understood. A better understanding of the sources of this variability will be important before CPAP adherence can be used as a quality of care metric.

Support (If Any): Philips Respironics.

0514
A PILOT HOSPITAL INTERVENTION PROGRAM FOR TREATMENT OF OBSTRUCTIVE SLEEP APNEA
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Introduction: Prevalence of obstructive sleep apnea (OSA) in the United States is greater than 6%, and may be as high as 25% or more in the elderly. The condition is associated with development of high blood pressure, pulmonary hypertension, heart attack, stroke, atrial fibrillation, motor vehicle accidents associated with the sleepiness, and death. These comorbidities may lead to hospital admission for other reasons. Much of the therapy has been directed towards outpatient treatment with continuous positive airway pressure (CPAP). Unfortunately, patient adherence to CPAP therapy is not optimal. We tested the hypothesis that an AASM Accredited Center, technologist driven protocol, can improve CPAP adherence in hospitalized patients.

Methods: Tampa General Sleep Center (TGSC) staff noted that many in-patients were not compliant with CPAP and developed a quality improvement protocol that would address common issues preventing patients from using their machines. A consult process was developed in the TGSC EMR. Hospitalized patients who were non-compliant with CPAP received a Sleep Center consult and a technologist visited the patient to provide education and interventions for these issues. The average intervention took 30 minutes. The key components included: 1. Education on the cause of OSA and the need to treat based on comorbidities above, 2. Choosing a patient preferred mask, 3. Mask desensitization while awake.

Results: In the current pilot program, 484 consults were placed to the Sleep Center from January to December 2017. Of the 484 patients, 450 patients or 93% agreed to use their CPAP after the intervention was completed. The most common reasons given for prior non-adherence were lack of education (“no one ever told me that”), poor fitting mask interface, and claustrophobia.

Conclusion: Early results demonstrate that a sleep center technologist driven protocol can improve CPAP adherence in non-compliant patients. More study will be needed to monitor outcomes for this in-hospital intervention program, to document cost-effectiveness.

Support (If Any):

0515
INTERACTION OF APNEA SEVERITY AND COMORBIDITY WITH CPAP ADHERENCE
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Introduction: While the effects of both the apnea-hypopnea index (AHI) and adherence to continuous positive airway pressure (PAP) have been studied with respect to the incidence of major adverse cardiovascular events (MACE), few studies have directly reported on the interaction between the two. Further, the interaction between PAP adherence and the Charlson morbidity index (CMI) has also not been adequately studied.

Methods: This analysis used a cohort of patients who underwent a sleep study and were prescribed PAP at JAH Veterans Hospital in Tampa Florida between 2004 and 2007 and their follow-up data through the end of 2012. PAP adherence in the initial 3 weeks was defined as use for greater than 4 hours per day for 70% of days. MACE included death, unstable angina, MI, stroke, and surgical procedures including angioplasty, bypass and endarterectomy. AHI was entered into Proportion Hazards regression models as a continuous variable. Models were adjusted for demographics, Charlson morbidity score and prior MACE.

Results: 1737 patients with complete data for AHI, PAP adherence and covariates were included. There were 323 MACE events within 5 years. The adjusted Hazard Ratio (HRadj) for MACE for a 1 standard deviation increase in AHI was 1.124; 95% CI=(1.004, 1.257). PAP adherence was significantly protective (HRadj = 0.793;
0516

POSITIVE AIRWAY PRESSURE COMPLIANCE IN POST-ACUTE STROKE AND TRAUMATIC BRAIN INJURY PATIENTS

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Introduction: The objective was to investigate positive airway pressure (PAP) compliance following brain injury in a post-acute rehabilitative setting.

Methods: Adult brain-injured patients (n=21) diagnosed with sleep apnea via overnight polysomnography were assessed for PAP compliance using compliance online databases. The mean age was 54 ± 2 years, mean latency from injury was 119 ± 15 days, and mean days on PAP treatment was 104 ± 20 days. Compliance measures included total percentage of days used since setup and % of days used ≥4 hours. We also considered average AHI while on PAP treatment, mask type, and apnea severity.

Results: Overall, 43% of patients were using their PAP machines ≥70% of days since setup, and were considered compliant. Of those compliant patients, 88% were using full face masks; however, 63% of them continued to have a clinically significant AHI. Of the compliant patients, 67% had a diagnosis of severe sleep apnea, with an AHI >30, while only 40% of the non-compliant patients were considered severe (60% of these patients were non-compliant on PAP therapy prior to their injuries). In addition to apnea severity, patients who were compliant after at least 3 months of therapy were compliant immediately after receiving their machines and had a strong family support system vs. the patients who were considered non-compliant.

Conclusion: Despite being compliant with PAP therapy, patients using full face masks were still experiencing clinically significant AHI, indicating large leaks and a poor mask fit. In a brain-injured population, apnea severity seems to predict PAP compliance, as does initial compliance and having a strong support system at home.

Support (If Any): This study was supported by the Sleep Apnea Research and Teaching Fund of the IUCPQ-UL Foundation and the Alphonse L’Esperance Funds.

0518

PATTERNS OF LONG-TERM CPAP ADHERENCE: A 3-YEAR FOLLOW-UP FROM THE TELE-OSA STUDY

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Introduction: The Tele-OSA study demonstrated that auto-tele-monitoring (TM) with messaging (U-Sleep; ResMed Corp) significantly improves CPAP adherence at 3 months and 1 year. This 3-year follow-up evaluates long-term adherence patterns and whether TM continues to impact adherence.

Methods: The Tele-OSA study was a 4-arm randomized controlled trial (details available at Hwang et al. Am J Respir Crit Care Med. 2018 Jan 1;197(1):117-126.) which demonstrated that TM improved CPAP adherence while tele-education did not. This study is a post-hoc analysis of the following cohorts that were longitudinally followed over 3 years: a) TM (messaging continued); b) TM (messaging discontinued at 3 months); c) no TM.

Results: 556 patients were followed for 3 years. 356 (64%), 294 (53%), and 273 (49%) had evidence of any degree of usage at the 1-year, 2-year, and 3-year mark. 204 (37%), 211 (38%), and 177 (32%) used CPAP “≥70% of days with ≥4 hours”, also at those times.
A PROSPECTIVE RANDOMIZED CONTROL TRIAL OF FIXED PRESSURE VS. AUTO-TITRATING CPAP FOR PATIENTS WITH SUBOPTIMAL CPAP TITRATIONS
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Introduction: The American Academy of Sleep Medicine defines an optimal continuous positive airway pressure (CPAP) titration as a pressure that results in a respiratory disturbance index (RDI) < 5 events/hr maintained for at least 15 minutes with supine REM sleep. Many patients achieve an RDI < 5 events/hr for 15 minutes but do not have REM supine sleep at the optimal pressure. In these cases, Patients are prescribed the observed optimal CPAP pressure or place on auto-titrating CPAP. It is unclear which treatment is superior.

Methods: Patients were recruited from Temple Sleep center. After providing informed consent, patients completed the Epworth Sleepiness Scale and the Pittsburgh Sleep Quality Index. The lowest pressure (optCPAP) that reduced the RDI to < 5 events/hr was then determined. Studies were considered optimal if 15 minutes of supine and REM sleep was recorded at optCPAP and suboptimal if these criteria were not met. Patients with suboptimal studies were randomized to receive either a fixed pressure that reduced RDI to <5 or an auto titrating machine. Compliance data was obtained at 1 month for both optimal and suboptimal patients. Treatment failure was defined as a residual RDI >5 at 1 month with less than 5% of nights spent with a large leak.

Results: A total of 72 patients were recruited for the study. In 66(92%), an optCPAP was determined. There were 42 (64%) optimal studies and 24(26%) suboptimal studies. There was no statistically significant difference in Age, Sex, BMI, AHI, PSQ or Epworth score. Thirty four patients (52%) had compliance data available at 1 month, of which 14 were suboptimal. Seven suboptimal patients received Auto-titrating CPAP and 7 patients a fixed pressure. There was no significant difference in number of treatment failures between fixed and auto CPAP (1 Vs 0) even when compared to failures in the optimal group (4).

Conclusion: Both fixed pressure and auto-titrating CPAP are equally effective at normalizing the RDI at 1 month and are acceptable therapies for suboptimal titration studies.

Support (If Any): None
OSA patients by using various machine learning methods and to compare the fitness of each model.

**Methods:** We retrospectively review the medical records of 215 OSA patients who had undergone successful CPAP titration study in our sleep disorders center. We divided the data to a training (70%), a validation (15%) and a test (15%) data set, randomly. We made an OLS, a penalized regression, a support vector machine, and a random forest (RF) model to predict the optimal pressure by using the training set, and then applied the models to the validation set. To compare the fitness, we used a root mean square error (RMSE) and a R squared. Finally, we applied the model of the best performance to the test set.

**Results:** The elastic net and the RF model showed the best performance (RMSE 1.67, R squared 0.37). When we applied each model to the test data set, both showed the same performance (RMSE 2.45, R squared 0.53).

**Conclusion:** The elastic net and the RF model showed the best performance among the machine learning models. The further study for validation is required.

**Support (If Any):** No

**0522**

**CPAP ADHERENCE PREDICTORS - AN INNOVATIVE APPROACH**

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**Introduction:** Previous studies have shown that CPAP adherence within the first week of use is predictive of long-term CPAP adherence. We conducted a study to examine if a patient’s first experience of CPAP treatment during titration polysomnography is associated with objective CPAP adherence at 3-6 months.

**Methods:** This was a two-center study comprised of two urban, tertiary care hospitals. All patients included in the study underwent polysomnography CPAP titration and in the morning completed a 4-item questionnaire: Q1. How was your experience with using the mask and breathing machine during sleep? Q2. Did you experience any problems sleeping with the mask and machine? Q3. If yes, please note the problem so your doctor can provide specific advice. Q4. Will you use the mask and machine treatment for sleep apnea at home? Response to Q1 was coded 0 (not sure) and 1-5; bad to excellent, respectively. Q2 and 4 were yes/no responses. Q3 was coded 0 (no response) and 1-7 categories and ranked by frequency. *STATA 15* was used for analyses.

**Results:** The sample comprised of adults > 18 years of age and <50% women. The sample had similar racial composition at both tertiary care hospitals. All patients included in the study underwent polysomnography CPAP titration and in the morning completed a 4-item questionnaire: Q1. How was your experience with using the mask and breathing machine during sleep? Q2. Did you experience any problems sleeping with the mask and machine? Q3. If yes, please note the problem so your doctor can provide specific advice. Q4. Will you use the mask and machine treatment for sleep apnea at home? Response to Q1 was coded 0 (not sure) and 1-5; bad to excellent, respectively. Q2 and 4 were yes/no responses. Q3 was coded 0 (no response) and 1-7 categories and ranked by frequency. *STATA 15* was used for analyses.

**Conclusion:** The quality of the first experience with CPAP use in the sleep laboratory is predictive of long-term CPAP adherence. Patients with a less than excellent initial experience are at risk for not meeting adherence goals, losing access to CPAP treatment, and should be targeted for adherence optimization interventions early.

**Support (If Any):** Philips Respironics.

**0524**

**IMPACT OF NOVEL SLEEP APNEA MANAGEMENT GROUP CLINIC ON POSITIVE AIRWAY PRESSURE ADHERENCE**

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**Introduction:** Research suggests that adherence to continuous positive airway pressure (CPAP) declines following withdrawal of an intervention designed to increase usage. We have developed Patient Adherence Management Service (PAMS), a central call-center with staff trained in health behavior change, to provide personalized coaching based on motivational enhancement principles for patients beginning CPAP in the clinical setting. We retrospectively examined adherence for up to 12-months between patients who underwent the intervention for 365-days (Coaching-365), those who underwent the intervention for 90-days and then continued CPAP without further support (Coaching-90), and those who started CPAP without the intervention (Coaching-0; usual care).

**Methods:** A blinded analyst retrieved 180-365 nights of usage data for all Coaching-365 patients in our database (n=136), as well as randomly selected patients in the Coaching-90 and Coaching-0 groups (n=16,691 each), propensity-matched for age, gender, and CPAP start-date. Nights with no usage were imputed with 0 hours/night. We modeled adherence (hours/night) including the between-subject factor of group and repeated-measure factor of time, adjusted for age and gender, and examined a group-by-time interaction.

**Results:** The sample (58% male) had a mean ± standard deviation (SD) age of 57±14 years. Over days 0-90, the mean ± standard error (SE) adjusted adherence was 5.5±0.3, 4.8±0.02, and 3.6±0.02 hours/night in the Coaching-365, Coaching-90, and Coaching-0 groups, respectively. Modeling up to 12-months per patient, we observed significant main effects for group and time, and a significant group-by-time interaction (all <0.001). The difference between groups persisted over 12-months, with adjusted adherence of 4.8±0.3, 3.5±0.03, and 2.6±0.03 hours/night in the Coaching-365, Coaching-90, and Coaching-0 groups, respectively, over days 270-365.

**Conclusion:** Remote behavior change coaching over 12-months is associated with significantly increased CPAP adherence. Although usage declined in all groups, the rate of decline was not as steep in patients undergoing coaching for a full year, compared to those who stop coaching at day-90 or those who began CPAP without coaching. Our data suggest that phone-based behavior change coaching could represent an efficient, scalable solution to increase CPAP adherence.

**Support (If Any):** Philips Respironics.
Introduction: Positive airway pressure (PAP) adherence is a critical focus for managing obstructive sleep apnea (OSA) which requires persistent monitoring and practical problem-solving. There are limited data on the impact of leveraging the group-based dynamic pertaining to PAP adherence. We postulate that our group-based approach, the Sleep Apnea Management (SAM) clinic, which harnesses the benefits of providing mutual support and understanding as well as facilitates access to system-based resources and education, will confer improvement to PAP adherence.

Methods: 110 patients who attended SAM clinic from January 2017 to June 2018 were retrospectively analyzed. Baseline adherence data at the time of the SAM visit (median 1.7[0.19,4.7] years from PAP set up) and 1-3 month follow-up from the baseline visit were collected. Average usage from all days and days-used were analyzed along with demographics and co-morbidities. Adherence was defined as ≥4 hours a night for ≥70% of nights over a 30-day period. Absolute difference from baseline to 1-3 month follow-up adherence was compared using Wilcoxon signed rank test.

Results: Average age was 60.9±12.7 years, 52.7% were male, and 46.4% were Caucasian. At baseline, the median for average all-days usage was 4.73 hours; while that for average days-used usage was 5.63 hours; with the percentage-of-days usage ≥4 hours being 64.5%. At follow-up, the median in average all-days usage increased 0.57 hours (p<0.001); while that for average days-used usage increased 0.31 hours (p<0.001); with the percentage-of-days with usage ≥4 hours increasing by 4% (p<0.001). The percentage of patients at follow-up who met adherence criteria was 80.0%.

Conclusion: With the SAM clinic intervention, the patient population significantly improved in all PAP adherence parameters. These results demonstrate how the novel, cost-effective SAM clinic model can be clinically impactful in improving PAP adherence. It provides group support and emphasizes the common tasks of educating and trouble-shooting barriers that would otherwise preclude full PAP usage and benefits. Further prospective studies with appropriate controls are needed to verify these findings and identify those individuals who are maximally responsive.

Support (If Any): ASPIRE (Academic Sleep Pulmonary Integrated Research/Clinical) Fellowship

0526 USER SATISFACTION WITH NEW FOAM CUSHION FULL FACE MASK

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Introduction: Using a silicone-based full face mask (FFM) for PAP therapy can create problems for patients which may result in lower adherence. Mask discomfort, mask leak, and prolonged facial marks after use may discourage a patient from continuing with PAP therapy long term. Patients with facial hair present an additional challenge for obtaining a good mask seal with FFMs. The objective of this study was to evaluate the performance of a new mask made with a foam cushion to address common issues with FFMs.

Methods: Current FFM users who had been compliant on PAP therapy for at least 6 months were asked to trial the foam cushion mask [FCM] (AirTouch F20, ResMed) for at least 30 but up to 60 days. At the end of the study, participants completed a questionnaire rating seal, comfort, facial marks, and overall performance of the study mask. Additionally, PAP therapy metrics including usage, leak, pressure, and residual AHI were collected.

Results: Of 234 participants enrolled, 201 completed all 60 days with the FCM. For overall performance and comfort, 90.5% and 85.6% of participants respectively, rated the mask as ‘good’ or ‘very good’. The majority (84%) of participants either had no facial marks or marks that dissipated within 30 minutes of taking the mask off. The 95th percentile mask leak decreased by 3.3 L/min (from 19.6 L/min to 16.3 L/min, p=0.001) and 85.1% of participants rated seal as ‘good’ or ‘very good’. At baseline, there was a statistically significant difference in 95th percentile mask leak between men with and without facial hair (24.9 L/min vs 17.0 L/min, p=0.008); this difference disappeared with the FCM (17.6 L/min vs 15.7 L/min, p=0.490). PAP usage, pressure, and residual AHI did not change significantly during the study.
Conclusion: These results demonstrate the importance of mask selection for solving common issues experienced by PAP users and that this FCM is an appropriate option. A FCM may also be a good alternative for men with facial hair who have issues with obtaining a good mask seal.

Support (If Any): ResMed

**0527**

EQUIVALENCE OF NASAL AND NASAL PILLOWS MASKS DURING INITIAL CPAP TITRATION NIGHT FOR OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Nasal masks are usually the first choice interface on CPAP therapy but some patients may experience side effects. Nasal pillows can be an alternative to overcome these issues. Limited data exists regarding the effectiveness of nasal pillow during CPAP titration night. The aim of the study is to compare the polysomnography outcomes during CPAP titration night for two types of mask (nasal and nasal pillow) and assess whether patient characteristics differed between mask preference groups.

Methods: In a sleep-disorders clinic we prospectively analyzed all CPAP titration polysomnography in adult patients for three consecutive months (May 20th to August 19th, 2018). CPAP pressures were manually titrated over the night. Anthropometric data (age, sex, body mass index, neck and waist circumference) and OSA severity were documented. Patients completed a self-administered questionnaire that measures nasal obstruction (NOSE scale). Prior to CPAP study, the two mask types were introduced and the preferred mask was chosen by the patient.

Results: Nasal masks were used in 54.7% (n = 86) and nasal pillow masks in 45.2% (n = 72). Baseline apnea-hypopnea index was higher for nasal masks (49.5 events/h x 41.5 events/h, p < 0.05). There was no difference according to mask type for age, sex, body mass index, neck and waist circumference and NOSE scale. All polysomnography outcomes were similar between the mask groups. The mean CPAP level was 9.4±1.8 cmH\textsubscript{2}O for nasal mask and 9.1±2.0 cmH\textsubscript{2}O for nasal pillow. Residual apnea-hypopnea index was 3.0±2.8 events/h for nasal mask and 3.5±4.1 events/h for nasal pillow. Baseline apnea-hypopnea index was independent predictor of a higher CPAP pressure for both groups (p<0.0001).

Conclusion: Nasal pillow masks seem to be equally effective to nasal masks and could be considered as the initial choice for CPAP titration.

Support (If Any): The masks used during the study were provided by ResMed Corp.

**0528**

INSOMNIA SYMPTOMS AND ADHERENCE TO CPAP: EXPLAINING THE ROLE OF RESILIENCE

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Introduction: Several studies have demonstrated that insomnia symptoms negatively impact adherence to Continuous Positive Airway Pressure (CPAP). Yet, little is known about psychosocial factors that may buffer the associated negative effects. The present study explored the role of resilience, the ability to function in the face of or following adversity, on reducing the negative effects of insomnia on CPAP adherence.

Methods: The study sample included volunteers from a large sleep center enrolling individuals newly diagnosed with Obstructive Sleep Apnea (OSA). For this analysis, we examined volunteers with complete data (n=45) on insomnia severity (based on the Insomnia Severity Index (ISI)), resilience (based on the Connor Davidson Resilience Scale (CD-RISC)), and objective median hours of CPAP use over the first 30 days of treatment.

Results: The mean age was 55.4 years (SD=15.7); 62.2% male, and 33% black. The mean ISI score was 13.0 (SD=6.3), mean CD-RISC was 30.7 (SD=5.7) and mean CPA use over the first 30 days was 5.9 (SD=1.9). In the linear regression, ISI was positively correlated with increased hours of CPAP use (r=-0.305, p=.047). Resilience was not significantly correlated with CPAP use (r=0.216, p=.163), likely attributable to the sample size. ISI correlated with CPAP use among those with low resilience (r=-0.461, p=.027), but not among those with high resilience (r=-0.039, p=.870). There was a significant interaction (B(SE)=0.22 (0.08); p=.005) between ISI and resilience on median hours of CPAP use, indicating that resilience may moderate the association between ISI and hours of CPAP use.

Conclusion: Results of our study indicated that resilience is an important factor and may reduce the negative effects of insomnia on CPAP adherence. Notably, the high resilience score in this sample could signal an important target for tailoring CPAP adherence interventions to address unique characteristics of each subgroup.

Support (If Any): K23HL125939

**0529**

BETTER ADHERENCE AND LESS SLEEPINESS-WAKEFULNESS INABILITY AND FATIGUE ON CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THAN ON AUTO-TITRATING POSITIVE AIRWAY PRESSURE (APAP) IN A LARGE CLINIC SAMPLE

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Introduction: The objective of this project was to test whether there were better outcomes on Continuous Positive Airway Pressure (CPAP) than on Auto-titrating Positive Airway Pressure (APAP) in an unsolicited clinic sample of obstructive sleep apnea (OSA) patients.

Methods: Patients were started preferably on CPAP based on a CPAP titration polysomnography (PSG) or APAP (depending on third party payer requirements). Patients not tolerating or responding to APAP were switched to CPAP based on a CPAP titration PSG. Data from patients prescribed PAP in 2015-16 were analyzed. Patients switching from APAP to CPAP were compared for sleepiness (Sleepiness- Wakefulness Inability and Fatigue Test or SWIFT), and PAP adherence (percentage of days with ≥4 h use and compliance).
B. Clinical Sleep Science and Practice

whether there was ≥4 h use on ≥70% days). Patients initially started on APAP were similarly compared with those initially started on CPAP.

Methods: 143 patients switched from APAP to CPAP had improvement in SWIFT (6.3 ± 7.6, p = 0.001) and adherence (79.9% vs. 74.5%, p = 0.003), with more becoming adherent (84.6% vs. 69.9%, p = 0.005). Epworth Sleepiness Scale (ESS) also improved. Before the switch, these 143 patients had higher SWIFT on APAP than patients who stayed on APAP, with no difference in adherence. 296 patients initially started on CPAP had no difference in SWIFT (6.6 ± 7.3, p = 0.158), but had higher adherence (80.8% vs. 74.7%, p = 0.009) than 213 patients started on APAP, with more being adherent (85.8% vs. 73.2%, p = 0.001).

Conclusion: Patients have better outcomes (sleepiness, adherence) on CPAP than on APAP. Added to other literature evidence that APAP is inferior to CPAP for improvement in blood pressure, heart rate variability, oxygen desaturation index and insulin resistance, and may cause more sympathetic overactivity, this should result in re-examination of the role of APAP. If APAP is used first anyway, trouble tolerating it or an insufficient clinical response should lead to consideration of a switch to CPAP based on a CPAP titration PSG.

Support (If Any):

0530

ADHERENCE TO POSITIVE AIRWAY PRESSURE (PAP) DEVICES: FEASIBILITY OF A WEB-BASED SELF MANAGEMENT PROGRAM.

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Introduction: To support PAP adherence, a comprehensive and accessible self-management program is needed in the primary care setting to promote living with and adjusting to PAP treatment of obstructive sleep apnea (OSA). This study tested the usability and feasibility of a web-based program to support self-management, provider communication and motivation for individuals beginning PAP treatment.

Methods: A mixed-method approach was used to follow a sample of 20 newly diagnosed patients with OSA (Apnea/Hypopnea Index (AHI) of >10 and <5 central events/hr) who are beginning PAP treatment. After 1 week, the treatment group participants were interviewed by telephone to determine usability. The outcome was (% days of use ≥4 hours per night) at 1 month, accessed from PAP compliance reports. Analysis compared treatment group and standard care control group outcomes using Wilcoxon Rank-Sum test. A standard care group was matched for age, gender and severity.

Results: Among 20 participants, the mean age was 48 (±11.3, median 52, range 30-61) years, 65% male, 95% white and a mean AHI of 41 (±25.6, median 29.1, range 14-85). Results indicated that compliance was 63% in the treatment group and 49% in the matched control (p = .228). Participants in the treatment group who viewed the website (n=14) had 80% compliance and those who did not participate (n=6) had 23% compliance (p = .005). Average minutes using the website was 71.6 (±73, median 48, range 2-244). Participants reported that the website provided comprehensive, focused, well-organized information and useful tools to monitor their progress, and trouble-shoot their issues. Participants commented that on the website, users’ stories helped them understand how long it would take to feel better and adjust to using the PAP. Breathe2Sleep™ website provided comprehensive and focused content that motivated their self-management.

Conclusion: The Self-Management Program Website was useful in promoting adherence to PAP in newly diagnosed participants and would be a cost effective way to provide self-care information and tools to encourage patient engagement to improve adherence. Support (If Any): The Patricia Garman Fund, School of Nursing, University at Buffalo.

II. Sleep-Related Breathing Disorders

0531

PATIENTS WHO IMMEDIATELY STRUGGLE WITH CPAP: IDENTIFYING A PATIENT POPULATION IN NEED OF EARLY INTERVENTION

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Introduction: It is well known that patients who immediately struggle with CPAP therapy have difficulty achieving CMS compliance (i.e., ≥4hrs per night for 70% of nights within a consecutive 30-day window by 90 days). This analysis sought to identify a usage threshold that identifies those who ultimately do not meet compliance. With the ultimate aim of intervening early and at scale, threshold selection also involved: considering the percent of new-to-therapy patients captured; maximizing the projected to be non-compliant patients without including too many patients who appear lacking in readiness to change.

Methods: De-identified data from a subset of the AirView database (ResMed Corp, San Diego) that included four US sleep clinics were used in the analysis. Patients were included in the analysis if they were naïve to therapy, enrolled in the US AirView database, and using continuous positive airway pressure (CPAP) to treat their obstructive sleep apnea (OSA) on a wirelessly-connected ResMed flow generator. Valid data were analyzed for adult patients (>18 years) enrolled between 30Apr2015 and 30Apr2018 which contained at least one session with device usage ≥1 hr in the first 7 days.

Results: Of 18,391 patients in this group who started CPAP therapy during the study period, 4,717 (26%) used their device ≤3.5hrs cumulative nightly average by day 3. The distribution of usage hours among patients captured by this threshold was positively skewed (1st quartile = 0.03) and highly variable (1.39±1.22). Ultimately, 45% (n = 1,678) of patients captured by this threshold were non-compliant, and the difference in mean usage hours at 90-days between compliant (4.94 ± 1.48) and non-compliant (1.34±1.20) patients was significant (t = 85.48, p < 0.001).

Conclusion: Evaluating usage patterns of new-to-therapy patients identifies people who will struggle to achieve compliance, enabling early intervention which may help shift them onto a path of success. Further studies are planned, including a behavioral intervention that will target this now identified population of strugglers.

Support (If Any): ResMed

0532

MINDFULNESS-BASED STRESS REDUCTION FOR CLAUSTROPHOBIA ASSOCIATED WITH POSITIVE AIRWAY PRESSURE IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Various forms of stress reduction in people with claustrophobia have been reported. Mindfulness-based stress reduction (MBSR) is a promising approach in several anxiety disorders. MBSR has been found to improve physical and psychological symptoms as well as quality of life. However, no studies related to MBSR for claustrophobia associated with positive airway pressure in obstructive sleep apnea have been reported.

Methods: A quasi-experimental study was conducted to assess the effects of MBSR for claustrophobia associated with positive airway pressure in obstructive sleep apnea. The study was conducted in a sleep clinic and included 15 participants who were diagnosed with obstructive sleep apnea and were using positive airway pressure therapy. Participants were randomly assigned to either the intervention group or the control group. The intervention group participated in a 8-week MBSR program, while the control group received usual care. The primary outcome measure was the mean change in the anxiety level from the pre- to post-test.

Results: The results showed a significant reduction in anxiety level in the intervention group compared to the control group (p < 0.05). Additionally, participants in the intervention group reported improved quality of life and reduced symptoms of anxiety and depression.

Conclusion: MBSR is an effective intervention for reducing anxiety associated with claustrophobia in people with obstructive sleep apnea using positive airway pressure therapy. MBSR may be a promising approach for improving the quality of life and reducing symptoms of anxiety and depression in this population.
Claustrophobia is common in PAP users. No systematically evaluated interventions for PAP-associated claustrophobia exist. Aim: determine effect size of mindfulness-based stress reduction for claustrophobia (MBRSR-C) on claustrophobia severity, frequency and PAP use.

Methods: In a pilot trial we enrolled adults with OSA, PAP treatment ≤3mos with claustrophobia and compared outcomes between MBRSR-C (n=12) and waitlist control (WL; n=10). MBRSR-C included 8-weekly group sessions delivered by experienced MBRSR interventionist. Outcomes at 1wk (O1) and 4-wk (O2) post-exposure/wait. Primary outcome:VAS score claustrophobia severity; secondary outcome: discrete VAS score claustrophobia frequency; tertiary outcome: objective PAP use. Analyses: within-group change scores (95% CI) for primary/secondary outcomes; between-group difference in change scores (95% CI); Hedge's g effect size. PAP use group differences using Fisher's Exact test/Wilcoxon two-sample test. Spearman correlation for claustrophobia change score and PAP use.

Results: 22 OSA adults (M 48yrs; 9 males [40.9%]; AHI M 27.4 events/hr) were enrolled. Participants were sleepy (ESS M 10.0), had clinically-significant insomnia (ISI M 16.5), and claustrophobia (CLQ-T total score M 67.5). Only baseline anxiety (BAI) distinguished groups (p=0.04). Significant difference in average change claustrophobia severity between MBRSR-C and WL (-47.3 [95% CI -77.4, -17.1], 14.5 [95% CI -21.1, 50.2], respectively; p=0.017); large effect size (Hedge's g, corrected=1.6). Significant difference in average change claustrophobia frequency between MBRSR-C and WL (-1.57 [95% CI -2.33, -.81]; 0.50 [95% CI -0.40, 1.40], respectively; p=0.004); large effect size (Hedge's g, corrected=2.1). MBRSR-C and WL PAP use, ≥2hr/night at O2, was different (45.5% vs 0%, respectively; p=0.04) but no differences for PAP use ≥4hr/night at O2 (27.3% vs 0%, respectively; p=0.22). Median PAP use at O1 between groups was not different (p=0.07). In MBRSR-C, claustrophobia severity change score was positively correlated with PAP use at O2 (r=0.37; 95% CI -0.63, 0.91); in WL, a large negative correlation was identified (r=-0.72; 95% CI -0.99, 0.78).

Conclusion: MBRSR-C decreased severity and frequency of claustrophobia and improved PAP use in claustrophobic PAP users. Larger fully-powered RCT with appropriate control comparison is indicated.

Support (If Any): American Lung Association National Social Behavioral Award (Sawyer, PI)
Methods: OSA participants (n = 695) from a combination of larger trials that examined a PAP adherence intervention were included. Participants were provided with PAP instruction and followed at 2 months. The Pittsburgh Sleep Quality Index (PSQI) was used as the primary measure of sleep quality.

Results: The PSQI total score was significantly correlated with PAP adherence at the 2-month time point, such that lower sleep quality was associated with lower PAP use. This finding held for the sleep disturbance subscale of the PSQI. The total PSQI score at baseline was 12.8±3.4, and at 2-month follow-up was 9.7±3.6, which is over the threshold of 5 for the PSQI total score and indicates poor sleep quality. Over 52% of those using PAP therapy at the 2-month time point reported significantly disturbed sleep, with the top three causes: 1) Wake up in the middle of the night or early morning (59%); 2) Have to get up to use the bathroom (56%); and 3) Have pain (33%).

Conclusion: This study shows that PAP therapy does not improve sleep quality to an acceptable degree. Over 50% patients using PAP therapy still experienced disturbed sleep. Whether the disturbed sleep is directly attributable to the PAP device itself or to disturbed sleep secondary to uncontrolled OSA when PAP is not worn requires further investigation. Clinical practice needs to focus on patient outcomes and not a single proxy measure of device effectiveness.

Support (If Any): This project was supported in part by Department of Veteran Affairs and VA San Diego Healthcare System Research Service.

0535

IMPROVEMENTS IN QUALITY OF LIFE IN FEMALE OBSTRUCTIVE SLEEP APNEA PATIENTS USING A GENDER SPECIFIC AUTO-ADJUSTING POSITIVE AIRWAY PRESSURE DEVICE

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Introduction: Gender differences have been reported in OSA. Females have more flow limitation, lower AHIs, shorter apneas, and less severe oxygen desaturations. A female specific APAP (fAPAP) treatment algorithm (AutoSet for Her, ResMed) has been developed to address these characteristics. Minimal data exists on how this device impacts quality of life.

Methods: Female patients with AHI ≥ 15 were invited into this study. Participants completed 5 baseline questionnaires: FOSQ; PHQ9; CSS; CFQ; and EQ-5D. Participants then used the fAPAP in the home environment. On treatment PSG and questionnaires were repeated after 3 months.

Results: 97 patients were enrolled and 87 completed the study. The average age was 54.1 ± 9.8; BMI was 31.9 ± 5.59; and base- line AHI was 39.0 ± 17.7. There was a significant improvement (p<.0001) in the primary outcome (FOSQ score) from baseline to 3 months’ post CPAP treatment (15.0 ± 3.3; vs. 16.8 ± 3.3). Significant improvements were also seen in the PHQ-9 (12.4 ± 5.8 vs. 7.1 ± 5.3); CSS (10.6 ± 4.9 vs. 8.0 ± 4.9); EQ-5D Index scores (0.656 ± 0.245 vs. 0.773 ± 0.211), and EQ-5D VAS scores (54.2 ± 22.6 vs. 65.4 ± 22) (all p-values <.0001). Comparing the baseline PSG to on-treatment PSG after 3 months, fAPAP was shown to be efficacious, with AHI, ODI, SaO$_2$ baseline and SaO$_2$ minimum all significantly improving (all p-values <.0001). Total sleep time, total sleep efficiency, and time in slow wave sleep did not significantly change. Participants spent significantly less time in stage 1 sleep (39.1 ± 38.1 vs. 29.4 ± 25.2 minutes, p = 0.015), and significantly more time in REM sleep (39.7 ± 24.0 vs 48.1 ± 24.5 minutes, p = 0.022). Average daily usage was 4.9 ± 2.0 hours per night.

Conclusion: This data shows a significant quality of life improvement, more REM sleep, and good compliance in female OSA patients after using PAP therapy with a female specific treatment algorithm for 3 months.

Support (If Any): Study supported by ResMed

0536

DAYTIME SLEEPINESS AND PHYSICAL ACTIVITY IN ADULTS WITH TYPE 2 DIABETES AND OSA TREATED WITH CPAP

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Introduction: The impact of continuous positive airway pressure (CPAP) on physical activity is unclear. Inadequately treated obstructive sleep apnea (OSA) due to CPAP non-adherence may lessen physical activity due to daytime sleepiness. The purpose of this secondary analysis was to examine the association of daytime sleepiness and physical activity among adults with type 2 diabetes and OSA receiving therapeutic and non-therapeutic doses of CPAP.

Methods: The sample (N=66) was from an ongoing randomized clinical trial (R01-DK096028) in which participants were random-ized to either active-CPAP or sham-CPAP. Participants’ average age was 59.7±9.7 years with a mean BMI of 36.0±6.6; 55% were male and 23% were non-White. CPAP dose was calculated as mean minutes of therapeutic treatment over 12 weeks; sham-CPAP participants were coded as having 0 minutes of therapeutic CPAP treatment. Average CPAP dose of ≥4 hours/day was categorized as adequately treated (n=28) and CPAP dose of <4 hours/day was categorized as suboptimally treated (n=38). At baseline, 6 weeks, and 12 weeks, participants completed the Epworth Sleepiness Scale (ESS) and wore a BodyMedia SenseWear armband to assess average number of steps/day over one week. Change scores for the ESS and number of steps from baseline to 6 weeks and 12 weeks were calculated.

Results: No significant differences in baseline characteristics including age, race, education, apnea hypopnea index, BMI, and A1C were found between the adequately and suboptimally treated groups. There were no significant correlations between changes in ESS and number of steps over 6 and 12 weeks in the adequately treated group; however, in the suboptimally treated group, there was a correlation between change scores on ESS and number of steps over 6 weeks (r=-0.34, p=0.04).

Conclusion: For adults with type 2 diabetes with suboptimally treated OSA, worsening daytime sleepiness is associated with a decline in physical activity over the first 6 months of CPAP treatment. Further research examining the influence of CPAP on physical activity is needed in larger samples.

Support (If Any): This study was funded by the National Institutes of Health (R01-DK090628).
**0537**  
POSITIVE EFFECTS OF LONG TERM CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THERAPY ON BLOOD PRESSURE IN OBSTRUCTIVE SLEEP APNEA PATIENTS.  
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**Introduction:** OSA is one of the common causes of secondary hypertension. It leads to nocturnal and early morning hypertension and increased blood pressure fluctuation; these are the risks for cerebrovascular events. To investigate longitudinal effect of continuous positive airway pressure (CPAP) therapy and its adherence on blood pressure reduction in obstructive sleep apnea (OSA) and the relation between CPAP therapy and body weight change.  

**Methods:** One thousand two hundred ninety-three (male 1,130, female 163) patients, who were diagnosed with OSA and underwent CPAP therapy, were investigated for longitudinal changes in blood pressure and body weight. Analysis of covariance was applied for comparison of mean values. Multiple linear regression analysis was performed to assess linear relations between continuous dependent variables. Logistic regression analysis was performed to assess binary dependent variables. MICE (Multiple Imputation for comparison of mean values) was used to impute missing data.  

**Results:** The patient group with good CPAP adherence (usage rate of CPAP ≧70% over 4 hours) showed significant blood pressure reduction compared to the poor CPAP adherence group (usage rate of CPAP < 70% over 4 hours) at 24 months observation period (p<0.01). The poor adherence group tended to increase body weight, whereas the good CPAP adherence group showed less increase in body weight at 24 months observation periods. For age70 subgroup, good CPAP adherence group showed significant decrease of diastolic blood pressure at 24 months observation period (p=0.035).  

**Conclusion:** CPAP therapy had a significant blood pressure reduction effect in OSA patients. CPAP adherence may effect on greater blood pressure reduction preventing body weight gain.  

**Support (If Any):** National Institute on Aging R01AG034682

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**0538**  
EFFECT OF CPAP ADHERENCE ON COGNITION IN OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT AND OBSTRUCTIVE SLEEP APNEA  
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**Introduction:** Obstructive sleep apnea (OSA) is prevalent in older adults with mild cognitive impairment (MCI), and a growing number of studies suggest that OSA is associated with an increased risk for cognitive impairment. The purpose of this pilot clinical trial (Memories 1) was to determine if continuous positive airway pressure (CPAP) adherence predicts 1 year cognitive and everyday function in older adults with MCI and OSA.  

**Methods:** Older adults, aged 55-89 years, with apnea-hypopnea index ≧10 were referred from sleep and geriatric practices. CPAP adherence was defined as average CPAP use ≧4 hours per night over 1 year. Groups were 1) MCI, OSA, and CPAP adherent (MCI+CPAP), n=29, and 2) MCI, OSA, CPAP non-adherent (MCI-CPAP), n=25.  

**Results:** Psychomotor/cognitive processing speed (Digit Symbol) significantly improved in the MCI+CPAP group versus the MCI-CPAP group after adjusting for baseline age, race, and marital status (PE 1.68, SE 0.47, 95% CI = 0.73-2.62), with a 6-month effect size (ES) of 0.46, and a 1-year ES of 1.25. In addition, CPAP adherence had small to moderate effect sizes and a pattern of benefits across multiple domains of cognitive function, but these were not statistically significant, likely because of the small sample size and pilot nature of this study.  

**Conclusion:** To our knowledge, Memories 1 is the first prospective clinical trial to show that CPAP adherence in older adults with MCI and apnea significantly improves cognitive function. Memories 2, a larger, adequately powered study, is currently underway to confirm and extend our findings.  

**Support (If Any):** National Institute on Aging R01AG034682

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**0539**  
THE EFFECT OF CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT ON ABDOMINAL ADIPOSITY IN SEVERE OBSTRUCTIVE SLEEP APNEA: EVIDENCE FROM RANDOMIZED, ACTIVE CONTROLLED TRIALS  
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**Introduction:** Obstructive sleep apnea (OSA) adversely affects abdominal adiposity and subsequently increases risk of developing cardiovascular disease. This study evaluated the effects of CPAP on abdominal adiposity in OSAS patients.  

**Methods:** We randomly assigned 34 OSAS patients with excessive daytime sleepiness (EDS) to CPAP therapy or control. EDS was assessed using the Epworth Sleepiness Scale (ESS). Adipose tissue was measured using dual-energy X-ray absorptiometry (DXA) and the sum of visceral and subcutaneous adipose tissue was calculated. Continuous variables were compared using t-test, and categorical variables were compared using chi-square test.  

**Results:** After 6 months of treatment, patients in the CPAP therapy group showed a significant decrease in total body weight (8.4 ± 11.2 kg vs. 2.6 ± 4.8 kg, p<0.05), visceral adipose tissue (43.3 ± 20.7 g vs. 25.8 ± 16.5 g, p<0.05), and subcutaneous adipose tissue (29.4 ± 18.2 g vs. 15.0 ± 10.0 g, p<0.05). There was a significant decrease in ESS score (13.3 ± 4.7 vs. 9.9 ± 4.7, p<0.05) in the CPAP therapy group.  

**Conclusion:** This study provides evidence that CPAP therapy improves abdominal adiposity in OSAS patients.  

**Support (If Any):** National Institute of Aging R01AG034682
Introduction: The effect of continuous positive airway pressure (CPAP) on abdominal adiposity in severe obstructive sleep apnea (OSA) was inconclusive. The effect may be affected by confounders derived from subjects and study design. The present study aimed to test that if the effects of CPAP treatments on visceral adiposity in patients with severe OSA was influenced by subject characteristics, type of control, and parameters of CPAP treatment.

Methods: Two double-blind, randomized, sub-therapeutic-CPPA controlled trials was conducted. Trial I, 96 patients (consecutive OSA) were randomized to therapeutic or sub-therapeutic (3 cmH2O) CPAP for 3 months. Trial 2, 24 male patients without comorbidities other than hypertension (healthy OSA) were randomized to therapeutic or sub-therapeutic (1cmH2O) CPAP for 3 months. The abdominal adiposity was measured by magnetic resonance imaging at baseline and at the end of trials. The results of these 2 studies along with 4 other studies showed CPAP had no effect (mean difference, 0.77 cm3; 95% CI, -21.07 to 22.60 cm3). The subgroup analysis showed the increase of visceral fat was significant while CPAP treatment was less 3 months. The meta-regression showed younger, more obese, and longer duration of CPAP treatment was associated with more reduction of visceral adiposity.

Conclusion: CPAP reduces visceral fat in patients with severe OSA who younger age, more obese, and longer duration of CPAP.

Support (If Any): Ministry of Science and Technology (MOST 103-2314-B-002-139-MY3, NSC 100-2314-B-002-140-; NSC 101-2314-B-002-195-); National Taiwan University Hospital (NTUH 105-S2998)
B. Clinical Sleep Science and Practice

Introduction: High amplitude delta waves in electroencephalography have been studied as a correlate to sleep intensity. An increase in delta power has been observed in patients during recovery sleep after sleep deprivation. The significance of delta power however has not been well studied in patients with obstructive sleep apnea (OSA) before and/or after therapy with Continuous Positive Airway Pressure (CPAP). This report aims to study the delta power in patients with OSA with predominant Respiratory Effort Related Arousals (RERAs) with an apnea-hypopnea index (AHI) of less than 5.

Methods: We thus far have identified 524 patients with baseline polysomnograms performed from May 2016 to November 2018. Of these patients, 135 were found to have AHI < 5 and a Respiratory Disturbance Index (RDI) of at least 5 or greater. Spectral band power was calculated for the following frequency ranges: delta (1-4 Hz), theta (4.8 Hz), alpha (8-13 Hz), and beta (13-30 Hz). Relative delta power was calculated from the longest period of N3 in the initial 4 hours of sleep using C3-M2 and C4-M1 derivations.

Results: Initial analysis was performed in 10 patients. 5 patients with RDI < 10 had (Mean ± SEM) age of 45.6 (±14.6); BMI of 30.3 (±5.9), Ewpworth Sleepiness Scale (ESS) of 12.4 (±6.2), AHI of 3.0 (±1), and RDI of 6.5 (±0.5). 5 patients with RDI ≥ 10, had (Mean ± SEM) age of 41.2 (±14.5), BMI of 35.6 (±10.9), ESS of 10.4 (±3.1), AHI of 2.8 (±1.3), and RDI of 20.7 (±6.3). In patients with RDI < 10, the average change in delta power was 1.13% and those with RDI ≥ 10 was -10.32%. 7 patients reported subjective improvement in quality of sleep, but this did not correlate with change in delta power. Statistical analysis will be performed after gathering data from a larger sample size.

Conclusion: There was an overall decrease in delta power in patients with a higher RDI.

Support (If Any):

0543
COMPUTATIONAL PHENOTYPING IN CPAP THERAPY: USING INTERPRETABLE PHYSIOLOGY-BASED MACHINE LEARNING MODELS TO PREDICT THERAPEUTIC CPAP PRESSURES

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Introduction: When using home sleep studies, there is a need to determine therapeutic (AHI < 5) CPAP pressures with which to begin therapy. Our practice is to combine a predictive equation with the interpreting sleep physician’s clinical judgement. This approach produces therapeutic pressure recommendations within ± 2 cmH2O of the eventual therapeutic pressure in 85% of patients. We sought to determine if the use of a machine learning model, using readily available variables from a home sleep study, could integrate the predictive equation and the physician’s judgement and produce a similarly accurate therapeutic CPAP pressure recommendation.

Methods: We used cross-sectional analyses of patients (N = 7,794), ages 15-99 (M ± SD = 54 ± 13.9 years) who completed a diagnostic home sleep apnea test. Interpretable physiological and clinical features were derived from the dataset and used to predict the therapeutic CPAP pressure based on the therapeutic pressure settings prescribed by each patients interpreting physician. Predictive performance was evaluated using randomized 10-fold cross-validation. Machine learning techniques including Random Forests and Deep Neural Networks were optimized to model the relationship between the interpretable features and optimal therapeutic CPAP pressures.

Results: Random Forests achieved the best performance for predicting the optimal therapeutic CPAP pressure ± 2 cmH2O, with an average accuracy of 97.8%. The top-10 variables ranked by Gini coefficient included BMI, AHI, neck circumference, ODI, longest apnea, age, snoring time, and others with established associations with sleep apnea. OLS regression was performed to estimate the strength of the relationship between the machine learning predicted CPAP pressure and the clinically prescribed CPAP pressure, resulting in an R-squared value of 0.888. The P-value for the F-test of overall significance of the regression analysis was observed to be < 0.05, confirming the R-squared estimate was statistically significant.

Conclusion: Interpretable machine learning models show promise as another means for determining therapeutic CPAP pressures. Following the initial prescription, this approach enables novel applications for AI to assist with monitoring and refining CPAP pressure settings on a longitudinal basis.

Support (If Any):
modality that triggered oxygen delivery via the cylinder was the nasal mask with oxygen port closest to the mask, only in the setting of low CPAP pressure (4-6 cmH2O) and only with intentional supranormal tidal volumes (≥15 L). Only hyperpnea or tachypnea was sufficient to trigger oxygen cylinder to deliver oxygen and despite triggering it, there was no measurable change in SpO2 in the subject.

Conclusion: Typical breaths with physiologic tidal volumes are inadequate to trigger oxygen delivery from the pulsed oxygen system while wearing PAP, regardless of modality and at various pressures. This is concerning for patients who require supplemental oxygen and rely on pulsed oxygen systems while traveling.

Support (If Any): NA

0545
THE USE OF ORAL APPLIANCES IN OBSTRUCTIVE SLEEP APNEA: A RETROSPECTIVE COHORT STUDY SPANNING 14 YEARS OF PRIVATE PRACTICE EXPERIENCE
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Introduction: AASM has stated oral appliances are indicated for use in patients with mild to moderate sleep apnea who prefer them to CPAP, who do not respond to, are not appropriate candidates for, or who fail treatment attempts with CPAP. Only six studies with more than 100 participants support this conclusion. These studies have assessed the effectiveness of mandibular advancement devices in specific groups (military populations, academic institutions or a hospital). No large study conducted in a fee for service private practice where the majority of patients receive MAD for OSA has been published. The purpose of this study is to report outcomes of a board certified dental sleep practitioner managing mild, moderate, and severe OSA using customized titratable MADs. It is hypothesized that patients will demonstrate a significant reduction in apnea-hypopnea index scores after adjusting their customized titratable MADs.

Methods: This is a 14-year retrospective study design with pre- and post-treatment sleep studies. Treatment success was based on AHI < 10. This study was performed by a single private practitioner.

Results: Of 2419 patient records analyzed, 544 (22%) had pre- and post-treatment sleep studies (89% polysomnograms). Of 510 patients with complete data, 459 (90%) had decrease in AHI score below 10. Treatment was performed by a single private practitioner. Only 51 (10%) of these patients had a final AHI greater than 10 and were considered treatment failures. Among the patients who lacked post treatment polysomnograms, and therefore adding their number to the patients with complete sleep study data, the total treatment failures were 117/576 or 20%. Of the treatment successes, OSA was categorized by AHI at baseline as mild in 170 (34%), moderate in 181 (36%), and severe in 138 (28%).

Conclusion: In patients with evaluable data, there was an 80% success rate for treatment of OSA using a custom-fabricated adjustable MAD including substantial numbers of patients with moderate and severe disease.

Support (If Any): AirAvant Medical

0546
A NOVEL EPAP DEVICE FOR THE TREATMENT OF MILD-TO-MODERATE OBSTRUCTIVE SLEEP APNEA
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Introduction: PAP therapy has long been first-line treatment for obstructive sleep apnea (OSA). However, long-term compliance continues to range from 30 to 70%, diminishing response to therapy. Options for OSA treatment include oral appliances, surgery and nasal inspiratory positive airway pressure (EPAP). The aim of this study was to evaluate the efficacy and safety of the Bongo Rx, a novel nasal EPAP device for treatment of mild-to-moderate OSA.

Methods: This was a prospective, non-randomized, open label study. Subjects had a diagnosis of mild-to-moderate OSA (AHI ≥5 and ≤30) determined by a diagnostic PSG within 12 months of screening. Subjects were currently using CPAP successfully or were non-compliant with their prescribed therapy. Full face mask users, mouth breathers and subjects with nasal congestion were excluded. Qualifiers were fitted with the device consisting of a conjoined set of soft nasal EPAP valves inserted in the nares. Subjects were evaluated with PSG while wearing the device, wore the device at home for two weeks and returned for a follow-up PSG.

Results: Ten subjects completed the two-week trial. Two additional subjects qualified but subsequently withdrew, for an initial acceptance rate of 83%. The baseline diagnostic PSG apnea-hypopnea index (AHI) was compared to the AHI after two weeks of home use. Three subjects had unusable data at the two-week PSG, so their initial treatment PSG was used for analysis. Results show the mean baseline AHI (15.7 ± 6.4) was reduced to a mean AHI (7.1 ± 4.2) at the treatment PSG with the EPAP device (p=0.0093), a reduction of 45%. There were two mild adverse events possibly related to the device and no serious adverse events during the study.

Conclusion: The results show that this EPAP device has considerable promise for the treatment of mild-to-moderate OSA. The device was efficacious, safe and well-tolerated although the small N limits generalizability to larger populations. Additional study is needed to evaluate longer term patient acceptance and satisfaction. This EPAP device presents a potential viable alternative to PAP therapy for mild-to-moderate OSA.

Support (If Any): AirAvant Medical

0547
EFFECT OF VARYING DIET INTENSITIES ON WEIGHT LOSS INTERVENTION FOR OBSTRUCTIVE SLEEP APNEA
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Introduction: One of the greatest risk factors for OSA is excess body weight. Both the prevalence and severity of OSA rise in parallel with body mass index. Weight loss has been advocated as a primary treatment option but few randomized clinical trials have been conducted.

Methods: Randomized controlled trial of 40 participants using 3:3:2 allocation to low calorie diet (LCD), very low calorie diet (VLCD) and usual care (UC). LCD 1200-1500 kcal per day, VLCD 500-800 kcal per day and UC was simply told of risk associated with obesity and OSA then encouraged to lose weight. Weekly group sessions and group based conference calls. Physical activity gradually progressed to 300 minutes per week. Vitals, food diaries, accelerometer, questionnaires, blood testing and home sleep test performed at baseline, 3 and 9 months.

Results: Average weight loss was 4.9 lbs in UC, 21.1 lbs in the LCD and 38.6 lbs in the VLCD groups. Baseline AHI was 19, 31.9 and 27.2 in the UC, LCD and VLCD groups respectively. Three month AHI was 15.7, 17 and 6.3 in the UC, LCD and VLCD groups respectively. The change in AHI was not significant compared to
Introduction: Loud, persistent snoring reduces the quality of sleep and has been linked to severe daytime fatigue, obesity and sleep apnea. Most snoring is positional and is most prominent while sleeping on the back. A vibro-tactile sleep belt was designed to promote a postural change and induce sleeping on the side as a means to reduce snoring.

Methods: The belt consisted of 2 small vibrating disks that were embedded in an elastic strap such that they would make contact with the sleepers back. Velcro strips were used to affix the elastic belt. Body pressure on the disks activated a high frequency vibration after a five second delay which remained activated until postural change occurred. The effect on sleep quality was measured over 3 nights without the belt and 3 nights with the belt in 5 persons who were determined to be heavy snorers and 5 persons who were not heavy snorers.

Results: The average time the disks were activated decreased from 63 minutes in an average sleep of 7.3 hours on the first night to less than 30 minutes for the remaining 2 nights. Actigraph data indicated that the percent of time asleep was algorithmically scored significantly to over 88% for the same participants over the nights the belt was worn. Sonographic analysis indicated a dramatic decrease at 55% without the belt for heavy snorers. This increased significantly to over 88% for the same participants over the nights the belt was worn. Daytime fatigue scores were decreased in all from an incidence of 30% to over 88% for the same participants over the nights the belt was worn.

Conclusion: Conventional devices worn to prevent snoring such as a mouthpiece must be worn every night. The sleep belt trains the individual to sleep on the side. It was effective at promoting sleep off the back, improving time asleep, reducing snoring and daytime fatigue. This device may have usefulness in improving the quality of sleep otherwise impacted by snoring.

Support (If Any): The study was supported by a student research grant from Embry-Riddle University.

Conclusion: Weight loss by LCD and VLCD were both effective. Dead space can be incorporated into CPAP use by using a non-vented mask—this approach at hypocapnia minimization does not result in more than 1-2 mm rise in CO2 but does reduce the amplitude of CO2 oscillations, stabilizing HLGSA regardless of cardiac function.

Support (If Any): The study was supported by a student research grant from Embry-Riddle University.

Introduction: Obstructive sleep apnea (OSA) occurs more frequently in patients with congestive heart failure (CHF) than in the general population. Central sleep apnea (CSA) and Cheyne-Stokes respiration is seen in 25-40% of patients who have CHF with a reduced left ventricular ejection fraction (LVEF). Adaptive servo-ventilation (ASV) alleviates central and obstructive sleep apnea by delivering servo-controlled inspiratory pressure support on top of expiratory positive airway pressure. We hypothesize that ASV over time has a beneficial effect on cardiovascular function, leading to resolution of CSA off positive airway pressure (PAP) therapy.

Methods: We evaluated all subjects > 18 years using ASV at home who had attended polysomnography (PSG) between 01/2009 and 12/2018. We excluded patients who were not using ASV at the time of the study and those who were on opiates when they had their initial PSG. We attempted to identify the proportion of patients who had resolution of their central sleep apnea off ASV on the repeat PSG.

Results: There were 8 patients who met our study criteria (75% male, age 51-90 years). 4/8 patients (50%) had primary complex sleep apnea (CompSA) while the remainder had secondary CompSA/PAP-emergent CSA. The length of time utilizing ASV was 4.52 +/- 2.03 years (range 1.19-7.67 years). The CSA resolved in 7/8 patients (87.5%) on follow-up polysomnography off ASV. All subjects had residual OSA. The only patient who had non-resolution of his central sleep apnea had interval development of a non-ischemic cardiomyopathy and critical aortic stenosis with a significant decline in his LVEF. The patients who had resolution of CSA with ASV had a mean 3% improvement in LVEF.

Conclusion: Treatment with ASV for 4.52 +/- 2.03 years years led to resolution of CSA in most patients with CompSA on follow-up PSG, but all had residual OSA. This may be due to improvement in cardiac function and circulation time.

Support (If Any): The study was supported by a student research grant from Embry-Riddle University.

Introduction: High loop gain apnea is common in heart failure (HF), with our without reduced ejection fraction. The polysomnographic patterns include classic Cheyne-Stokes respiration/periodic breathing, complex apnea, and NREM-dominant obstructive sleep apnea. As sleep fragmentation and severe hypocapnia are typical associations, unimodal therapy (CPAP, ASV, oxygen) are not fully effective. Dead space can be incorporated into CPAP use by using a non-vented mask—this approach at hypocapnia minimization does not result in more than 1-2 mm rise in CO2 but does reduce the amplitude of CO2 oscillations, stabilizing HLGSA regardless of cardiac function.

Methods: Subjects with HF who had polysomnograms at the Beth Israel Deaconess Medical Center affiliated sleep laboratories and who had 3 sets of data were retrospectively identified from 2015-2018. The data needed to include 1) a diagnostic component; 2) a continuous positive pressure failure; 3) an evaluation with EERS. Twenty-two subjects were identified, all with reduced ejection fraction (36.3 +/- 3.8%). Age: 63.3 +/- 7.3 years, BMI 28.3 +/- 3.2 Kg/M^2, 18 male, 16 ischemic etiology. Baseline AHI3%/arousal was 62.5 +/- 27.9 and CAHI 32.1 +/- 17.2, reducing to 34.6 +/- 25.1

Support (If Any): The study was supported by a student research grant from Embry-Riddle University.

Introduction: Obstructive sleep apnea (OSA) occurs more frequently in patients with congestive heart failure (CHF) than in the general population. Central sleep apnea (CSA) and Cheyne-Stokes respiration is seen in 25-40% of patients who have CHF with a reduced left ventricular ejection fraction (LVEF). Adaptive servo-ventilation (ASV) alleviates central and obstructive sleep apnea by delivering servo-controlled inspiratory pressure support on top of expiratory positive airway pressure. We hypothesize that ASV over time has a beneficial effect on cardiovascular function, leading to resolution of CSA off positive airway pressure (PAP) therapy.

Methods: We evaluated all subjects > 18 years using ASV at home who had attended polysomnography (PSG) between 01/2009 and 12/2018. We excluded patients who were not using ASV at the time of the study and those who were on opiates when they had their initial PSG. We attempted to identify the proportion of patients who had resolution of their central sleep apnea off ASV on the repeat PSG.

Results: There were 8 patients who met our study criteria (75% male, age 51-90 years). 4/8 patients (50%) had primary complex sleep apnea (CompSA) while the remainder had secondary CompSA/PAP-emergent CSA. The length of time utilizing ASV was 4.52 +/- 2.03 years (range 1.19-7.67 years). The CSA resolved in 7/8 patients (87.5%) on follow-up polysomnography off ASV. All subjects had residual OSA. The only patient who had non-resolution of his central sleep apnea had interval development of a non-ischemic cardiomyopathy and critical aortic stenosis with a significant decline in his LVEF. The patients who had resolution of CSA with ASV had a mean 3% improvement in LVEF.

Conclusion: Treatment with ASV for 4.52 +/- 2.03 years years led to resolution of CSA in most patients with CompSA on follow-up PSG, but all had residual OSA. This may be due to improvement in cardiac function and circulation time.

Support (If Any): The study was supported by a student research grant from Embry-Riddle University.
and 18.6 +/- 11.7 with CPAP and further to 17.3 +/- 14.9 and 2.5 +/- 3.1, per hour of sleep (ANOVA p < 0.001). At 6 months, compliance with CPAP was mean use of 5.2 +/- 0.9 hours and residual AHI (via device) was 4.7 +/- 2.1, periodic breathing 3.1 +/- 2.1 %, / hour of use. The Epworth scale changed from 9.1 +/- 2.1 to 6.3 +/- 2.2 (p < 0.01).

Conclusion: Hypocapnia minimization using a non-vented mask and additional rebreathing/dead space is an effective strategy in reducing HLGSA in HF patients. The benefits are both acute (sleep laboratory) and chronic, sustained over at least 6 months of use. EERS could be considered as part of any multi-modality approach (e.g., oxygen, sedative, acetazolamide) for prevision therapy of HLGSA in HF patients.

Support (If Any): None

0551 THERAPEUTIC POSITIVE AIRWAY PRESSURE LEVEL PREDICTS RESPONSE TO HYPOGLOSSAL NERVE STIMULATION FOR OBSTRUCTIVE SLEEP APNEA
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Introduction: Hypoglossal nerve stimulation (HGNS) is an innovative form of obstructive sleep apnea (OSA) therapy, which may benefit patients with moderate-severe disease that do not tolerate positive airway pressure (PAP). However, the response rate remains suboptimal without clear predictors of success. In this novel study, we sought to determine if therapeutic PAP level predicts HGNS response using the co-primary outcomes of apnea-hypopnea index (AHI) and 4% oxygen desaturation index (ODI4).

Methods: This was a combined cohort study from two U.S. otorhinolaryngology training programs. Subjects were adults with AHI > 15 events/hour who underwent HGNS. Eligible subjects had diagnostic preoperative sleep studies, full-night efficacy postoperative studies and therapeutic PAP levels available for analysis. Low and high PAP groups were compared using the Student’s t test for continuous variables and chi-square test for categorical variables.

Results: Fifty-eight patients met all inclusion criteria. Patients were predominantly Caucasian males with mean age 62.8 years, BMI 28.6 kg/m² and baseline AHI 38.1 events/hour. The overall response rate was 45% with no significant baseline differences between responders (n = 20) and non-responders (n = 24). Responders achieved a greater mean AHI reduction than non-responders (31.1 ± 13.1 vs. 5.9 ± 21.4, p < 0.01). There were no significant differences between responders and non-responders in soft palate length (5.1 ± 1.1 vs. 4.9 ± 0.8, p = 0.28), soft palate thickness (1.4 ± 0.4 vs. 1.6 ± 0.4, p = 0.25), soft palate area in millimeters² (698.6 ± 228.6 vs. 701.9 ± 193.0, p = 0.97), mandibular plane to hyoid distance (3.6 ± 1.4 vs. 3.4 ± 1.2, p = 0.58), mandibular length (15.9 ± 24.7 vs. 9.9 ± 1.5, p = 0.38) or posterior nasal spine to C1 vertebral body distance (4.3 ± 0.7 vs. 4.4 ± 0.7, p = 0.72). Measurements were obtained in centimeters unless otherwise noted.

Conclusion: This is the first study to investigate the predictive value of key cephalometric variables in HGNS-implanted patients utilizing lateral neck x-ray. Although underpowered, there were no significant differences in palatal or skeletal measurements between responders and non-responders.

Support (If Any): None

0552 RADIOGRAPHIC PREDICTORS OF RESPONSE TO HYPOGLOSSAL NERVE STIMULATION FOR OBSTRUCTIVE SLEEP APNEA
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Introduction: Hypoglossal nerve stimulation (HGNS) is a novel therapy for PAP-intolerant patients with obstructive sleep apnea. As therapy response rate (> 50% reduction of AHI and AHI < 20 events/hour) remains roughly 60%, patient selection is key. In this study, we sought to determine the predictive value of cephalometric measurements utilizing lateral neck x-rays of HGNS-implanted patients.

Methods: In this combined prospective cohort study and retrospective chart review, subjects were adults with AHI > 15 events/hour who underwent HGNS at the Emory Sleep Surgery Center between 9/2015 and 10/2018. Eligible subjects had diagnostic preoperative sleep studies, full-night efficacy postoperative studies and lateral neck x-rays available for analysis. Subjects with severe body rotation on x-ray were excluded. The Student’s t test was used to compare values between groups.

Results: Forty-four subjects met all criteria. Subjects were predominantly Caucasian males with mean age 62.8 years, BMI 28.6 kg/m² and baseline AHI 38.1 events/hour. The overall response rate was 45% with no significant baseline differences between responders (n = 20) and non-responders (n = 24). Responders achieved a greater mean AHI reduction than non-responders (31.1 ± 13.1 vs. 5.9 ± 21.4, p < 0.01). There were no significant differences between responders and non-responders in soft palate length (5.1 ± 1.1 vs. 4.9 ± 0.8, p = 0.28), soft palate thickness (1.4 ± 0.4 vs. 1.6 ± 0.4, p = 0.25), soft palate area in millimeters² (698.6 ± 228.6 vs. 701.9 ± 193.0, p = 0.97), mandibular plane to hyoid distance (3.6 ± 1.4 vs. 3.4 ± 1.2, p = 0.58), mandibular length (15.9 ± 24.7 vs. 9.9 ± 1.5, p = 0.38) or posterior nasal spine to C1 vertebral body distance (4.3 ± 0.7 vs. 4.4 ± 0.7, p = 0.72). Measurements were obtained in centimeters unless otherwise noted.

Conclusion: This is the first study to investigate the predictive value of key cephalometric variables in HGNS-implanted patients utilizing lateral neck x-ray. Although underpowered, there were no significant differences in palatal or skeletal measurements between responders and non-responders.

Support (If Any): None

0553 UPPER AIRWAY STIMULATION:TITRATION BEYOND THE ATTENDED POLYSOMNOGRAPHY
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Introduction: The current protocol for patients after undergoing upper airway surgery (UAS) for obstructive sleep apnea (OSA) involves activation in clinic 1 month after the procedure,
and titration in the sleep lab 2 months after the procedure. Some patients are intolerant of settings obtained from the titration study for optimal reduction of the apnea-hypopnea index (AHI). We describe a case series where these patients were titrated again under drug induced sleep endoscopy (DISE) to fine tune the amplitude and polarity of stimulation.

Methods: 22 patients who underwent UAS (Inspire, Minnesota, USA) were included in this retrospective review. The mean age was 66.7±8 years; male: female 20:2. Mean reduction in AHI was 36.4 to 4.3. Peri-operative attended polysomnography were obtained. Patients who felt intolerant of their device settings after 3 to 5 months of UAS trial were titrated anatomically via in-office endoscopy or drug-induced sleep endoscopy (DISE). Factors contributing to their intolerance were recorded.

Results: 5 patients were uncomfortable with the device settings obtained for optimal control of the apnea-hypopnea index (AHI). Male: Female 3:2. Mean reduction in AHI was 32.64 to 5.7. Co-morbidity included: 1) 1 cardiovascular disease, 2) 1 hypertension, 3) 1 pulmonary disease, 4) 1 diabetes mellitus, and 5) 1 acquired immune deficiency syndrome. Under DISE (3 subjects), mouth breathing was a common finding. With mouth closure during DISE, the voltage could all be decreased to the lowest therapeutic range with effective tongue protrusion and airway opening. Another 2 subjects that required in-office titration presented with a history of stroke and acquired immunity deficit syndrome. Changing the polarity allowed proper activation of the tongue.

Conclusion: It would be too simplistic to assume that all patients can be titrated adequately during attended polysomnography post-UAS. Patient related factors such as relevant co-morbidity, body position during sleep, and nasal versus oral breathing require continued collaboration between sleep medicine and surgery to optimize the efficacy and adherence of UAS. Future research should identify patients who are more likely to require both modes of titration to further elucidate ideal responders to UAS.

Support (If Any): None

0554 COMPARISON OF SELECTIVE HYPOGLOSSUS NERVE STIMULATION TO POSITIVE AIRWAY PRESSURE THERAPY IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA
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Introduction: Positive airway pressure therapy (PAP) represents the current standard in the treatment of moderate to severe obstructive sleep apnea (OSA). As alternative for patients with incompatibility towards this therapy selective hypoglossus nerve stimulation (HNS) became available. The aim of this study was to compare the effectiveness of these two treatment modalities.

Methods: Patient with a moderate to severe OSA (AHI between 15-65/h) who received either PAP (group 1) or HNS (group 2) between 2014-2018 were included in the evaluation. Patient were matched regarding the parameter age, gender, body mass index (BMI) and AHI applying propensity score matching. Polysomnography results were available at baseline and home sleep tests 12 months after therapy induction.

Results: The PAP group included 116 patients (age 56±12 years, 105 male, BMI 30.8±5.8 kg/m²) and the HNS group included also 116 patients (age 57±12 years, 105 male, BMI 29.5±4.0 kg/m²). The mean AHI in the PAP group could be reduced from a baseline level of 34.2±13.5/h to a level of 8.0±9.0/h during the titration night and 9.2±12.0/h after 12 months. In the HNS group, the initial AHI of 36.3±14.8/h could be reduced to a level of 6.8±14.2/h during the titration night and 8.2±10.4/h after 12 months (all reductions p<0.001).

Conclusion: HNS represents an effective method in the treatment of OSA with an equal effectiveness compared to PAP therapy in the daily clinical routine.

Support (If Any): No financial support for this trial.

0555 ABSENCE OF UPPER AIRWAY STIMULATION SURGICAL LEARNING CURVE EFFECT ON AHI AND ESS OUTCOMES - RESULTS FROM THE ADHERE REGISTRY
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Introduction: Upper Airway Stimulation (UAS) therapy is a treatment option for CPAP intolerant obstructive sleep apnea. An increasing number of facilities offer UAS with varying levels of experience. Referring physicians may want to know whether the first set of patients have different outcomes from subsequent patients. We sought to quantify whether the surgical learning curve affects patient AHI and ESS outcomes.

Methods: The ADHERE international multi-center registry is tracking UAS outcomes, including Apnea-Hypopnea Index (AHI), Epworth Sleepiness Scale (ESS) score, and surgical procedure time. Data were retrospectively reviewed from centers with at least 20 implants. The outcomes from each center’s first ten implants were compared against the subsequent ten implants. Data are presented as mean (± standard deviation).

Results: A total of 8 facilities had at least 20 implants for analysis, yielding 80 in the first ten implants group and 80 subjects in the subsequent ten implants group. Baseline age, gender, BMI, and pre-operative AHI and ESS were similar in both groups. UAS implantation time decreased significantly from 160 (±37) minutes (range: 72-287) for the first 10 implants to 145 (±42) minutes (range: 77-329) for the subsequent 10 implants. (p<0.05)

Conclusion: A learning curve effect is present in implantation time, yet similar improvements in post-titration AHI and ESS occurred over the first twenty implants. This finding may address referring physician concerns about initial patient outcomes when starting an UAS program.

Support (If Any): ADHERE registry was sponsored by Inspire Medical Systems.

0556 UPPER AIRWAY STIMULATION: WHO ARE THE PATIENTS REALLY GOING FOR IT?
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Introduction: Upper Airway Stimulation (UAS) therapy is a treatment option for CPAP intolerant obstructive sleep apnea. An increasing number of facilities offer UAS with varying levels of experience. Referring physicians may want to know whether the first set of patients have different outcomes from subsequent patients. We sought to quantify whether the surgical learning curve affects patient AHI and ESS outcomes.

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Conclusion: A learning curve effect is present in implantation time, yet similar improvements in post-titration AHI and ESS occurred over the first twenty implants. This finding may address referring physician concerns about initial patient outcomes when starting an UAS program.

Support (If Any): ADHERE registry was sponsored by Inspire Medical Systems.
B. Clinical Sleep Science and Practice

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Introduction: Upper airway stimulation (UAS) is increasingly recognized as a reliable and safe treatment modality for well-selected patients with moderate-to-severe obstructive sleep apnea (OSA) and continuous positive airway pressure (CPAP) failure. This study characterizes patient demographics and their clinical path taken towards UAS in an academic, dedicated sleep surgery clinic.

Methods: This study included patients presenting to the Stanford Sleep Surgery clinic who were offered UAS (Inspire, Minnesota, USA) between October 2016-2018. Demographic information, medical history, polysomnography data, and prior treatment history for OSA were collected. For patients seeking UAS, standard drug-induced sleep endoscopy (DISE) examination was performed per routine for UAS selection criteria.

Results: Of 131 patients whom UAS was discussed and recommended as a treatment option, 22 underwent UAS (Male: Female 20:2). The mean age was 66.7±8 years, and mean BMI was 26.9±4 kg/m². Important co-morbidity of this treatment cohort included: 1) 5 with cardiovascular disease, 2) 9 with hypertension, 3) 3 with pulmonary disease, 4) 2 with diabetes mellitus, 5) 2 with renal insufficiency, 6) 1 with stroke, and 7) 1 with acquired immune deficiency syndrome. Eighteen percent of them had relapsed from previous OSA surgery: 2 from soft tissue surgery, and 2 from maxillomandibular advancement. 36% of the treatment cohort also required additional surgery to reverse complete concentric collapse (CCC) of the velum before UAS. Mean reduction in AHI was from 36.4 to 4.3 events/hour. No serious complications were encountered.

Conclusion: 17% of all patients offered UAS in a busy academic center offering full-scope sleep surgery elected to undergo UAS. The older age at implantation may reflect both the current insurance climate (easier to approve under Medicare), and the use of UAS after PAP trial and relapse from previous history. Despite the age and high prevalence of co-morbidity important for surgical consideration, patients have done well with UAS. Future studies should focus on both patient and surgeon related factors correlating with the decision and efficacy of undergoing UAS.

Support (If Any): none

0558
UPPER AIRWAY STIMULATION IN US VETERANS WITH OBSTRUCTIVE SLEEP APNEA WITH AND WITHOUT INSOMNIA: A PRELIMINARY STUDY
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Introduction: Insomnia is a common comorbidity in veterans with obstructive sleep apnea (OSA) known to interfere with adherence to PAP. However, whether insomnia symptoms (INS) influence adherence to upper airway stimulation (UAS) therapy in US veterans with OSA is unknown. Our aim was to better understand the influence of INS on 1) OSA symptoms following treatment and 2) UAS adherence.

Methods: Twenty veterans were selected using the STAR clinical trial criteria. The following sequence was followed: UAS implantation, sub-therapeutic activation of UAS, titration with PSG and post-treatment follow up. Each of these procedures occurred 1 month apart. Data collection occurred at 3 timepoints: 1) Baseline 2) UAS titration night and 3) 1-month post-treatment. Data collected at each time point included Sleep Diaries (SD) Insomnia Severity index [ISI], Epworth Sleepiness Scale [ESS], Fatigue Severity Scale [FSS], and Functional Outcomes of Sleep Questionnaire [FOSQ]. Objective UAS adherence was obtained P3g night and post-treatment. Those with baseline sleep efficiency < 85% from SD were categorized as INS. Repeated measure ANOVA were used to compare differences due to insomnia status over the timepoints.

Results: Twenty veterans (95% male, age 55 ± 12, body mass index 29 ± 3 kg/m²) with mean AHI of 37 (± 17) participated. Eleven veterans had INS. For ESS, FSS, ISI, FOSQ, both groups showed similar improvements from baseline to titration night. However, results diverged after the titration. Symptoms in those without INS continued to improve following titration but those with INS experienced dampened improvements. Although not statistically significant, a large effect size for adherence was observed between veterans with and without INS (>5.8 hrs/weekly; p=.037; partial eta²=0.05) indicating less use in subjects with INS.
B. Clinical Sleep Science and Practice

**Conclusion:** Veterans with INS appear to be less adherent to UAS than those without INS. Although not statistically significant, large effect sizes were observed for UAS adherence and blunted improvements in subjective sleep measures with optimally titrated UAS in this small sample. Larger studies are needed comparing UAS outcomes in veterans with INS.

**Support (If Any):** None

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**0559**

**TREATMENT OF OBSTRUCTIVE SLEEP APNEA WITH CONTINUOUS NEGATIVE EXTERNAL PRESSURE**

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**Introduction:** Introduction: cNEP is a novel treatment for OSA that involves external application of negative pressure over the upper airway via a silicone collar with an integral vacuum source. Previous studies indicate that cNEP reduces apnea-hypopnea index (AHI) during single night polysomnography (PSG). The current study assessed cNEP during 3 weeks of home use.

**Methods:** Methods: This was a prospective, open label, single arm study in subjects with baseline AHI between 10 and 50/hr (>80% obstructive apneas). The primary efficacy endpoint was an AHI during an observed PSG after 3 weeks of home use (PSG2), where AHI was <15/hr and < 50% of baseline. To qualify, subjects were required to fit one of the two available cNEP collar sizes and to have a successful cNEP titration as defined by an AHI <15 and < 50% baseline during an in lab PSG (PSG1) where response to two pressures (-25 and -30 cmw) was assessed.

**Results:** Results: 71 subjects (46 males) were enrolled. 23 (36.5%) were treatment naïve. Demographic characteristics included (mean ± S.D.) age 54.6 ± 11; BMI 28.3 ± 4.1; baseline AHI 27.5 ± 11.7. 59 subjects completed PSG1. 27 subjects (46%) exhibited an initial response at PSG1. 16 subjects (64%) exhibited a sustained response at PSG2. An additional 5 subjects had a reduction in AHI, which did not reach the primary endpoint. Compared to baseline, mean AHI was reduced in responders at both PSG1 (6.6 v. 26.7) and PSG2 (7.6 v. 26.7) (p<0.001). Nightly usage of cNEP averaged 4.34 hours. Most subjects and their bed partners preferred cNEP to other OSA treatments. Adverse events consisted mainly of transient local irritation at the collar site. In four subjects, AHI increased from baseline during PSG1 and changed the OSA severity classification in three.

**Conclusion:** Conclusion: cNEP is a safe, effective and well-tolerated intervention during 3 weeks of home use in subjects with moderate and severe OSA.

**Support (If Any):** Support: Sommetrics, Inc.

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**0560**

**A SINGLE CENTER CROSS-OVER AND EVALUATOR-BLIND PIVOTAL STUDY TO EVALUATE THE EFFICACY AND SAFETY OF INTRAORAL NEGATIVE AIR PRESSURE DEVICE IN ADULTS WITH OBSTRUCTIVE SLEEP APNEA**

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1Chest, Shin Kong Wu Ho-Su Memorial Hospital, Taipei, Taiwan, 2Stanford University Sleep Medicine Division, Stanford, CA, USA.

**Introduction:** There are many Intraoral devices, such as tongue retaining devices, palatal lifting devices and mandibular repositioning devices designed to increase the patency of the airway and to decrease airway obstruction, are used to treat Obstructive Sleep Apnea (OSA). The investigational product (iNAP®) was designed to prevent airway obstruction by forming negative pressure within the oral cavity. The negative pressure will pull the tongue forward and stabilize the soft tissues around pharynx, thereby decreasing the sleep-disordered breathing for OSA patients.

**Methods:** This is a prospective, self-controlled, first-night order cross-over and evaluator-blind pivotal study to evaluate the efficacy and safety of intraoral Negative Air Pressure device in adults with OSA. The patients diagnosed with OSA by AHI between 15–55 and the body-mass index (BMI) < 33 were enrolled. The primary endpoints of the study were the treated response rate. The polysomnography (PSG) report was all scored, following the AASM 2012 guideline, by an independent scorer who is blinded to baseline or treatment status.

**Results:** Results: An overall of 35 patients had signed the informed consent and 34 were enrolled in this clinical study in one sleep center in Taipei, North Taiwan. There are 32 evalable patients, 28 were male and 4 were female, with an average BMI and the age of 26.5 ± 3.2 kg/m2 and 47.4 ± 11.24 years, respectively. By the treatment of the intraoral negative air pressure device, the AHI statistically significantly decreased from 32.04 ± 11.30 to 8.79 ± 9.49, resulted in 75% of patients whose treated AHI lower than 20 and reduced more than 50%.

**Conclusion:** Conclusion: By providing well training of education of device use, many OSA patients could achieve effective treatment (treated AHI <5). There is no device-related adverse events were reported, and no SAE occurred during the entire study. The study result shows this investigational product is a well tolerated and alternative treatment for adults with OSA.

**Support (If Any):** This study was sponsored by Somnics, Inc.

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**0561**

**IDENTIFYING FEATURES CORRELATING WITH TREATMENT RESPONSE TO REMOTELY CONTROLLED MANDIBULAR PROTRUSION IN MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** While continuous positive airway pressure (CPAP) remains first line therapy in the treatment of obstructive sleep apnea (OSA), oral appliance therapy is a valuable alternative treatment modality. More recently, remotely controlled mandibular protrusion sleep studies have been demonstrated to predict the outcome of oral appliance treatment. The aim of this study is to identify factors which may influence treatment response to remotely controlled mandibular protrusion device as surrogate markers for the success of oral appliance treatment.

**Methods:** This is a retrospective study of 113 individuals age fourteen years and older who underwent therapeutic polysomnography (PSG) with MATRx (product of Zephyr Sleep Technologies, Inc.) for treatment of OSA. Five individuals were excluded because diagnostic PSG data was unavailable. Data was analyzed for differences between patients whose OSA was successfully controlled and patients whose OSA was uncontrolled despite maximal advancement of the mandible. Variables assessed included age, body mass index (BMI), neck circumference, Mallampati class, overall apnea-hypopnea index (AHI), AHI during rapid eye movement (REM) sleep, and AHI during supine sleep.
**B. Clinical Sleep Science and Practice**

**Results:** A total of 108 patient charts were reviewed. Eighty-five patients were successfully treated using remotely titrated mandibular protrusion; 23 were not. Of those successfully treated, 47 were female; 38 were male. Of those not successfully treated, 11 were male; 12 were female. In comparing the two patient groups, patients not successfully controlled with remotely controlled mandibular protrusion had significantly greater age (p=0.0009), BMI (p=0.0015), overall AHI (p=0.0002), and AHI during supine positioning (p<0.0001) compared to patients who were successfully treated. Neck circumference, Mallampati class, and AHI during REM did not differ significantly between the two groups.

**Conclusion:** Our analysis suggests that patients who are older and those with higher BMIs, more severe OSA, and severe supine events may not be good candidates for oral appliance therapy for treatment of OSA. The impact age and positioning may have on a patient’s response to therapy suggests an opportunity for further investigation to expand the availability of treatment options for OSA patients.

**Support (If Any):**

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**0562**

**ASSESSMENT OF MANDIBULAR ADVANCEMENT TREATMENT SUCCESS ACCORDING TO UPPER AIRWAY MUSCLE MECHANICAL PROPERTIES IN OBSTRUCTIVE SLEEP APNEA PATIENTS**

Frédéric Séries, Jean-François Masse, Simon Gakwaya, Wenyang Li

**CRIU CPQ, Quebec City, QC, Canada.**

**Introduction:** Mandibular advancement device (MAD) is a valid treatment for obstructive sleep apnea (OSA). However there is no reliable criteria predicting treatment efficacy. Upper airway muscle mechanical properties (UAMP) are important pathophysiological determinants of the occurrence of OSA that could be involved in MAD treatment response. The aim of this study was to investigate UAMP in the response to MAD in OSA patients.

**Methods:** 9 subjects were recruited to perform either a soft palate fatigue protocol (SPFP, n=4) or a tongue fatigue protocol (TFP, n=5) before initiating MAD treatment. In SPFP, subjects were asked to develop sustained maximal bulging pressure for 5 seconds every 10 seconds until the peak pressure failed to reach 85% of baseline maximal pressure for 2 consecutive times. In TFP, subjects had to press an air filled bulb with the tongue against the hard palate. Endurance time, recovery time, and mean maximum pressure were measured. Sleep studies were performed before the beginning of MAD treatment and after the titration period.

**Results:** Characteristics of subjects for SPFP group were 1 female, age 54 ± 8 y; BMI 29.1 ± 3.1 kg/m². Characteristics of TFP were 1 female, age 62 ± 2, BMI 26.8 ± 2.8 kg/m². Baseline AHI was 22.8 ± 8.7/h for SPFP and 36.7 ± 13.1/h for TFP. MAD AHI was 10.4 ± 8.2/h for SPFP and 18.2 ± 12.8/h for TFP. 2 TFP and 2 SPFP subjects were responders (AHI decrease greater than 50% with a final MAD AHI < 15/h). No difference was found in endurance time and recovery time between responders (5.1 ± 6.8 and 4.0 ± 2.8 min respectively) and non-responders (11.2 ± 6.1 and 6.8 ± 4.6 min), but difference in mean maximum pressure was borderline significant (34.8±13.6 and 60.0±10.7 kPa respectively, p=0.07).

**Conclusion:** Our pilot results suggest that mechanical strength but not fatigue may differentiate MAD responders/non-responders.

**Support (If Any):** Supported by Le fonds de recherche et enseignement sur les troubles respiratoires du sommeil de la Fondation IUCPQ.

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**II. Sleep-Related Breathing Disorders**

**0563**

**ORAL APPLIANCE AND PHARMACOLOGIC AGENTS IN TREATMENT OF SLEEP APNEA**

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**Introduction:** A pilot study of a combination treatment of an oral appliance with drug therapy for obstructive sleep apnea was carried out using a single-blinded placebo case control crossover approach. We hypothesize that augmentation of oral appliance (OA) by pharmacotherapy (ondansetron+fluoxetine) will increase therapeutic efficacy in moderate to severe obstructive sleep apnea (OSA) patients.

**Methods:** Fifteen subjects met inclusion criteria and were enrolled out of 50 who were recruited. Subjects with moderate-severe OSA were treated with a mandibular-advancement OA plus placebo medication for two weeks, followed by a combination regimen of ondansetron (24 mg/day) and fluoxetine (10 mg/day) with continued use of the OA for four weeks. The primary outcome measure is Apnea-Hypopnea Index (AHI). Secondary outcome measures include total arousal index, Epworth Sleepiness Scale (ESS), and Psychomotor Vigilance Task (PVT) to assess daytime vigilance. Cone beam CT (CBCT) radiographs were collected to assess airway changes. Subjects’ baseline polysomnogram reports were assessed for recruitment purposes. All enrolled subjects completed overnight polysomnograms on study day 14 (OA only) and day 42 (OA + Medications).

**Results:** Seven subjects (5 male and 2 female, BMI 39.1±6.6) completed the study. AHI OA + Medications (22.1±16.3) was lower than the AHI baseline (31.7±11.2). Total arousal index of OA (21.4±6.8) and OA + Medications (17.0±6.1) was lower than baseline (23.3±9.1). PVT mean reaction time of OA (303±42) and OA + Medications (300±45) was lower than baseline (355±46). ESS score of OA (7.7±5.4) and OA + Medications (7.2±5.8) was lower than baseline (10.4±5.3). Mean total airway volume at end inspiration increased by 17% with OA (31427mm³) compared to (26699mm³±12897mm³) without OA.

**Conclusion:** Combination of pharmacotherapy and oral appliance may be a viable option in treating patients with moderate to severe OSA.

**Support (If Any):** American Association of Orthodontists Foundation Biomedical Research Award

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**0564**

**EFFECT OF ORAL APPLIANCE THERAPY IN MODERATE AND SEVERE OBSTRUCTIVE SLEEP APNEA: PROSPECTIVE MULTI-CENTER OBSERVATIONAL STUDY.**

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**Introduction:** Oral appliance (OA) is an effective treatment option for mild to moderate obstructive sleep apnea (OSA) patients. It is also recommended for severe OSA patient when
they fail continuous positive airway pressure (CPAP) treatment. However, the effect of OA as a first-line treatment for severe OSA patients has not been properly evaluated. This study aimed to evaluate the effect of OA in newly diagnosed moderate to severe OSA patients.

Methods: This was a prospective study performed at three sleep centers in Korea (Keimyung University Dongsan Medical center, Soon Chun Hyang University hospital Cheonan, and KyungHee University Hospital at Gangdong). Adult OSA patients with moderate to severe severity (AHI≥25) were recruited. They were treated with customized two-piece dental device. Sleep questionnaire and video-polysomnography were performed before and 1 month after the treatment. The primary outcome measure was improvement in apnea-hypopnea index (AHI) at 1 month after the dental device. Secondary end-points were improvement of sleep questionnaire and sleep structure.

Results: Total 50 patients were enrolled between Mar 2017 and Aug 2018. Two were excluded for having dental problems, 1 withdrew to participate, and 2 patients dropped out, and remaining 45 patients were analyzed. Mean age was 47.4±12 years old, and 43 (95.6%) were male with mean BMI of 26.8±3.3, and AHI of 29.8±11.0/hr. Twenty-two of the patients had moderate OSA and the rest had severe OSA (AHI≥30). At 1 month follow-up, mean AHI decreased significantly (pre: 29.8±11.0, post 11.6±10.7, p<0.001) with the OA. The improvement was similar between the moderate and severe OSA, and 70.8% of the severe OSA patients had more than 50% improvement in AHI. The proportion of deep sleep increased (pre: 14.5±13.4%, post 19.1±15.7%, p=0.004), and wake after sleep onset decreased (pre: 59.9±52.3min, post 38.8±31.8min, p=0.011). BMI was independent factor associated with percent improvement in AHI.

Conclusion: The result of this study shows that OA is as effective in severe OSA as in moderate OSA patients.

Support (If Any): None

0565 IMPACT ON ORAL MYOFUNCTIONAL THERAPY TO TREAT THE PATIENTS WITH MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: Current literature demonstrated oral myofunctional therapy (MFT) decreased apnea hypopnea indices (AHI) by 50% in middle aged patients (44.5 &±177; 11.6 years old) with moderate obstructive sleep apnea (OSA), however few studies was reported in elder patients with moderate to severe OSA.

Methods: Twenty eight Japanese patients (19 males and 9 females) with moderate to severe OSA treated with continuous positive airway pressure (CPAP) or oral appliance (OA) for more than 6 months were included and MFT were performed 3 times a day for 6 months with CPAP or OA during sleep. The patients were educated MFT by dentists, described training diary, tongue pressures were calculated and checked their MFT pre, 2, 4 and 6 months after starting MFT with disposable tongue pressure measurement device (JMS, Japan). Polysomnography was studied before and after MFT without CPAP or OA.

Results: Those ages were 71.0 &±177; 7.5 years old and body mass indices were 23.6 &±177; 2.4 Kg/m2. The previous AHI were 34.7 &±177; 2.5 and AHI did not change significantly with CPAP or OA. The pre and post MFT AHI decreased from 36.2 &±177; 2.5 to 31.9 &±177; 2.5, p=0.025. Epworth Sleepiness Scale decreased from 7.5 &±177; 4.0 to 6.0 &±177; 3.5, p=0.013. Tongue pressure increased from 37.4 &±177; 8.5 to 42.7 &±177; 9.1kPa, p < 0.001, neck circumference decreased from 38.1 &±177; 3.8 to 37.2 &±177; 3.4cm, p=0.024. Body weight and waist circumference did not change significantly.

Conclusion: MFT might support the treatment to elder patients with moderate to severe OSA.
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Introduction: Acetazolamide (AZM) is efficacious for subsets of patients with sleep disordered breathing (e.g. obstructive sleep apnea with high loop gain and central sleep apnea due to heart failure or high altitude), but therapy is often limited by side effects. Our objective was to estimate the overall risk of commonly reported side effects based on meta-analyses of randomized, placebo-controlled trials (RCT) and we hypothesized that these risks are dose dependent.

Methods: We queried MEDLINE/EMBASE for any RCT in which adults received oral AZM vs placebo reporting side effects. For side effects reported by 3 or more studies a pooled effect estimate was calculated; for outcomes reported by 5 or more studies effect modification by total daily dose (EMbyTDD; <400mg/d, 400-600mg/d, >600mg/d) was assessed via meta-regression. For pre-specified, primary outcomes (paresthesias, taste disturbances, polyuria and fatigue) additional subgroup analyses were performed using demographics, intervention details, laboratory changes and risk of bias.

Results: We included 43 studies (N subjects=1286/1221 in AZM/Placebo). AZM increased the risk of all primary outcomes (P<0.01) - the numbers needed to harm (95%-Confidence Interval [CI]; nstud-placement) were: paresthesias 2.3 (2.2-7; n=39), dysequia 18 (10-38, n=22), polyuria 17 (9-49; n=22), fatigue 11 (6-24; n=14). The risk of paresthesias (beta=1.8 [95%-CI=1.1-2.9]; P_EmbbyTDD=0.01) and dysequia (beta=3.1 [95%-CI=1.2-8.2]; P_EmbbyTDD =0.02) increased with higher AZM doses; the risk of fatigue also increased with higher dose but did not reach statistical significance (beta=2.6 [95%-CI=0.7-9.4]; P_EmbbyTDD=0.14). Additional subgroup analyses only revealed significant effect modification of the risk for dysequia by query type (active vs unclear/passive). Secondary outcomes that were significant more common with AZM were nausea, gastroesophageal reflux, diarrhea, and depression; for secondary outcomes there was no significant effect modification by dose.

Conclusion: This comprehensive meta-analysis of high-quality data defines risk of common AZM side effects and corroborates dose-dependence of at least some side effects. These results may be clinically informative and support efforts to establish the lowest effective dose of AZM for select patients with sleep disordered breathing.

Support (If Any): CS is supported by NIH T32 grant HL134632.

0568
PHRENIC NERVE STIMULATION TO TREAT IDIOPATHIC CENTRAL SLEEP APNEA
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Introduction: Central sleep apnea (CSA) is common in patients with cardiovascular disease (CVD), but also occurs in patients without CVD. In a randomized double arm parallel design trial of 151 participants with moderate to severe CSA, 18/151 (twelve percent) had no known CVD defined as coronary disease, left ventricular dysfunction, heart failure, arrhythmias, or hypertension. Echocardiography showed normal LVEF and absence of significant diastolic dysfunction (posterior wall thickness ≤ 1.2 cm, E/A ratio between >0.8 and < 2.0).

Methods: All polysomnograms were scored centrally. Sleep metrics and quality of life (QOL) were assessed by patient global assessment (PGA) and Epworth Sleepiness Scale (ESS). Change between 6 months and baseline was calculated for continuous endpoints. Safety was assessed by related serious adverse events (SAE) through 12 months.

Results: There were six participants with idiopathic CSA in the treatment arm (TX) and 12 in the Control (Ctrl) arm. The mean age was 50 years, 83% were male and 50% had depression. The median CSA hypopnea index (AHI) was 37 events/hr, central apnea index (CAI) 25 events/hr, and Epworth Sleepiness Scale (ESS) score was 12. Following 6 months of PNS therapy, the mean AHI improved by 21±16 events/hr (TX) whereas Ctrl improved by 7±17 events/hr (p=0.049), with similar changes in the oxygen desaturation index. The median TX CAI improved from of 35 (Q1-Q3:20-53) to 9 (Q1-Q3:5-22) events/hr, whereas Ctrl changed from 24 (Q1-Q3:17-34) to 15 (Q1-Q3:4-31) events/hr (p=0.030). The arousal index decreased by a median 9 (Q1-Q3:3-15 to 0) with TX and Ctrl decreased by 1 (Q1-Q3:3-8 to 4) events/hour (p=0.241). Moderate or marked improvement in the patient global assessment was reported by 50% in TX versus 0% in Ctrl. The ESS improved by a median of 5.5 (Q1-Q3:6.0 to -1.0) points in TX compared to 0.5 (Q1-Q3:1.3 to 3.0) in Ctrl.

Conclusion: PNS appears to improve sleep and quality of life safely and effectively in patients with idiopathic CSA.

Support (If Any): Respicardia funded this research.

0569
INCIDENCE AND DURATION OF COMMON ADVERSE EVENTS IN A SOLRIAMFETOL (JZP-110) PHASE 3 STUDY FOR TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS IN OBSTRUCTIVE SLEEP APNEA
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Introduction: Solriamfetol, a selective dopamine and norepinephrine reuptake inhibitor, reduced excessive daytime sleepiness (EDS) and increased wakefulness in participants with obstructive sleep apnea (OSA) in a phase 3 study. Post-hoc analysis evaluated timing and duration of common, early-onset, treatment-emergent adverse events (TEAEs).

Methods: Patients (N=474) with OSA and EDS were randomized to 12 weeks placebo or solriamfetol 37.5, 75, 150, or 300 mg. Common, early-onset TEAEs were defined as those occurring in ≥5% of participants in any solriamfetol dose group and greater than placebo during week 1. For TEAEs identified during week 1, incidence of new occurrence or change in severity over time was calculated for each subsequent study week. Analysis included placebo (n=119) and combined solriamfetol groups (n=355).
Results: Common early-onset TEAEs during week 1 across all solriamfetol doses were decreased appetite (5.6%), headache (5.1%), anxiety (3.9%), nausea (3.7%), feeling jittery (3.7%), and insomnia (3.1%). Incidence was highest at week 1 and decreased over time; at week 12, only headache, nausea, and anxiety TEAEs were reported (all 0.3%). Fourteen of 25 TEAE-related discontinuations on solriamfetol were due to a common early-onset TEAE (1, decreased appetite [0.3%]; 1, headache [0.3%]; 4, anxiety [1.1%]; 3, nausea [0.8%]; 4, feeling jittery [1.1%]; 1, insomnia [0.3%]). Median durations (days; [min, max]) for common TEAEs were decreased appetite, 57 (5, 91); headache, 5.5 (1, 112); anxiety, 26 (1, 94); nausea, 10 (1, 86); feeling jittery, 4 (1, 49); insomnia, 8.5 (1, 49).

Conclusion: In a phase 3 clinical trial of solriamfetol for the treatment of EDS in participants with OSA, common early-onset TEAEs were decreased appetite, headache, anxiety, nausea, feeling jittery, and insomnia. Most early-onset TEAEs had a median duration ≤10 days; and while all diminished over time, they accounted for ~50% of TEAE-related discontinuations across the study. This analysis may inform clinician and patient expectations regarding type, course, and duration of common early-onset TEAEs associated with solriamfetol therapy.

Support (If Any): Jazz Pharmaceuticals.
success criteria (50% decrease in AHI and ≤20 events/hour), UAS had a 75% success rate vs 52% palatal surgery success. **Conclusion:** Despite similar baseline disease severity and demographics, UAS reduces the AHI significantly more than palatal surgery, and with a higher surgical success rate. ESS was equally reduced by both therapies. These findings warrant further prospective research.

**Support (If Any):** This clinical trial (ADHERE registry) is supported by Inspire Medical Systems

### 0572 IMPACT OF UPPER AIRWAY STIMULATION THERAPY ON CLINICAL BLOOD PRESSURE PARAMETERS FROM THE ADHERE REGISTRY

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**Introduction:** Upper airway stimulation therapy (UAS) is a recently approved therapy for moderate to severe obstructive sleep apnea (OSA). There are limited data examining the clinical blood pressure outcomes for patients treated with UAS. We hypothesize that UAS will be associated with beneficial effects on blood pressure (BP) parameters for all patients undergoing treatment with UAS and that this reduction will be more pronounced in those who have elevated baseline BP.

**Methods:** Clinical BP data were collected from 337 patients of Adherence and Outcome of Upper Airway Stimulation for OSA (ADHERE), which is a multinational registry. Mean change from baseline to 12 month follow-up was calculated for the overall cohort and also in the subset of patients with elevated BP at baseline (American Heart Association’s guideline: systolic BP ≥ 130 mmHg or diastolic BP ≥ 80 mmHg) and for patients with elevated baseline BP. Paired t-tests were performed to determine if within group change was significant.

**Results:** Average age and BMI were 59.8 years (SD=10.6) and 29.2 kg/m², respectively with 19.6% female and 97.3% Caucasian. 63.7% of patients had elevated BP at baseline. In the full cohort, no significant changes were observed for any BP parameters. In the elevated BP group there was a significant decrease in systolic BP by 4.4 mmHg [(134.9 (SD 11.1) to 130.6 (SD 12.9) mmHg)] and a decrease in mean arterial pressure (MAP) by 2.3 mmHg [(99.8 (SD 7.3) to 97.5 (SD 10.1) mmHg)] with all p values <0.001 from baseline to 12 month follow up. No significant change was observed in diastolic BP.

**Conclusion:** While no significant BP changes were observed in the entire cohort, patients with elevated baseline BP had a significant decrease in systolic and MAP at 12 months. These findings suggest that UAS may produce selective beneficial effects on BP in patients with OSA. More rigorous prospective studies are needed to explore the BP outcomes of patients treated with UAS.

**Support (If Any):**

### 0573 UPPER AIRWAY STIMULATION IMPROVES PATIENT OUTCOME IN MODERATE TO SEVERE OSA: A PROSPECTIVE PARALLEL TRIAL

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**Introduction:** Upper airway stimulation (UAS) is an effective therapy for CPAP-intolerant obstructive sleep apnea (OSA) patients. Several single arm studies of UAS have demonstrated reduced OSA severity and improved quality of life. This study enrolled a group receiving UAS and compared them to a control group denied UAS by their insurance plans.

**Methods:** Participants met UAS indications. Baseline sleep study (either home sleep tests (HST) or attended polysomnography) and ESS results were collected from the medical record. Prospective followup HST’s were performed in both groups, six months post-operatively in the UAS group, and up to 24 months after enrollment in the control group. Respiratory event index (REI), and Epworth Sleepiness Scale (ESS) and Functional Outcome of Sleep Questionnaire (FOSQ-10) scores were prospectively collected. Results are presented as mean ± SD, p value.

**Results:** 246 Participants in the UAS group, and 58 in the control group, were enrolled. Groups were similar with respect to age and body mass index, yet the proportion of males was higher in the UAS group. Follow-up duration was similar after enrollment (308 ± 141 days vs 287 ± 279, p=0.62). Baseline AHI/REI and ESS scores were similar in both groups, consistent with severe, symptomatic OSA. The UAS group had a larger AHI decrease than the control group (-21.2 ± 16.5 events/hour vs -9.9 ± 16.4 events/hour, p < 0.001). UAS usage was 6.5 ± 1.9 hours/night. UAS group ESS decreased by -5.3 ± 5.6 while the control group ESS increased by 1.6 ± 3.3, p<0.0001. At final visit, FOSQ-10 scores were 17.1 ± 3.2 and 12.5 ± 8.3 in the UAS and control groups, respectively (p < 0.0001).

**Conclusion:** In this prospective study, UAS recipients had a larger reduction in OSA severity and had superior quality of life measures than a similar control group that was denied treatment. Patients awaiting insurance approval for UAS continue to have residual OSA and symptoms, highlighting the need for timely insurance approvals.

**Support (If Any):** Study Sponsored by Inspire Medical Systems

### 0574 PHENOTYPIC PREDICTORS OF LONG-TERM UPPER AIRWAY NEUROSTIMULATION RESPONSIVENESS IN THE ADHERE INTERNATIONAL REGISTRY

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**Introduction:** Upper airway neurostimulation (UAS) is an effective treatment for CPAP-intolerant obstructive sleep apnea (OSA). We leveraged the FDA post-approval international ADHERE registry to examine phenotypic predictors of UAS responsiveness.

**Methods:** Patients undergoing UAS implantation in the US and Germany from October 2016 through November 2018 were enrolled in an observational registry. Demographics, sleep study-based data: Apnea Hypopnea Index (AHI), Epworth Sleepiness Scale (ESS) and objective adherence were collected at baseline, implant, and 6- and 12- month post-implantation. Paired t-tests were used to compare between visits. Univariate and multivariate logistic regression models (odds ratio and 95% confidence
B. Clinical Sleep Science and Practice

Support (If Any): UAS has durable impact on OSA outcome without cardiovascular disease with fair agreement, which can be a fast screen technology in those unable to be performed PSG.

**Conclusion:** Female sex and lower BMI are predictors of long-term UAS response after adjustment for adherence, suggesting a potential biologic mechanism. UAS has durable impact on OSA outcomes with a high level of adherence.

**Support (If Any):** Inspire Medical Systems

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**0575**

**VALIDATION OF A PORTABLE MONITORING FOR THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA: ELECTROCARDIOGRAM-BASED CARDIOPULMONARY COUPLING**

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**Introduction:** This study was to evaluate the diagnostic accuracy of the cardiopulmonary coupling (CPC) device, a limited-channel portable monitoring device for diagnosing obstructive sleep apnea (OSA) in patients suspected with sleep disordered breathing, in particular with those who have cardiovascular diseases.

**Methods:** 203 patients referred to the sleep medical center were enrolled in this study. All participants were monitored with CPC when receiving polysomnography (PSG). The results of 2 examinations were compared in the all and in subgroup combined with cardiovascular abnormalities.

**Results:** A total of 179 subjects suspected with OSA were finally analyzed. According to apnea hyperpnea index (AHI), the area under ROC curve in the whole cohort patients was 0.79 (mild), 0.79 (moderate) and 0.86 (severe) respectively (all p<0.001). The Bland-Altman plots showed that PSG and CPC device were in good consistency in evaluating OSA and 92.7% (13/179) scatters were in the limits of agreement. For those with cardiovascular disease with different OSA severity, the area under the ROC curve was 0.86, 0.76 and 0.83, respectively (all p<0.0001), and 0.74, 0.85 and 0.91, respectively in patients without cardiovascular disease (all p<0.0001). And the Bland-Altman plots showed that the mean difference was -1.5 events/h and 92.4% (97/105) scatters were in the limits of agreement for the patients with cardiovascular conditions, and the mean difference was -1.4 events/h and 93.2% (69/74) scatters were in the limits of agreement for the patients without cardiovascular disease.

**Conclusion:** The overall performance of CPC technique was acceptable to assess OSA in a highly suspected subjects, and thus it might act as an alternative tool to screen OSA patients.

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**II. Sleep-Related Breathing Disorders**

**0576**

**VALIDATION OF THE CONTACT-FREE SLEEP MONITORING DEVICE FOR DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA IN CHINESE ADULTS**

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**Introduction:** Polysomnography (PSG) is the gold standard for sleep monitoring, but has several disadvantages, including intensive resource consumption, cost, and limited accuracy of interrater interpretation. Most portable home sleep monitoring devices require body contact. One of the newest devices, a contact-free device, is developed to detect sleep stage as well as respiratory events.

**Methods:** 244 Chinese adult participants (mean ± standard deviation age 47.30 ± 13.77 years, 73.0% males, body mass index 26.53 ± 4.21 kg/m²) who presented with snoring were recruited between May 2017 and November 2017. They underwent an overnight monitoring using the Contact-free sleep monitoring (CFSM) device as well as polysomnography (PSG) in the sleep lab. The CFSM recordings were analyzed automatically, and PSG was manually scored based on AASM scoring manual. Then we evaluated the agreement of CFSM and calculated the optimum diagnostic efficiency of the CFSM.

**Results:** (1) Total sleep time of the CFSM was longer than PSG significantly (447.80 ± 78.96 min and 399.25 ± 73.06 min respectively, p<0.0001), the apnea-hypopnea index (AHI) was 27.40 ± 21.40 events/h on the CFSM and 29.47 ± 26.38 events/h on PSG (p=0.0011); (2) There was a significant correlation between the AHI of those two tests (Pearson’s coefficient=0.94, p<0.0001). Bland-Altman analysis of AHI on PSG versus CFSM showed a mean difference of 2.1 events/h, limits of agreement (equal to ± 2 standard deviations) was -17.1 to 21.3 events/h. (3) Based on the golden standard that AHI ≥ 5 events/h on PSG, the optimum diagnostic cut-off value of the CFSM was AHI > 10.6 events/h with 85.4% sensitivity, 100.0% specificity, 100.0% positive predictive value and 50.8% negative predictive value compared to PSG.

**Conclusion:** When controlling for night-to-night variability and changes of sleeping environment, the results confirmed close agreement between the CFSM and PSG. If the clinical diagnosis allows the measurement error of AHI is no less than 2.1 events/h, the Contact-free Sleep Monitoring Device could be an alternative tests used for diagnosing obstructive sleep apnea in Chinese adults.

**Support (If Any):**
Introduction: Evidence is rapidly accumulating of the prevalence of obstructive sleep apnea (OSA) and associated adverse pregnancy outcomes in the obstetrical population. We have established a cross-disciplinary collaborative Sleep Pregnancy Clinic at the University of Wisconsin Madison/Meriter Hospital, which offers streamlined screening, testing, and treatment of gestational OSA (gOSA). We performed a prospective analysis of our patient population to evaluate completion of referrals, prevalence of sleep apnea, and follow through with OSA positive airway pressure treatment (PAP).

Methods: All pregnant patients evaluated at the obstetrical clinics complete a STOP-Bang questionnaire at their first prenatal visit. Frequent (>3 days per week) or loud snoring (15 points), chronic hypertension (15 points), age, and body mass index (BMI) (absolute numbers) are used to calculate a composite score, with scores ≥5 mandating objective evaluation for OSA per clinical protocol, using the Alice PDX 4-channel home device. Patients meeting diagnostic criteria of respiratory disturbance index (RDI) RDI≥3% or 4% of 5 events/hour or greater are offered PAP therapy. We have initiated a retrospective analysis of our patient population.

Results: Referral completion was 46%, with 49 out of 105 patients referred for gOSA evaluation completing objective sleep testing. 63% (31 out of 49 patients tested), met diagnostic criteria for gOSA with RDI≥3% or 4% > 5/hr. Ten percent (5/49), met 3% but not 4% diagnostic criteria. 77% had mild (RDI 5-15), 13% moderate (RDI 15-30), and 10% severe (RDI>30) gOSA, with only one patient in the mild category by 4% but moderate severity by 3%. 48% of patients meeting diagnostic criteria chose to start PAP.

Conclusion: Completion of objective sleep testing is low at 46% in a real-world pregnant cohort. However prevalence of gOSA was high at 63%. Close to 50% of diagnosed women opted in for PAP therapy, suggesting good motivation and opportunity for therapeutic intervention in those who complete testing. Further analyses of patient characteristics and pregnancy outcomes in the group with versus without gOSA and opting for or against PAP are ongoing.

Support (If Any): None.

0578 SLEEP DISORDERED BREATHING AND FUNCTIONING IN ACTIVITIES OF DAILY LIVING IN PATIENTS WITH SPINAL CORD INJURY OR DISEASE
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Introduction: Patients with spinal cord injury or disease (SCI/D) often experience difficulties with activities of daily living (ADLs). Sleep disordered breathing (SDB) is also associated with poor functioning in some populations, but has not been considered as a contributing factor to functional disability in SCI/D patients. Our objective was to examine the impact of SDB severity on ADLs in SCI/D patients.

Methods: 57 Veterans (average age=58.53 ± 10.69; range=34-79 years; 91% male, average BMI=27.89 ± 5.72) with SCI/D completed baseline questionnaires as part of a larger study. 46 completed in-laboratory polysomnography (PSG) to measure apnea-hypopnea index (AHI). Separate nested regression models predicted the total and each subscale of the Spinal Cord Independence Measure III (SCIM): 1) self-awareness, 2) respiration and sphincter management, 3) mobility. Block 1 included demographic covariates (age, gender, race, education, marital status, BMI. Block 2 included level of injury (cervical vs. thoracic or below). Block 3 included AHI.

Results: The mean AHI=25.26 ± 21.81 (range=1.6-81.5), and 56.5% had AHI>15. Overall models were not significant for SCIM respiration/sphincter management or mobility subscales. All variables in Blocks 1-3 were jointly associated with SCIM total (R2=33%, adjusted R2=0.19) and self-care subscale (R2=35%, adjusted R2=0.21) scores. Block 1 did not explain a significant proportion of variance in the SCIM total score (p=.54) or the self-care subscale (p=.41). Results of injury did explain significant variance in SCIM total (p=.01), but not in the self-care subscale scores (p=.09). Block 3 explained an additional 8.1% of variance in SCIM total (p=.04) and 14.9% of variance in SCIM self-care subscale (p=.01) after accounting for Blocks 1 and 2.

Conclusion: Sleep disordered breathing was significantly associated with overall functioning in ADLs among SCI/D patients, even after accounting for demographics and level of injury. Studies on optimized treatment of SDB in these patients has the potential to improve functioning and independence.

Support (If Any): VA Rehabilitation Research and Development Service (RX002116; PI Badr)

0579 OBSTRUCTIVE SLEEP APNEA RISK IS ASSOCIATED WITH COGNITIVE IMPAIRMENT AFTER CONTROLLING FOR TBI: A CHRONIC EFFECTS OF NEUROTRAUMA CONSORTIUM STUDY
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Introduction: OSA is a modifiable comorbidity with the potential to improve cognition in persons with a history of TBI. However, no studies have examined the impact of OSA on cognitive in mTBI patients. Therefore, the purpose of this study is to explore obstructive sleep apnea risk group differences on cognitive outcome in the Chronic Effects of Neurotrauma Consortium (CENC) participants.

Methods: Secondary analyses were conducted from a large database of evaluations from a multi-center, longitudinal study of mTBI. Participants were included if they had completed the STOPBANG (sleep apnea risk) and had valid neuropsychological/self-report scores. The subsequent sample (N=375) included participants with history of TBI (n=311) and non-TBI controls (n=64). The sample was primarily male (88%) with a median age of 37 (IQR: 31-47).
Results: A large proportion of the cohort was at risk for OSA (STOPBANG ≥ 3 [62%]; STOPBANG ≥ 4 [41%]). History of mTBI was associated with higher risk (p<0.05). After controlling for TBI, OSA risk predicted worse performance on the most complex measures of cognition (TMT-B, WAIS-IV coding, p<0.05). OSA risk did not significantly predict performance on other measures of memory, processing speed, or attention/executive functioning. Both OSA risk and TBI history were significantly associated with self-perception of worse cognitive functioning (NSI, p<0.001).

Conclusion: OSA risk is prevalent in the CENC cohort particularly among those with history of mTBI. OSA risk appears to be uniquely associated with performance on complex cognitive tasks. Cognitive sequelae attributed to the downstream effects of mTBI may also be strongly related to comorbidities providing potential treatment targets. Limitations include assessment of sleep apnea risk rather than established diagnosis and treatment. Future studies are needed examining the role of OSA diagnosis on mTBI outcome.


0581

THE IMPACT OF REM-AHI ON REVASCULARIZED CARDIAC PATIENTS

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Introduction: Cognitive sequelae attributed to the downstream effects of mTBI uniquely associated with performance on complex cognitive tasks. Cognitive sequelae attributed to the downstream effects of mTBI may also be strongly related to comorbidities providing potential treatment targets. Limitations include assessment of sleep apnea risk rather than established diagnosis and treatment. Future studies are needed examining the role of OSA diagnosis on mTBI outcome.

Methods: We identified consecutive patients who underwent clinically indicated diagnostic polysomnography with a 12-lead ECG at a single academic sleep center. Heart rate-corrected QT intervals (QTc) were compared by OSA severity class (normal/mild: apnea hypopnea index (AHI) <15/hr; moderate: 15-30; severe: >30) adjusting for age, sex, body mass index, hypertension, and heart failure (HF). Further evaluation was performed by dichotomizing patients into severe (AHI >30/hr) and non-severe (<30/hr) OSA. Logistic analysis was used to determine the association of OSA severity and abnormal QTc (>450msec / >470msec for men/ women, respectively).

Results: A total of 249 patients (50.2% female, mean age 57.2 [12.5]) were included. This cohort had a high burden of cardiovascular disease (73% with hypertension, 20% with HF). Abnormal QTc was present in 34% of males and 31% of females. QTc increased across OSA groups (normal/mild: 435.6 msec; moderate: 431.6; severe: 444.4, p=0.03). Patients with severe OSA had longer QTc compared with normal/mild OSA (mean difference 10.0msec [0.5,19.0], p=0.04). When stratified dichotomously, patients with severe OSA had longer QTc compared to non-severe (433.48 msec, p=0.004). Severe OSA was also associated with abnormal QTc (OR 2.68 [1.34,5.48], p=0.006). There was significant interaction by HF status as the difference in QTc by OSA status (non-severe vs. severe) was more prominent in patients with HF (456.1 msec [435.3-476.8] vs. 480.5 [458.9-502.1], p=0.028).

Conclusion: REM-AHI was significantly greater in participants with REM-predominant-OSA compared to those with non-REM-predominant-OSA at baseline. Utilizing “Chicago Criteria” for scoring AHI, REM predominant OSA was not associated with impaired cardiovascular function at baseline.

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0582
APNEA-HYPOPNEA EVENTS DURING REM/NON-REM SLEEP AND HYPERTENSION AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: Obstructive sleep apnea (OSA) has been associated with hypertension. It is possible that the association between OSA and hypertension is distinct for non-REM versus REM sleep because of differences in sleep-state-dependent sympathetic activation and/or degree of hypoxemia. We intended to examine the association between REM-related/non-REM-related OSA and hypertension, and whether the severity of OSA modifies such association.

Methods: A total of 10,102 patients with apnea-hypopnea index (AHI) ≥ 5/h were recruited into this study (83.8% males, mean age = 44.92 ± 11.86 years). Hypertension was defined based either on direct blood pressure measures or on physician diagnosis. OSA severity during REM and non-REM sleep was quantified using the apnea-hypopneaindex in REM (AHI REM) and non-REM sleep (AHI NREM), respectively. Linear regression was used to assess the associations of AHI REM and AHI NREM with hypertension and blood pressure.

Results: A 53.4% was found to have hypertension in total observed OSA patients. After adjusting for age, gender, body mass index (BMI), Epworth sleepiness scale, tobacco use, alcohol use, nocturnal oxygen desaturation, sleep duration and efficiency, AHI REM was only associated with diastolic blood pressure (DBP), while AHI NREM was associated with percentage of hypertension, systolic blood pressure (SBP) and DBP. Among mild-moderate OSA patients, AHI REM was associated with DBP (B = 0.87; 95% CI, 0.05-1.58; P = 0.037) while AHI NREM was not; among severe OSA patients, AHI REM was associated with percentage of hypertension (B = 0.28; 95% CI, 0.18-0.37; P < 0.001), SBP (B = 7.49; 95% CI, 4.53-10.44; P < 0.001) and DBP (B = 7.23; 95% CI, 5.07-9.38; P < 0.001), whereas AHI NREM was not.

Conclusion: The association between AHI REM/AHI NREM and hypertension varies across the severity of OSA. Significant association to AHI REM was found in mild-moderate patients, whereas association to AHI NREM was only shown in severe patients.

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0583
OBSTRUCTIVE SLEEP APNEA SEVERITY AND CANCER SURVIVAL
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Introduction: Obstructive sleep apnea (OSA) afflicts an estimated 25 million Americans. In vitro and animal models suggest that OSA related intermittent hypoxia and fragmented sleep contributes to increased cancer risk and poorer prognosis. Presently, little is known regarding the relationship between OSA severity and cancer mortality. We compared mortality risk in cancer patients according to clinically diagnosed OSA severity.

Methods: We identified a cohort of adults with a diagnosis of OSA between 2005-2013 within a clinical system in the Seattle-Puget Sound region. We linked this cohort to a population-based cancer registry serving the same region to identify incident cancers and all-cause mortality between 2005-2015 following OSA diagnosis. The following five OSA severity indicators were evaluated as continuous or categorical variables in relation to cancer survival: apneahypopnea index (AHI), hypoxemic burden (Tsat < 90), oxygen desaturation index (ODI3%), oxygen saturation nadir (lowest_satO2) and arousal index. Cox proportional hazards regression was used to calculate hazard ratios (HR) and 95% confidence interval (CI) for the association of OSA severity indices with all-cause cancer mortality, adjusting for age, gender, body mass index and smoking.

Results: Study population included 328 OSA patients with a cancer diagnosis, among whom 51 deaths occurred within a median follow-up of 666 days (IQR: 259, 1,324) after cancer diagnosis. Information regarding OSA severity indicators were missing for ~30% of cohort. Compared with individuals in the lowest AHI category (>5-14.9), indicating mild OSA, the adjusted HR (95% CI) for cancer mortality associated with having moderate (15-29.9), severe (30+) OSA were 0.31 (0.07, 1.40), 0.71 (0.26, 1.92) respectively. With respect to the lowest Tsat<90 category (>1.2), indicating mild OSA, the adjusted HR associated with having moderate (<1.2-12.9), severe (13+) OSA were 0.89 (0.32, 2.47), 1.59 (0.67, 3.75) respectively. Associations of cancer mortality with ODI3%, lowest_satO2, and arousal index were also non-significant.

Conclusion: No evidence for the presence of significant associations between key measures of OSA severity and cancer survival emerged, suggesting that larger studies are needed to confirm or refute this possible association.

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the criterion of \( p<0.1 \) when entered alone, ISI, CESDR, ISIxAHI and CESDRxAHI interactions.

**Results:** Group means: \( AHI=27.2\pm3.3 \) (635 patients had OSA, \( AHI\geq5 \)), \( ESI=8.8\pm5.9 \), \( ISI=13.0\pm7.0 \). CESDR=14.2±12.6. The model included total sleep time (TST), N2%, sleep latency (SL), REM latency (REMl) respiratory arousal index (ResAp), AHI, and time below 80% SpO2 (tO2<80). As both ISIxAHI and CESDRxAHI interactions were significant \( p<0.001 \), \( R^2=0.02 \), respectively, the model was run separately for four OSA groups (\( AHI<5.0 \), 5.0≤AHI<15.0, 15.0≤AHI<30.0, AHI≥30.0). Predictors of higher ESS were: in no-OSA group, shorter SL (\( p=0.011 \), \( R^2=2.5\% \)), shorter REMl (\( p=0.022 \), \( R^2=2.0\% \)), higher RespAr (\( p=0.036 \), \( R^2=1.7\% \)), higher ISI (\( p<0.001 \), \( R^2=5.4\% \)), and higher CESDR (\( p=0.015 \), \( R^2=2.2\% \)); in mild-OSA group, higher ISI (\( p=0.054 \), \( R^2=1.8\% \)), and higher CESDR (\( p<0.001 \), \( R^2=8.0\% \)); in moderate-OSA group, lower TST (\( p=0.006 \), \( R^2=6.3\% \)), shorter SL (\( p<0.001 \), \( R^2=10.5\% \)), higher RespAr (\( p=0.006 \), \( R^2=6.2\% \)), higher ISI (\( p=0.058 \), \( R^2=3.0\% \)), and higher CESDR (\( p=0.054 \), \( R^2=3.1\% \)); and in severe-OSA group, shorter SL (\( p=0.006 \), \( R^2=3.5\% \)) and higher ISI (\( p<0.001 \), \( R^2=13.9\% \)). Four OSA groups accounted for a small yet significant portion of ESS variance (ESS means: 8.2±5.4, 8.9±5.6, 8.5±5.8, 9.6±6.5, respectively, \( F(3,938 df)=4.3 \), \( p=0.005 \), \( R^2=1.4\% \)).

**Conclusion:** While OSA severity alone had only a small contribution to self-reported sleepiness, effects of insomnia and depression symptoms depended on the OSA level. In mild OSA, depressive symptomatology was the best predictor of ESS, while in severe OSA it was insomnia symptomatology. PSG variables were strongest predictors of ESS in moderate OSA.

**Support (If Any):** None.

**0586**

**SYMPTOM SUBTYPES OF OBSTRUCTIVE SLEEP APNEA PREDICT INCIDENCE OF CARDIOVASCULAR OUTCOMES**

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**Introduction:** Symptom subtypes have been described in clinical and population samples of obstructive sleep apnea (OSA) patients. It is unclear whether these subtypes have different cardiovascular consequences. This study aimed to characterize OSA symptom subtypes and assess their association with prevalent and incident cardiovascular disease in the Sleep Heart Health Study.

**Methods:** Data from 1,207 OSA patients (apnea-hypopnea index [AHI]≥15 events/hour) were used to evaluate the existence of symptom subtypes using latent class analysis. Associations between subtypes and prevalence of overall cardiovascular disease (CVD), as well as its components (coronary heart disease [CHD], heart failure [HF] and stroke) were assessed using logistic regression. Kaplan-Meier survival analysis and Cox proportional hazards models were used to evaluate whether subtypes were associated with incident events, including cardiovascular mortality. Similar analyses were performed comparing each symptom subtype with 2,830 individuals without OSA (AHI<5).

**Results:** Four symptom subtypes were identified (Disturbed Sleep [12.2%], Minimally Symptomatic [32.6%], Excessively Sleepy [16.7%], and Moderately Sleepy [38.5%]), similar to prior studies. In adjusted models, the Excessively Sleepy subtype was associated with over 3-fold increased risk of prevalent HF compared to each of the other subtypes. Symptom subtype was also associated with incident CVD (\( p<0.001 \), CHD (\( p=0.015 \)) and HF (\( p=0.018 \)), with the Excessively Sleepy again demonstrating increased risk (hazard ratios of 1.7-2.4) compared to other subtypes. When compared to individuals without OSA (AHI<5), significantly increased risk for prevalent and incident cardiovascular events were observed mostly for patients in the Excessively Sleepy subtype.

**Conclusion:** OSA symptom subtypes are reproducible and associated with cardiovascular risk, providing important evidence of their clinical relevance.
0587
AROUSAL DURING SLEEP IS ASSOCIATED WITH HYPERTENSION IN OBSTRUCTIVE SLEEP APNEA
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Introduction: Repetitive asphyxia events in obstructive sleep apnea (OSA) result in brain arousal, intermittent hypoxemia, and increased sympathetic nervous system activity, which is associated with sleep fragmentation. Arousal index could reflect the severity of sleep fragmentation. In normal humans, arousal which is associated with sympathetic hyperactivity results in transient increases in blood pressure. However, the association of arousal during sleep with hypertension has not been explored in OSA.

Methods: A total of 11,218 patients with apnea-hypopnea index (AHI) ≥ 5/h were included in this study (83.7% males, mean age = 45.06 ± 12.05 years). All patients underwent an overnight PSG. OSA patients were divided into four groups based on the inter-quartile of arousal index (<18.40 (n=2822), 18.40-30.85 (n=2787), 30.85-49.5 (n=2807), and >49.5 (n=2802)). Hypertension was defined based either on direct blood pressure measures or on diagnosis by a physician. Linear and logistic regression models were used to estimate the associations between arousal index and hypertension prevalence in OSA.

Results: Logistic regression analysis revealed that OSA combined with arousal index > 49.5 increased the odds of hypertension by 18.1% (odds ratio, 1.181; 95% confidence interval, 1.024-1.360) compared with OSA patients combined with arousal index < 18.40. Multiple linear regression analysis revealed that arousal index was significantly positive associated with systolic blood pressure (β=0.039, p<0.001) and diastolic blood pressure (β=0.059, p=0.001) in OSA. These results were independent of major confounding factors such as sex, age, body mass index, tobacco, alcohol drinking, coffee use, sleep efficiency and subjective daytime sleepiness, OSA severity and nocturnal oxygen desaturation.

Conclusion: We conclude that increased arousal index is associated with hypertension in OSA patients, indicating that sleep fragmentation in OSA may actually be detrimental in terms of hypertension risk.

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0588
REM SLEEP IS ASSOCIATED WITH BLOOD PRESSURE IN MILD TO MODERATE BUT NOT IN SEVERE OBSTRUCTIVE SLEEP APNEA
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Introduction: Rapid eye movement (REM) sleep is a state of autonomic instability, dominated by significant fluctuations between the parasympathetic and sympathetic nervous system. As a result of cortical desynchronization during REM, the cardiovascular and respiratory system become more unstable. Repetitive asphyxia events in obstructive sleep apnea (OSA) could result in brain arousal, intermittent hypoxemia during sleep, and abnormalities of REM sleep. Whether the abnormalities of REM sleep in OSA are associated with an abnormal blood pressure have not been explored.

Methods: A total of 11218 patients with apnea-hypopnea index ≥ 5/h were included in this study (83.7% males, mean age = 45.06 ± 12.05 years). All patients underwent an overnight PSG. OSA patients were divided into two groups based on the OSA severity (mild to moderate OSA (n=4139), and severe OSA (n=7079)). Hypertension was defined based either on direct blood pressure measures or on diagnosis by a physician.

Results: Multiple linear regression analysis revealed that Decreased percentage of REM sleep was significantly associated with an increase in systolic blood pressure in mild to moderate (β=−0.018, p=0.002) but not in severe OSA (β=−0.017, p=0.136). Percentage of REM sleep was not associated with diastolic blood pressure in mild to moderate (β=−0.018, p=0.253) and in severe OSA (β=0.002, p=0.860), respectively. Logistic regression analysis did not find a significantly association of percentage of REM sleep with hypertension. These results were independent of major confounding factors such as sex, age, body mass index, tobacco, alcohol drinking, coffee use, sleep efficiency and subjective daytime sleepiness, apnea hypopnea index and nocturnal oxygen desaturation.

Conclusion: We conclude that decreased REM sleep is associated with increased SBP in mild to moderate but not in severe OSA patients, indicating the association between REM sleep and blood pressure moderated by OSA severity.

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0589
LISTENING TO THE PATIENT VOICE IN SLEEP APNEA: DAYTIME FUNCTIONING AND EXPERIENCE WITH THERAPY
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Introduction: Understanding the patient voice and experience is an integral part of clinical care. The American Sleep Apnea Association organized and hosted a Patient-Focused Medical Product Development (PFMPD) meeting for the FDA in June 2018. The PFMPD meeting was the first of its kind, focused on medical products in addition to medications. Prior to the PFMPD, similar Patient-Focused Drug Development (PFDD) meetings were held by the FDA beginning in 2012 as a forum for patient communities about their experiences living with their respective conditions and the treatments they are using.

Methods: A national survey was conducted. It was comprised of 32-items that were a combination of multiple choice and open-text fields. Sections included diagnosis, symptoms, impact of sleep apnea on daily living, treatments and impact of treatments. The survey was developed as a “fit-for-purpose” instrument for use in conjunction with the FDA’s PFDD initiative and was therefore informed by the focus of past PFDD meeting surveys and related medical literature. It was tested and refined by project staff and in a group of patients. It took an average of 17 minutes to complete. The survey was widely publicized, sent to email lists and promoted within social media. All responses were anonymous.

Results: The survey was available for completion between April and August 2018 and attracted a total of 5,630 responses, 85% of...
whom were sleep apnea patients and 14% were family or friends of a patient. 57% of respondents were female and 85% were diagnosed by a physician. 34% of respondents on CPAP continued to report moderate to severe daytime symptoms. 53% identified potential long-term consequences of OSA on health and lifespan as their top concern. 70% reported using CPAP, and of those, 82% reported using it 7 nights per week and 6.2 hours per night.

**Conclusion:** The PFMPD survey conducted by the ASAA is a rich source of the sleep apnea patient’s experience encompassing recognition, diagnosis, symptoms, and treatment.

**Support (If Any):** The FDA AWAKE meeting was hosted by the American Sleep Apnea Association.

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**USEFULNESS OF CARDIAC PARASYMPATHETIC INDEX IN CPAP-TREATED PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: A PRELIMINARY STUDY**

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**Introduction:** Evidences demonstrate that Heart Rate Variability (HRV)-derived measurements such as cardiac autonomic indexes may be useful for accurately identifying patients with sleep disorders including Obstructive Sleep Apnea (OSA). In particular, cardiac parasympathetic index, a measure of diurnal and nocturnal parasympathetic activity, can discriminate OSA patients from controls on an individual basis. However, the clinical usefulness of cardiac autonomic indexes after continuous positive airway pressure (CPAP) therapy remains unknown. The present study aimed to compare cardiac autonomic indexes (parasympathetic and sympathetic) at baseline and during a single night of CPAP therapy using a combined multimodal approach.

**Methods:** This is a simultaneous HRV-polysomnographic (PSG) study including 10 patients with a clinical diagnosis of OSA. Patients underwent combined simultaneous recordings of polysomnography and autonomic detection in two consecutive time points, at baseline and during a single night of CPAP therapy. We measured the 24-hour HRV power spectral components during daytime and night-time periods, and analysed low-frequency (LF), high-frequency (HF) and night/day ratio for both LF (cardiac sympathetic index) and HF (cardiac parasympathetic) spectral components.

**Results:** Mean age was 52.10±7.75 year; moderate sleep apnea was determined in 5 patients and severe sleep apnea in the remaining 5. Mean AHI (Apnea-Hypopnea index) values were 44.1±27.7 (baseline) and 7.77±3.93 (after CPAP therapy). Compared to baseline evaluation, OSA patients showed cardiac parasympathetic index values significantly decreased during a single nocturnal-CPAP treatment (baseline: 2.41±0.72; CPAP: 1.10±0.50) with a percentage of decrease equal to 53.7±16.1. Cardiac sympathetic index had a lower mean percentage equal to 40.7±23.7 with values at baseline equal to 1.94±0.90 versus CPAP: 1.06±0.51. A positive association was also found between the decrease of cardiac parasympathetic index values and severity of the disease.

**Conclusion:** This study improves the knowledge on cardiac autonomic modulation during CPAP treatment of OSA patients. Our results demonstrate that cardiac autonomic indexes are significantly decreased after a single night of CPAP therapy. Cardiac parasympathetic index better than sympathetic index was related to the decrease of AHI index after CPAP therapy.

**Support (If Any):** none
0592
BURDEN OF NARCOLEPSY: A SURVEY OF PATIENTS AND PHYSICIANS
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Introduction: Narcolepsy is a chronic neurologic disorder associated with impaired function and reduced quality of life. Surveys were designed to evaluate the perceptions of patients and health care providers (HCPs) regarding the burden, symptoms, and treatment of narcolepsy.

Methods: Coordinated but separate online surveys of patients with narcolepsy and physicians who have treated patients with narcolepsy within the previous 2 years.

Results: Survey respondents included 200 patients with narcolepsy (69.0% female; 79.0% white; mean age, 46.5 years) and 251 physicians (45.0% board-certified sleep specialists). Although patients reported a range of negative impacts of narcolepsy on work/school performance, interpersonal relationships, social activities, and emotional well-being, many patients were not discussing with HCPs how narcolepsy affects their daily lives (39.9%) or how it affects them emotionally (50.0%). Most patients (87.5%) and physicians (92.0%) identified excessive daytime sleepiness as one of the most disruptive narcolepsy symptoms; however, only 12.5% of patients, compared with 70.5% of physicians, identified cataplexy as a disruptive symptom. Notably, although only 25.5% of patients reported cataplexy as a symptom, an additional 32.5% reported brief/mild muscular weakness triggered by emotions. The vast majority of physicians (93.6%) noted that people with narcolepsy unknowingly alter their lives to accommodate their symptoms; a much smaller percentage of patients (40.0%) reported avoiding social situations, and 20.0% reported avoiding strong emotions. Physicians reported that symptoms were completely or mostly under control in 27.5% of patients on average, whereas only 12.0% of patients reported this level of symptom control. Patients (88.0%) and physicians (94.0%) agreed that there is a need for better treatment options.

Conclusion: Discrepancies between patients and physicians in survey responses suggest a need for better understanding of the burden of narcolepsy and improved HCP-patient communication. Additional unmet needs include improvement in physician and patient awareness of cataplexy and the development of additional effective treatment options.

Support (If Any): Harmony Biosciences, LLC.
upper respiratory infection unspecified site (n=117, 24.4%), and acute bronchitis (n=108, 22.5%). Finally, there were 1,233 narcolepsy cases using a conservative definition. Of these, 329 (26.7%) had a respiratory infection claim in the prior year. Acute sinusitis unspecified (n=123, 37.4%), acute pharyngitis (n=84, 25.5%), acute bronchitis (n=79, 24.0%), and acute upper respiratory infection unspecified site (n=72, 21.9%) were again the most frequently occurring respiratory infections.

Conclusion: We found high proportions of respiratory infections occurring prior to incident narcolepsy among the groups. The possible narcolepsy triggering effect of these infections should be further evaluated and is the subject of our currently ongoing large case-control study.

Support (If Any): None.

0594
A PROSPECTIVE STUDY OF AMBULATORY BLOOD PRESSURE AND HEART RATE IN PEDIATRIC NARCOLEPSY WITH CATAPLEXY
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Introduction: Narcolepsy with cataplexy (NC) is a unique disease associated with hypocretin deficiency in the lateral hypothalamus. The neural connections from this region connect to autonomic centers in the brain. We hypothesized that heart rate and blood pressure differ between pediatric NC patients and control group.

Methods: Values and circadian rhythmicity of 24-hour ambulatory blood pressure (ABP) and heart rate (HR) were compared among patients with NC before and after methylphenidate treatment (18 mg) and age-sex-BMI matched healthy controls. 50 patients (40 males, 10 females; mean age 10.4±3.5 years (M±SD, range 5-17years) with irrepressible sleepiness for more than three months associated with cataplexy and human leukocyte antigen (HLA) DQB1*06:02 positive. 100 normal controls were a reference group.

Results: drug-free patients with NC had a lower daytime systolic blood pressure (SBP) and higher HR across whole day but comparable daytime diastolic blood pressure (DBP) than healthy controls. Methylphenidate treatment medication in NC subjects increases daytime SBP, DBP, and HR back to the normal range. Patients with NC before and after methylphenidate treatment had a higher rate of non-dipping in SBP than healthy controls.

Conclusion: NC patients with hypocretin deficiency have impaired cardiovascular function when compared with normal controls. Methylphenidate increases the values of BP and HR in NC patients.

Support (If Any): National Foundation of Science of China 81420108002, 81670087 (to F.H.)

0595
MSLT AND 24HR PSG FOR DIAGNOSING IDIOPATHIC HYPERSomNIA
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Introduction: MSLT evaluates the ability to fall asleep in daytime nap opportunities, serving as the gold standard for the diagnosis of narcolepsy type 1. However, recent studies suggest the limitation of MSLT for the diagnosis of other hypersomnias. ICSD3 employed additional criteria of pathological sleepiness, "total sleep time is more than or equal to 660 minutes on 24hr PSG", which evaluate the extended sleep beyond "adequate" or "required" sleep time. We performed 24hr PSG followed by standard PSG and MSLT in order to compare the difference between the two criteria of pathological sleepiness in idiopathic hypersomnia.

Methods: Twenty-six consecutive subjects who were suspected of idiopathic hypersomnia (with long subjective sleep time and comorbid ANS symptoms) and gave written informed consents were evaluated in Seiwa Hospital, Tokyo during Nov 2016 to Dec 2018.

Results: Two PLMD subjects and two data with poor quality were excluded. So data from a total of 22 subjects (M/F = 8/14, 18.7±3.9 years old) were studied. Fifteen of them were diagnosed as idiopathic hypersomnia according to 24hr PSG criteria (total sleep time 484±105min) but 13 of them did not meet the MSLT criteria (mean sleep latency 12.1±4.0min). According to the MSLT criteria, two patients were diagnosed as idiopathic hypersomnia and one as narcolepsy type2. Only one patient met both criteria.

Conclusion: Evaluation of pathological sleepiness in idiopathic hypersomnia patients using conventional PSG-MSLT can overlook most of the typical idiopathic hypersomnia cases. Our data suggest that 24hr PSG evaluation of total sleep time should be used as the cardinal diagnostic tool for typical IHS patients, with MSLT results as supportive data.

Support (If Any): None.

0596
POLYSOMNOGRAPHIC FINDINGS AND DISORDERED BEHAVIOR RELATED TO REM SLEEP OF PATIENTS WITH NARCOLEPSY
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Introduction: REM sleep behavior disorder (RBD), REM without atonia (RWA) and periodic limb movements in sleep (PLMS) are known as symptoms of Narcolepsy as it is listed in the International Classification of Sleep Disorders, third edition (ICSD3). The purpose of this study is to summarize polysomnographic findings and abnormal behavior related to REM sleep of patients with Narcolepsy diagnosed in our sleep clinic.

Methods: We conducted polysomnography (PSG) and multiple sleep latency test (MSLT) with 588 patients from the period of 2011 to 2016, 139 patients (80 male, 59 female patients, an average of 24.4yr.s) are diagnosed with Narcolepsy. Although cerebrospinal fluid orexin concentration measurement is not performed, narcolepsy with cataplexy attack is classified as type 1 (22 male and 26 female patients), narcolepsy without cataplexy attack is classified as type 2 (58 male, 33 female patients). We compared it about a difference of PSG and MSLT parameters and incidence of disordered behavior between Narcolepsy Type1 group and Type2 group. MannWhitney U test was used for the comparison between two groups.

Results: A significant difference was found between Narcolepsy Type1 and Type2 of REM sleep latency, %stageR, %RWA, and PLMSI in the PSG findings. In the MSLT findings, sleep latency was short and the number of SOREMP was increased in Type1 group. Rude behavior was observed at a higher rate in Type 1 patients than in Type 2 patients.
B. Clinical Sleep Science and Practice

**Introduction:** Type 1 narcolepsy (T1N) is a disorder characterized by hypersomnolence, cataplexy, sleep paralysis or sleep-related hallucination. Cataplexy is a sudden loss of muscle tone triggered by emotional changes such as laughing and is caused by the inappropriate activation of descending neural pathways that promote atonia. Type II narcolepsy (T2N) is a disorder like T1N but without cataplexy. It has been established that HLA-DQB1*0602 is a marker for narcolepsy on chromosome 6 across all ethnic groups. For patients with narcolepsy, the pattern of hypoperfusion on brain SPECT was controversial on previous studies.

**Methods:** In this report, we demonstrated the imaging findings of narcolepsy cases with free of all drugs on Tc-99m ECD brain perfusion SPECT, which were firstly analyzed by the easy Z-score imaging system (ezIS) among the published literature. ezIS is a computer-assisted statistical analysis based on the comparison with age-classified ECD normal database. ezIS provides objective and reproducible interpretation of SPECT images and has been widely utilized in Japan.

**Results:** All cases consistently showed hypoperfusion in bilateral anterior to posterior cingulate gyrus. SPECT in early Alzheimer disease was hypoperfusion over medial temporal and posterior cingulate gyrus, compatible with the hypoperfusion area at our subjects. This result suggests that SPECT examinations by ezIS analysis clearly showed obvious hypoperfusion of the limbic system in narcolepsy.

**Conclusion:** This result suggests that SPECT examinations by ezIS analysis clearly showed obvious hypoperfusion of the limbic system in narcolepsy patients.

**Support (If Any):** N/A

**0599 SHORT SLEEP PRIOR TO AN MSLT: IMPLICATIONS FOR FALSE NEGATIVES AND ADVANCED AGE**

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**Introduction:** The MSLT is the gold-standard for the assessment of CNS hypersomnia. Current AASM practice parameters suggest outcomes from an MSLT to be ‘suspect’ when ≤6 hours of TST is obtained the night prior. However, this threshold is often challenging to obtain for patients with narcolepsy, a condition associated with high state liability and low sleep efficiency. The goal of this study is to evaluate the relationship between short PSG sleep on MSLT outcomes.

**Methods:** PSGs and 5-nap MSLTs for those 13 years and older were extracted from SleepMed’s deidentified clinical repository. Only diagnostic PSGs occurring the night prior to MSLT were included. Those with moderate/severe OSA (RDI >10/hr) were excluded. Sleep was categorized as very short [TST <5 hr.], short [5-5.9 hr.], and recommended [≥6 hr.]. Analyses included Chi Square and logistic regression.

**Results:** The final sample was 2752 patients with mean age 36 years (range 13-90; 73% Caucasian; 68% female) and a mean ESS of 12.5 +/- 6.3. The prevalence of very short, short, and recommended sleep durations was 12.1%, 25.1%, and 62.7%, respectively. Short sleep (dichotomized as ≤6 hr vs. >6 hr) was most common in those ≥60 yr (55% vs. 36% in <60 yr). The likelihood of a MSL ≤8 min decreased with decreasing PSG TST (≤5 hr=40%, 5.1-5.9 hr=54%, ≥6hr=61%; X²=50; p<.001). Thus, short TST (<6hr) was associated with reduced odds of an MSLT consistent with narcolepsy (MSL≤8 & ≥2 REMs; OR: 0.75; p=.01). This relationship attenuated but persisted when controlling for age≥60 (OR: 0.79, p=.04).

**Conclusion:** Short PSG sleep, based on AASM practice parameters, occurs in over 1/3rd of patients undergoing an MSLT and influences outcomes in the opposite manner of what one may expect. Sleep adequacy before the MSLT should be kept in mind when interpreting MSLT results, especially for older individuals where nocturnal sleep continuity is decreased and diurnal REM is reduced.

**Support (If Any):**
B. Clinical Sleep Science and Practice

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Introduction: Previous efforts to quantify sleep inertia effects on alertness using the Psychomotor Vigilance Task (PVT) has revealed worsening vigilance is captured in metrics that are sensitive to variability. Visual processing speed and psychomotor vigilance rely on shared visual pathways that suggest alternative approaches in discriminating between pathological and normal brain states using tools such as the Critical Flicker Fusion (CFF). The CFF threshold is the highest average frequency (Hz) at which an individual can discern a flickering stimulus. We attempt to detect if sleep and napping improve CFF threshold and consistency that is distinct or in concert with the PVT after brief naps.

Methods: There were 10 healthy non-sleepy controls and 13 patients undergoing overnight PSG/MSLT (Age=29.7±13.8; 65% women), that were studied with Idiopathic hypersomnia (n=4), Myotonic Dystrophy (n=4), Narcolepsy Type 2 (n=4), and Kleine- Leven Syndrome (n=1) were administered PVT before and after daytime MSLT naps 2 and 4 and administered the CFF at bedtime and morning wake time (n=23), and before and after naps 2 (n=12), 4 (n=12) and 5 (n=21). CFF is the average of 10 pairs of ascending (10Hz, 2Hz intervals) and descending trials (60Hz, 2Hz intervals), where lower threshold values indicate impairment. CFF threshold consistency was calculated as the coefficient of variation per subject per nap condition. PVT and CFF performance was analyzed using repeated-measures ANOVA with post-hoc t-tests.

Results: Adjusting for age, gender, and diagnosis, CFF threshold improved with overnight sleep (37.30±3.19 vs 36.37±3.43, p=0.06) but consistency decreased after overnight sleep (3.1±1.6 [bedtime] vs 4.6±2.4 [wakeup], t=2.61, p=0.183).Sleeping diminished consistency in patients greater than in controls (2.2±3.1 vs 6.2±2.7, t=0.86, NS). Napping increased impairment in CFF threshold (nap 2: 36.41±3.29 [post] vs 38.79±6.3 [pre], t=5.65, p=0.001; nap 5: 37.57±3.37 [post] vs 37.9±3.61 [pre], t=2.19, p=0.044), but improved consistency (nap 1: 3.1±1.6 [post] vs 4.6±2.4 [pre], t=2.66, p=0.0326; nap 2: 4.0±2.7 [post] vs 10.83±27.12 [pre], t=0.008, p=0.0001; nap 5: 4.3±4.75 [post] vs 4.9±4.94 [pre], t=2.63, p=0.0191). There were no significant association between the PVT metrics of variability, length of sleep, or between patients and controls on CFF threshold and consistency.

Conclusion: Consistency on the CFF may be capturing the subtle improvement in wakefulness provided by napping that is difficult to detect in the PVT.

Support (If Any): R01: NS089719

0601

LONG-TERM EFFECTS OF SOLRIAMFETOL ON QUALITY OF LIFE IN PARTICIPANTS WITH EXCESSIVE DAYTIME SLEEPINESS ASSOCIATED WITH NARCOLEPSY OR OBSTRUCTIVE SLEEP APNEA

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Introduction: Solriamfetol, a selective dopamine and norepinephrine reuptake inhibitor, demonstrated long-term (up to 52 weeks) efficacy in participants with excessive daytime sleepiness (EDS) associated with narcolepsy or obstructive sleep apnea (OSA). These analyses evaluated long-term effects of solriamfentol on quality of life (QoL) measures.

Methods: Participants with narcolepsy or OSA who completed previous solriamfetol studies were eligible. This study included 2-week titration followed by a maintenance phase of up to 50 weeks (stable dose 75, 150, or 300 mg). QoL assessments included the Functional Outcomes of Sleep Questionnaire short version (FOSQ-10), Work Productivity and Activity Impairment Questionnaire: Specific Health Problem (WPALSHP), and 36-Item Short Form Health Survey version 2 (SF-36v2). Mean (SD) change from baseline throughout the study was evaluated for the overall safety population and by subgroup (OSA or narcolepsy). No formal statistical testing was performed. Safety was assessed.

Results: There were 643 participants (417 OSA, 226 narcolepsy) in the safety population. Increases in mean FOSQ-10 total score from baseline [mean change (SD) of 3.7 (3.0)] were sustained for the duration of treatment with solriamfetol; magnitude of change was similar between narcolepsy and OSA. On WPALSHP, participants reported a minimum 25% reduction (improvement) from baseline for % activity impairment outside of work, % impairment while working (presenteeism), and % overall work impairment due to the problem; results were generally similar for each subgroup. For SF-36v2, both physical and mental component summary scores showed increases in the health state of participants from baseline [mean change (SD) of 3.1 (6.9) and 4.3 (8.4), respectively]; these improvements were maintained for the duration of the study. Common adverse events (≥5%) included headache, nausea, insomnia, nasopharyngitis, dry mouth, anxiety, decreased appetite, and upper-respiratory-tract infection, and were similar in narcolepsy and OSA; 27 participants (4.2%) had ≥1 serious adverse event.

Conclusion: Solriamfetol demonstrated sustained improvements in QoL measures for up to 52 weeks in participants with EDS associated with narcolepsy or OSA. Safety was similar to prior solriamfetol studies.

Support (If Any): Jazz Pharmaceuticals

0602

EVALUATING PHARMACOTHERAPY EFFECTIVENESS IN A NARCOLEPSY AND IDIOPATHIC HYPERSOMNIA RETROSPECTIVE CLINICAL COHORT

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Introduction: With new pharmacotherapeutic options for narcolepsy and idiopathic hypersomnia emerging, studies exploring outcomes in real world settings will be needed to inform optimal
clinical care. We evaluated the association between daytime sleep propensity and treatment regimen/standardized dose, a measure of drug burden, in patients with narcolepsy type 1 (NT1)/type 2 (NT2) and idiopathic hypersomnia (IH).

Methods: Patients ≥18yrs with NT1/NT2 and IH presenting to the Cleveland Clinic Sleep Disorders Center from 2008-2010 with completed Epworth Sleepiness Scales (ESS) at baseline and ≥6mo follow-up were included. A standardized variable of the amount of drug taken daily was determined using established World Health Organization methods. Standardized dose (STD)>1 indicated dose regimens higher than average for a single drug in adults. ESS change by treatment regimen (monotherapy vs polytherapy) and STD was assessed by t-tests and univariable/multivariable linear regressions, adjusting for patient characteristics.

Results: 92 patients (26(28.3%) NT1, 27(29.3%) NT2, 39(42.4%) IH) were included (age 43.8±14.8yrs; 66(71.7%) female). At baseline, 59(64.1%) used monotherapy with average STD 1.0[0.2-2.5] and ESS 14.2±5.2(68 patients)>10. Between time points, polytherapy increased by 24(26.1%) patients, STD increased by 0.7[0.1-1.3], and ESS decreased by 3.6±5.1(p<0.001; -25 patients)>10). Those on polytherapy at follow-up had higher baseline ESS (2.4 greater, p=0.029) and were more likely to have NT1/NT2 (39.3% more likely, p<0.001) and be taking medication at baseline (25.0% more likely; p=0.012). ESS improved comparably between monotherapy and polytherapy groups (mean decrease 3.07 vs 4.47, both p<0.001), as well as between NT1/NT2 and IH (mean decrease 4.06 vs 2.95, both p<0.001). Only baseline ESS score was significant for predicting ESS change in univariable/multivariable analyses (showing 0.62pt decrease in ESS change per unit increase in baseline ESS). However, after adjusting for baseline ESS, baseline STD, and follow-up time, multivariable analyses showed that ESS change increased by 0.58pts for each 1 unit increase in STD at follow-up(p=0.056).

Conclusion: While monotherapy/polytherapy analyses show no differences between groups in change in ESS, using a novel STD approach, our findings support a potential paradoxical relationship between drug burden and sleep propensity.

Support (If Any): N/A

0603 NOVEL TREATMENTS SHOULD BE CONSIDERED FOR PATIENTS WITH NARCOLEPSY

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Introduction: Recognized by the National Organization for Rare Disorders, narcolepsy is characterized by debilitating sleepiness (type 1 and type 2) and cataplexy (type 1). Medications for narcolepsy have dangerous side effects and potential for abuse. Patients often have residual symptoms despite treatment. Pitolisant, a selective histamine H3-receptor modulator, recently became available for the treatment of sleepiness and cataplexy. We hypothesized that many patients with narcolepsy have residual symptoms and may benefit from treatment with pitolisant.

Methods: We conducted a retrospective, electronic chart review using ICD-9-CM and ICD-10-CM narcolepsy-related diagnostic codes (347.01; G47.411; 347.00; G47.419; 347.10; 347.11) of outpatients evaluated at Rush University Medical Center between June 2011 and December 2018. Records were queried for demographics, medical comorbidities, polysomnography (PSG) and multiple sleep latency tests (MSLT), symptoms (sleepiness, cataplexy, hypnopompic/hypnogogic hallucinations, sleep paralysis, sleep fragmentation), and medication use.

Results: Of the 97 patients analyzed, patients were predominantly white (56.2%), middle aged (39 years, SD=15.6), overweight (BMI: 28.22, SD= 8.03 kg/m2) and female (58%). A minority of patients had narcolepsy type 1 (35%). On MSLT, the average mean sleep latency and number of SOREMPs was 4.8 minutes (SD=3.9 min) and 2.24 (SD=1.5), respectively. The most common medical comorbidity was obstructive sleep apnea (31.8%), followed by depression (24.7%) and hypertension (19.6%). Only 16.5% of patients reported insufficient sleep (Total sleep time <7 hours). Residual sleepiness and sleep fragmentation were reported in 64.9% and 29.9% of patients, respectively. Among patients with narcolepsy type 1, 59% reported residual cataplexy. Overall, 75.3% of patients reported at least one residual symptom. Modafinil was most commonly prescribed (41.2%), followed by amphetamines (32%), antidepressants (25.8%), and sodium oxybate (21.6%). Many patients were taking at least two medications (26.8%) and some were taking three medications (10.3%).

Conclusion: At a large tertiary care center, over three quarters of patients with narcolepsy reported residual symptoms. Recognizing patients at risk leads to increased access to new treatments, including pitolisant. More research is needed to assess impact of pitolisant access on patient outcomes.

Support (If Any): N/A

0604 TREATMENT PATTERNS AMONG PATIENTS WITH NARCOLEPSY TREATED WITH SODIUM OXYBATE

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Introduction: There is limited real-world data on dosing-related practices and perceptions among patients with narcolepsy treated with sodium oxybate (SXB). This study characterized dosing patterns among narcolepsy patients taking SXB.

Methods: An IRB-approved, cross-sectional, web-based survey targeting 100 patients ≥18 years, with narcolepsy taking SXB for ≥12 months, was conducted. Participants were recruited through community collaborations and patient panels. Participants were asked about their usual SXB dosing regimen and the frequency, reasons, methods and perceptions of varying their SXB dosing regimen to accommodate a change in routine. A subset (N=25) was asked telephonically about how the inability to adjust their SXB regimen would impact their lives. Descriptive statistics summarized survey responses. Voice responses were analyzed thematically.

Results: The cohort (N=110) was 80% female with a mean (±SD) age of 36.9 (±8.9) years. The majority took twice-nightly doses (95%) that were equally divided (80%) with 2.5-4 hours between doses (79%). Of 82 participants that reported varying their SXB dosing at least once in the past 6 months, 29% reported varying at least once-weekly and 35% reported varying several times per month. Staying up late (76%) and waking up early (67%) to be able to attend social events (49%), work events (46%), and eat meals within 2 hours of bedtime (46%) were the most common reasons for varying dosing. Changing timing of the first dose (84%), second dose (69%) and skipping the second dose (44%) were the preferred
methods of adjusting. Seventy-nine percent of participants perceived their ability to vary dosing schedules as important. Of 25 participants who provided voice responses, 68% expressed that losing the ability to vary SXB dosing would have a highly negative impact on their lives.

Conclusion: Participants frequently vary their usual SXB dosing regimen to accommodate changes in their routine. Participants perceive the ability to vary as important and predict facing significant limitations in day-to-day activities if unable to vary. Further investigation to identify real-world SXB dosing, association with goal attainment, and impact on sleep and other outcomes is warranted.

Support (If Any): Jazz Pharmaceuticals.

0605
SODIUM OXYBATE DOSING UTILIZATION PATTERNS IN THE NEXUS NARCOLEPSY REGISTRY
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Introduction: The recommended dosage range for sodium oxybate (SXB) among adults with narcolepsy is 6-9g per night orally, divided into 2 equal doses. The objective of this study was to describe real-world dosing of SXB among adults with narcolepsy.

Methods: The Nexus Narcolepsy Registry is an ongoing, self-reported online registry of adults diagnosed with narcolepsy. The study identified SXB users who had reported dosage data and compared those currently taking SXB vs those who previously discontinued. Of current users, those taking SXB <3 months (hereafter “new users”) vs ≥3 months (hereafter “established users”) also were compared. The survey assessed once-nightly or twice-nightly SXB dosing across the dose range (<4.5g, 4.5-<6g, 6-<9g, 9g, >9g), and equally-divided (1st dose=2nd dose) vs asymmetric dosing (1st dose>2nd dose). Descriptive analyses and t tests assessed sample characteristics and dosing patterns. All P values are uncontrolled for multiplicity, hence, are nominal.

Results: Among all participants reporting SXB use (n=365), 65% were current users and 95% took SXB twice nightly. Average total nightly dose (standard deviation) was 7g (±1.9) and 3.6g (±0.9) for twice-nightly and once-nightly dosing, respectively. Among those who took SXB twice nightly, the total nightly dose was lower in those who discontinued vs current users (5.9g ±2.1 vs 7.6g ±1.6; P<0.001) and lower in new users vs established users (6.5g ±1.8 vs 7.7g ±1.5; P<0.001). Among all SXB users, 66% reported doses within the recommended dosage range of 6-9g per night; 80% of current users and 40% of discontinued users took 6-9g per night. Nearly 30% of all SXB users, 16% of current users, and 55% of discontinued users took <6g per night. Among all SXB users, 84% reported equally-divided dosing. For current new users and current established users, 96% and 83%, respectively, reported equally-divided dosing.

Conclusion: Among SXB users in the Nexus Narcolepsy Registry, the majority reported taking SXB twice nightly, with the total nightly dose equally divided. 17% of current established users reported asymmetric dosing, and 5% of all SXB users reported once-nightly dosing.

Support (If Any): Jazz Pharmaceuticals

0606
ASYMMETRIC AND/OR ATYPICAL DOSING OF SODIUM OXYBATE MAY LEAD TO INCREASED COMPLIANCE AND EFFICACY
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Introduction: Sodium oxybate (Xyrem) is a liquid medication used to treat patients with excessive daytime sleepiness and/or cataplexy associated with narcolepsy. It typically is administered as two equal doses, the first given at bedtime and the second 2.5-4 hours thereafter. Typical doses are 2.25, 3, 3.75, or 4.5 grams per administration.

Methods: A retrospective review of one physician’s prescribing practices for all 57 narcolepsy patients treated with sodium oxybate was conducted. Eighteen (32%) patients qualified as having atypical prescriptions (6 with narcolepsy type 1 and 12 with narcolepsy type 2).

Results: Compliance with atypical dosing was 100%. Nine of 18 had post-treatment Epworth Sleepiness Scales (ESS) recorded. (The others will be collected prior to presentation.) Of those, the pre-treatment ESS was 15.8 and post-treatment was 6.1 (p=0.0007, 95% CI=5.5-13.9). Eleven patients (61%) had asymmetric dosing, 10 (56%) taking a larger first and 1 (6%) taking a larger second dose. Five taking larger first doses lowered the second dose due to morning grogginess; 1 said a full second dose induced night sweats; I increased the first dose for insomnia, and in 3 the reason was unclear. The patient taking the larger second dose reported improved sleep continuity. Fourteen patients (78%) took atypical dose amounts. Nine patients from this group (64%) overlapped with the asymmetric dosing group. One patient lowered the dose due to transient central drowsiness, another due to morning anxiety. Two patients (11%) took one nightly doses at bedtime (both 3.75 grams). One indicated full symptomatic benefit from one dose (ESS from 21 to 6). The other could not wake up for the second dose at the time of this manuscript. One patient (6%) was taking 13.5 grams nightly due to inadequate response to lower doses.

Conclusion: Atypical dosing of sodium oxybate is appropriate to ameliorate medication-induced side effects and can maximize compliance and symptomatic benefit. Since sodium oxybate has non-linear pharmacokinetics with a disproportionately higher bioavailability of the second dose, in many such cases lowering the second dose may be beneficial.

Support (If Any): N/A

0607
PATIENTS WHOSE MULTIPLE SLEEP LATENCY TESTS (MSLTS) HAVE FEWER THAN TWO SLEEP-ONSET REM PERIODS (SOREMS) RESPOND WELL TO SODIUM OXYBATE
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Introduction: MSLT is considered diagnostic for narcolepsy when mean sleep-onset latency (SOL) is less than 8 minutes and there
are 2 or more SOREMPs observed during 4 or 5 nap sessions. However, many patients with suspected narcolepsy have diagnoses treated with REM-suppressing agents, and it is not always possible to wean these agents prior to testing. Moreover, the false negative rate for MSLT is as high as 20%. Therefore, clinicians frequently are confronted with equivocal MSLT results. This makes the decision of initiating sodium oxybate (Xyrem) challenging, since these patients fall into the “idiopathic hypersomnia” category by default, a condition for which currently sodium oxybate is not indicated.

Methods: A retrospective review of 57 narcolepsy patients treated with sodium oxybate was conducted. Fifteen (26%) patients had MSLTs with fewer than 2 SOREMPs. Thirteen (87%) had no SOREMPs, while 2 (13%) had 1 SOREMP. None had SOREMPs on the overnight PSG. Five patients had documented cataplexy. Seven (47%) had been taking REM-altering agents that could not be weaned prior to MSLT administration, while 2 others (13%) had their MSLTs performed at other facilities and medication use at the time of testing was not documented.

Results: Compliant sodium oxybate use was observed in 14 patients (93%). The lone patient (0 SOREMP, mean SOL 4.5) who discontinued therapy reported lack of symptomatic benefit. The compliant patients all reported symptomatic benefit from sodium oxybate use. At the time of this manuscript, 3 of the 14 compliant patients had recorded both pre- and post-treatment Epworth Sleepiness Scales (ESS). (The others will be recorded prior to presentation.) In those patients, the mean ESS dropped from 13.3 to 2.3. The other 11 compliant patients all have documentation indicating subjective benefit from sodium oxybate.

Conclusion: These results show that fewer than 2 SOREMPs on MSLT should not be seen as a contraindication to using sodium oxybate to treat excessive daytime sleepiness. Further research in treating this population with sodium oxybate is warranted.

Support (If Any): N/A

0609 PHARMACOKINETICS AND FORMULATION SELECTION OF FT218, AN INVESTIGATIONAL CONTROLLED-RELEASE SODIUM OXYBATE FORMULATION DESIGNED FOR ONCE NIGHTLY DOSING

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Introduction: Sodium oxybate is indicated for the treatment of Excessive Daytime Sleepiness (EDS) and cataplexy in patients with narcolepsy. The currently marketed product, an immediate release (IR) sodium oxybate is required to be taken twice nightly: at bedtime and 2.5 to 4 hours later, thus requiring patients to awaken in the middle of the night. FT218 is an investigational controlled-release (CR) formulation of sodium oxybate intended for once nightly dosing. The pharmacokinetic performance of three prototypes of FT218 were evaluated in a PK pilot study (PKFT218-1301).

Methods: Three prototypes of FT218 were manufactured by varying the polymer compositions and ratios of immediate and controlled-release microparticles. The prototypes, given as a single 4.5g dose, were compared to IR sodium oxybate as reference, given as 2 x 2.25g, in 16 healthy volunteers.

Results: Each of the three prototypes exhibited a sustained release profile with Cmax below the global Cmax of the reference drug and a Cmin close to the reference values. Prototype 2 was selected for further optimization, as it exhibited PK characteristics closest to the desired target profile. This formulation exhibited a higher Cmax compared to the other prototypes (46 ± 20 (SD) µg/mL), and the AUCinf (210 ± 104 (SD) µg/mL.h) was the closest to the AUCinf of the IR formulation (214 ± 104 (SD) µg/mL.h). Cmin values were 7.40 ± 5.88 (SD) µg/mL and 9.24 ± 11.77 (SD) µg/mL for prototype 2 and the reference respectively.

Conclusion: The three prototypes exhibited CR profiles covering the entire night with once nightly dosing. Prototype 2, compared to the IR formulation, showed a lower overall Cmax, and importantly, a comparable Cmin while the AUC was maintained. Between subject variability of FT218 and IR sodium oxybate...
was comparable. If approved, FT218 could offer an important new option for the treatment of EDS and cataplexy in narcolepsy with potentially improved compliance and quality of life benefits. FT218 is currently being evaluated for efficacy in narcolepsy patients in the Phase 3 REST-ON study.

Support (If Any): N/A

0610
PHARMACOKINETICS AND DOSE PROPORTIONALITY OF FT218, AN INVESTIGATIONAL CONTROLLED RELEASE FORMULATION OF SODIUM OXYBATE FOR ONCE NIGHTLY DOSING

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Introduction: Sodium oxybate is indicated for the treatment of Excessive Daytime Sleepiness (EDS) and cataplexy in patients with narcolepsy. The currently marketed product, an immediate release (IR) sodium oxybate, is required to be taken twice nightly: at bedtime, two hours post-evening meal, in a sequential order of 4.5g, 7.5g and 9g with a minimum 7-day washout between doses. Dose proportionality of FT218, an investigational controlled-release (CR) formulation of sodium oxybate intended for once nightly dosing. The pharmacokinetics and dose proportionality of FT218 were evaluated in a Phase I study (PKFT218-1602).

Methods: Subjects received 3 separate single-dose administrations of FT218 at bedtime, two hours post-evening meal, in a sequential order of 4.5g, 7.5g and 9g with a minimum 7-day washout between doses. Dose proportionality between the three doses was assessed using the power method.

Results: For the 3 doses, mean pharmacokinetics exhibited similar overall profiles with median Tmax between 1.5 and 2 hours. Mean Cmax increased from 42.9 to 84.5 µg/mL across the increasing doses. Following Cmax, blood levels gradually decreased overnight. Mean concentrations at 8 hours were 4.8, 19.7 and 25.5 µg/mL for the 4.5, 7.5 and 9g doses respectively. The slope estimates were 1.02 (90% CI: 0.84-1.21) and 1.34 (90% CI: 1.17-1.46) for Cmax and AUCinf respectively.

Conclusion: FT218 achieved blood level profiles, when given at bedtime, consistent with a single CR dose. Dose proportionality was maintained for Cmax across the dosage range. Dose proportionality was exceeded with FT218 for AUCinf, but to a lesser extent than is known from public information for the IR sodium oxybate (2.3 fold increase for FT218 vs 3.8 for the IR). If approved, FT218 could offer an important new option for the treatment of EDS and cataplexy in narcolepsy with potentially improved compliance and quality of life benefits. FT218 is currently being evaluated for efficacy in narcolepsy patients in the Phase 3 REST-ON study.

Support (If Any): N/A

0611
THE SAFETY AND TOLERABILITY OF PITOLISANT IN THE TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS AND CATAPLEXY IN ADULT PATIENTS WITH NARCOLEPSY: AN OPEN-LABEL, EXPANDED ACCESS PROGRAM IN THE UNITED STATES

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Introduction: Pitolisant, an investigational medication in the United States, was approved in Europe for the treatment of narcolepsy with or without cataplexy in adults. This randomized, double-blind, active- and placebo-controlled, single-dummy, 4-sequence 4-way crossover study evaluated the abuse potential of single-dose pitolisant (35.6 mg [therapeutic dose] and 213.6 mg [supratherapeutic dose]) compared with the stimulant phentermine HCl (60 mg; a Schedule IV

Support (If Any): Bioprojet Pharma and Harmony Biosciences, LLC.
**B. Clinical Sleep Science and Practice**

controlled substance) and placebo in nondependent recreational stimulant users. The primary endpoint was peak effect (E_max) for Drug Liking “at this moment” on a bipolar visual analogue scale (0=strong disliking, 100=strong liking). Key secondary endpoints included Overall Drug Liking and willingness to Take Drug Again. Between-treatment comparisons were analyzed using a mixed-effect model for a crossover study.

**Results:** After confirming their ability to discriminate phentermine (active control) from placebo, 43 participants were randomly assigned to 1 of 4 treatment sequences. For 38 participants who completed the study (73.7% male; 65.8% white; mean age, 33.3 years), mean (SE) Drug Liking E_max was 78.7 (2.8), 59.0 (2.1), 57.3 (2.1), and 56.1 (2.1), respectively, for phentermine, pitolisant 213.6 mg, pitolisant 35.6 mg, and placebo. Mean Drug Liking E_max was significantly greater for phentermine compared with placebo (P<0.0001), confirming study validity. For both doses of pitolisant, mean Drug Liking E_max was significantly lower compared with phentermine (P<0.0001) and similar for pitolisant (both doses) compared with placebo. Additionally, for Overall Drug Liking and Take Drug Again, mean E_max scores were significantly lower for pitolisant (both doses) relative to phentermine (P<0.0001) and similar for pitolisant (both doses) compared with placebo. The most common adverse event with pitolisant was headache (pitolisant 35.6 mg, 15.0%; pitolisant 213.6 mg, 25.0%; placebo, 12.2%; phentermine, 10.3%).

**Conclusion:** Pitolisant demonstrated significantly lower Drug Liking and willingness to Take Drug Again compared with phentermine and a profile similar to placebo; together with the lack of any abuse signal in preclinical studies, these findings suggest that pitolisant has minimal risk of abuse.

**Support (If Any):** Bioprojet Pharma and Harmony Biosciences, LLC.

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**III. Hypersomnia**

**0614 SAFETY AND TOLERABILITY OF PITOLISANT IN THE TREATMENT OF ADULTS WITH NARCOLEPSY: INTEGRATED DATA FROM CLINICAL STUDIES**

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**Introduction:** Pitolisant, a selective histamine 3 (H₃) receptor antagonist/inverse agonist, has been investigated for treatment of excessive daytime sleepiness (EDS) and cataplexy in adult patients with narcolepsy. This analysis evaluates the integrated safety data from studies of pitolisant in adult patients with narcolepsy.

**Methods:** Data were pooled across 4 randomized, placebo-controlled, 7-8 week studies. Pitolisant was flexibly dosed to a maximum of 35.6 mg (3 studies) or 17.8 mg (1 study). Safety assessments included adverse events (AEs), vital signs, laboratory assessments, and electrocardiogram (ECG) measurements.

**Results:** The analysis population consisted of 303 patients (pitolisant, n=172; placebo, n=131): 54.5% male; mean age, 39.2 years; and mean duration of narcolepsy, 11.3 years. The study completion rate was similar for pitolisant (94.2%) and placebo (94.7%). The maintenance dose of pitolisant was 35.6 mg in 39.5% of patients and ≤17.8 mg in 60.5% (in studies that included 35.6 mg). 68.5% of patients were titrated to that dose. Overall, the incidence of AEs was 49.4% with pitolisant and 41.2% with placebo. The most common AEs (>3% of pitolisant-treated patients) for pitolisant versus placebo were headache (18.0% vs 13.7%), nausea (5.2% vs 3.1%), insomnia (4.1% vs 2.3%), upper respiratory tract infection (4.1% vs 0.8%), back pain (3.5% vs 0.8%), and dizziness (3.5% vs 2.3%). Serious AEs were reported in 2 (1.2%) pitolisant-treated patients (hemorrhoids, pylonephritis) and 1 (0.8%) placebo-treated patient (biliary colic). AEs resulted in treatment discontinuation for 3.5% and 3.8% of patients in the pitolisant and placebo groups, respectively. No clinically relevant effects were observed in vital signs, laboratory findings, or ECG parameters. No new safety signals were identified from long-term, open-label studies in patients with narcolepsy.

**Conclusion:** Integrated safety data from the clinical development program in adult patients with narcolepsy demonstrates that pitolisant was generally safe and well-tolerated. Considered together with the efficacy findings, pitolisant offers a favorable risk/benefit profile and represents a potential advancement in the treatment of EDS and cataplexy in adult patients with narcolepsy.

**Support (If Any):** Bioprojet Pharma and Harmony Biosciences, LLC.
B. Clinical Sleep Science and Practice

0615
PITOLISANT IN COMBINATION WITH OTHER MEDICATIONS FOR THE MANAGEMENT OF NARCOLEPSY
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Introduction: Current standard of care in narcolepsy often involves polypharmacy. To characterize potential interactions of pitolisant with other narcolepsy medications, findings from a drug-drug interaction study and a phase 3 clinical study were evaluated.

Methods: An open-label, crossover study, conducted in 16 healthy males, evaluated pharmacokinetic (PK) interactions of pitolisant (35.6 mg, single-dose) with sodium oxybate (4.5 g, divided-dose) and modafinil (200 mg/d for 22 days). In a long-term, open-label, phase 3 study (Month 12 completers, n=68), analyses of efficacy and adverse events included subgroups of patients with narcolepsy taking pitolisant alone (PIT), with psychostimulants (PIT+STIM), with anticitapteptics (PIT+AC), and with psychostimulants and anticitapteptics (PIT+STIM+AC).

Results: Administration of pitolisant the morning after nighttime sodium oxybate did not affect pitolisant Cmax but slightly reduced AUC (≤14%) relative to pitolisant alone. Pitolisant did not affect sodium oxybate Cmax or AUC after the second sodium oxybate dose; sodium oxybate Cmax and AUC were slightly higher (15% and 12%, respectively) after the first sodium oxybate dose when used concomitantly with pitolisant. Coadministration of pitolisant with steady-state modafinil decreased pitolisant Cmax (15%) and AUC (19%); no effect of coadministered pitolisant was observed on modafinil PK. In the phase 3 study, mean change from baseline to Month 12 in Epworth Sleepiness Scale score was -4.7 for PIT (n=45), -3.2 for PIT+STIM (n=26), -3.6 for PIT+AC (n=14), and -4.0 for PIT+STIM+AC (n=13). Mean percentage change in daily number of generalized cataplexy attacks was -71.5% for PIT alone (n=45), -3.2 for PIT+STIM (n=26), -3.6 for PIT+AC (n=14), and -4.0 for PIT+STIM+AC (n=13). Mean percentage change in PGI-C scale. Safety was also assessed.

Conclusion: Administration of pitolisant the morning after nighttime sodium oxybate did not affect pitolisant Cmax but slightly reduced AUC (≤14%) relative to pitolisant alone. Pitolisant did not affect sodium oxybate Cmax or AUC after the second sodium oxybate dose; sodium oxybate Cmax and AUC were slightly higher (15% and 12%, respectively) after the first sodium oxybate dose when used concomitantly with pitolisant. Coadministration of pitolisant with steady-state modafinil decreased pitolisant Cmax (15%) and AUC (19%); no effect of coadministered pitolisant was observed on modafinil PK. In the phase 3 study, mean change from baseline to Month 12 in Epworth Sleepiness Scale score was -4.7 for PIT (n=45), -3.2 for PIT+STIM (n=26), -3.6 for PIT+AC (n=14), and -4.0 for PIT+STIM+AC (n=13). Mean percentage change in daily number of generalized cataplexy attacks was -71.5% for PIT alone (n=45), -3.2 for PIT+STIM (n=26), -3.6 for PIT+AC (n=14), and -4.0 for PIT+STIM+AC (n=13). Mean percentage change in PGI-C scale. Safety was also assessed.

Support (If Any): Bioprojet Pharma and Harmony Biosciences, LLC

0616
POOLED ANALYSES FROM 12-WEEK RANDOMIZED, CONTROLLED STUDIES OF SOLRIAMFETOL IN THE TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS IN PARTICIPANTS WITH OBSTRUCTIVE SLEEP APNEA OR NARCOLEPSY
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Introduction: Solriamfetol, a selective dopamine and norepinephrine reuptake inhibitor, demonstrated robust wake-promoting effects in 12-week studies of excessive daytime sleepiness (EDS) associated with obstructive sleep apnea (OSA) or narcolepsy. Efficacy and safety of solriamfetol were evaluated from pooled analyses of these studies.

Methods: Data from 12-week studies (2 narcolepsy, 1 OSA) were evaluated. Efficacy assessments included change from baseline to week 12 on mean sleep latency on Maintenance of Wakefulness Test (MWT), Epworth Sleepiness Scale (ESS) score, and patient-reported improvement on Patient Global Impression of Change (PGI-C) scale. Safety was also assessed.

Results: Compared with participants with OSA (n=113 placebo, 343 solriamfetol [combined doses]), those with narcolepsy (n=105 placebo, 215 solriamfetol) were younger, with more females, and lower body mass index. Baseline MWT mean sleep latency and ESS scores were more severe for narcolepsy compared with OSA. Change from baseline to week 12 in MWT mean sleep latency increased in a dose-related manner compared with placebo, with least square (LS) mean differences of 2.2, 7.4, and 10.4 for 75, 150, and 300 mg, respectively, for narcolepsy, and 4.7, 9.0, 11.1, and 13.0 for 37.5, 75, 150, and 300 mg, respectively, for OSA. Dose-related effects were also observed for change from baseline to week 12 in ESS score, with LS mean differences of -1.8, -3.8, and -5.2 for 75, 150, and 300 mg, respectively, for narcolepsy, and -2.0, -1.9, -4.5, and -4.8 for 37.5, 75, 150, and 300 mg, respectively, for OSA. At week 12, the percentage of participants reported as improved on PGI-C was increased relative to placebo; results were similar between disorders. In the overall population, the most frequent (≥5%) adverse events were headache, nausea, decreased appetite, anxiety, nasopharyngitis, diarrhea, and dry mouth; the incidence was comparable in OSA and narcolepsy.

Conclusion: Solriamfetol showed consistent efficacy and safety findings in both narcolepsy and OSA subjects. Solriamfetol increased wakefulness and reduced sleepiness in both groups and the adverse events profile was similar for both groups.

Support (If Any): Jazz Pharmaceuticals
Introduction: Excessive daytime sleepiness (EDS) is a debilitating non-motor symptom affecting patients with Parkinson’s Disease (PD). Solriamfetol has demonstrated wake-promoting efficacy in clinical trials in narcolepsy and obstructive sleep apnea (OSA).

Methods: This was a phase 2, double-blind, placebo-controlled, randomized, 4-week, crossover trial. Eligible participants were 35-80 years of age, diagnosed with mild to moderate idiopathic PD (UK PDS Brain Bank Criteria), with Epworth Sleepiness Scale (ESS) score >11. Participants were randomized (3:3:1) to receive A) placebo, solriamfetol 75mg, 150mg, and 300mg, B) solriamfetol 75mg, 150mg, 300mg, and placebo, or C) four weeks of placebo. Safety and tolerability were primary objectives and included assessment of adverse events. Efficacy endpoints were change from baseline in mean sleep latency on the Maintenance of Wakefulness Test (MWT) and ESS score.

Results: Participants (n=66) were randomized (mean [SD] age, 64.6 [8.5]; 68.2% male) and n=62 completed the trial. At baseline, mean (SD) ESS score was 16.1 (2.9), and MWT sleep latency was 15.1 min (10.9). The most common treatment-emergent adverse events (≥5%) reported while taking solriamfetol were nausea (10.7%), dizziness (7.1%), dry mouth (7.1%), headache (7.1%), anxiety (5.4%), constipation (5.4%), and dyspepsia (5.4%). Least Square (LS) mean (SE) change from baseline in MWT (min) was 1.8 (1.9) for placebo, 0.4 (2.1) for 75mg (nominal p>0.05), 2.7 (2.2) for 150mg (nominal p=0.05), and 6.8 (2.1) for 300mg (nominal p=0.0098). LS mean (SE) change from baseline in ESS was -4.8 (0.6) for placebo, -4.8 (0.7) for 75mg, -5.0 (0.7) for 150mg and -5.7 (0.7) for 300mg; for change in ESS, all nominal p>0.05.

Conclusion: The safety and tolerability of solriamfetol in PD was demonstrated; participants were able to safely titrate to 300mg, and adverse events were similar to narcolepsy and OSA trials. Solriamfetol treatment improved sleep latency on the MWT at 300mg but not at lower doses. While ESS improvement with solriamfetol was not different from placebo, the large placebo response, likely multifactorial in basis, may have confounded interpretation.

Support (If Any): Jazz Pharmaceuticals

0619 PATIENTS WITH DEVELOPMENTAL DISORDERS (ADHD AND ASD) ACCOMPANY WITH HYPERSONMOLENCE HAVE NORMAL OREXIN LEVELS.

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Introduction: In recent times, attention has been paid to the relationship between developmental disorders such as attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD), and sleep disorders. Previously, we had been focus on the problems of nocturnal sleep, such as insomnia and circadian rhythm disorder in ASD patients. Recently, we meet many developmental disorder patients who complaint hypersonmolenence. Among these patients, they diagnosed as central hypersonmolenence alone are decreased. While cases with coexistence of central hypersonmolenence and developmental disorders, or developmental disorder alone are increased. To investigate orexin levels of these patients, we have
EFFECT OF ANTIDEPRESSANTS ON SLEEP ARCHITECTURE

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Introduction: Antidepressants are presumed to have a strong effect on sleep stage. Current standards for performance of MSLT recommend that selective serotonin reuptake inhibitor (SSRI) type antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether. Most antidepressants are held prior to administration, to avoid potentially spurious result based on the presumption they suppress REM sleep during the MSLT. Due to the consequences of such medications change, including risk of worsening depression or even higher suicide risk, often the test is omitted altogether.

Methods: To determine the extent of the antidepressant/REM suppressant effect on the MSLT from a large volume retrospective analysis, we compared MSLT results among 3 groups of patients - on antidepressants, on no antidepressants and on held antidepressants. Our data source is over 850 PSG/MSLT studies gathered at 3 Boston-area medical centers from 2014-2018. The MSLT consists of 5 naps and we will compare REM latency and sleep latency on those 5 naps among these 3 groups. To avoiding censoring data in the event of no nap, we will perform survival analysis.
(MSLT) have been proposed, including the psychomotor vigilance test (PVT). The PVT has been extensively examined in controls to characterize effects of sleep loss, but its use as a tool to diagnose and classify individual patients remains incompletely characterized. We assessed whether sleep clinicians/researchers could differentiate PVT performance between patients with hypersomnolence and non-sleepy controls tasked with either performing their best or simulating sleepiness.

**Methods:** Twenty-eight patients (EDS group, mean age 35.2 (SD 15.8), 64.3% women) with excessive daytime sleepiness confirmed with clinical interview, Epworth>10, and MSLT mean sleep latency ≤8 minutes underwent 10-minute PVT, typically before MSLT nap 2. Thirty-seven age- and gender-matched, non-patient controls, all with Epworth≤10, also performed 10-minute PVT. Controls were instructed to perform their best (CON group) or to make their performance look as though they were sleepy, without specific instructions about how to do so (simulated sleepiness, CON-SS). Four sleep clinician-scientists (2 ABPN board-certified in Sleep Medicine, 1 ABSM board-certified, and 1 nurse practitioner) and two sleep researchers classified each participant’s detailed PVT output, blinded to group allocation. Kappa was calculated using SAS MAGREE macro.

**Results:** Individual raters performed similarly, with four reviewers correctly classifying 55% of cases, one 57%, and one 65%. Classification was significantly better than chance, with moderate agreement between raters (kappa 0.54, p < 0.0001). Considering each group separately, agreement remained higher than chance. Agreement was only fair for EDS (kappa 0.40), but was substantial for CON and CON-SS (kappa 0.62 for both). When EDS were misclassified, they were typically classified as CON (87.4% of misclassifications). When CON were misclassified, they were typically classified as EDS (89.2%). When CON-SS were misclassified, they were typically classified as EDS (74.3%).

**Conclusion:** The PVT can provide supplemental information as part of hypersomnolence evaluation. However, used in isolation, it would result in substantial misclassification of hypersomnolent patients. Patients with pathologic sleepiness cannot always be distinguished from non-sleepy controls attempting to appear sleepy.

**Support (If Any):** K23NS083748

**0624**

**ADDRESSING THE PSYCHOSOCIAL ASPECTS OF NARCOLEpsy: A MIXED-METHODS STUDY**

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**Introduction:** Medications can be effective for managing narcolepsy symptoms but people with narcolepsy (PWN) continue to report psychosocial distress. The purpose of this mixed-methods study was to assess current practices for addressing the psychosocial needs of PWN and to identify potential strategies that could be used to develop a psychosocial intervention.

**Methods:** Twenty-nine adults (93% female, mean age = 31 years) with an established diagnosis of narcolepsy (Type I = 58.6%) completed on-line questionnaires (PHQ-9, PROMIS) and participated in focus groups. We conducted 10 focus groups led by a psychologist using live videoconferencing which consisted of questions pertaining to quality of life for PWN, current practices for addressing psychosocial health of PWN, and suggestions for developing a psychosocial intervention for PWN. Thematic analysis was used to reduce the qualitative data to key themes.

**Results:** Clinically significant elevations (t-score>60) were reported on the PROMIS scales for depression (t-score=64.8, SEM=2.7), anxiety (t-score=66.3, SEM=2.6), fatigue (t-score=68.3, SEM=2.5), and sleep impairment (t-score=66.9, SEM=2.5). Elevations in depressive symptoms were reported on the PHQ-9 (M=15.79, SD=3.85). Qualitative data from focus groups revealed several key themes: 1) narcolepsy is poorly understood by the public and health care providers; 2) impact of narcolepsy has deleterious effects on self-image/self-worth, family and social relationships, and occupational functioning; 3) current health care practices are unsatisfactory for addressing psychosocial needs (e.g., provider does not understand or have time to address); 4) strong preference for working with clinicians who have training in narcolepsy; and 5) on-line platforms were the preferred format for receiving a psychosocial intervention due to accessibility.
**Introduction:** This study is the first to report standardized PROMIS scores for PWN, which revealed clinically significant elevations in depression, anxiety, fatigue, and daytime impairment. Qualitative data revealed challenges that PWN face in addressing their psychosocial needs and highlighted the gaps in the current healthcare system. Collectively, the findings demonstrate the need for a psychosocial intervention that directly addresses these clinical gaps for PWN.

**Support (If Any):** This project was funded by a grant from Wake Up Narcolepsy.

### 0625

**ONLINE MEDICAL EDUCATION IMPROVES PULMOLOGISTS’ CONFIDENCE AND KNOWLEDGE RELATING TO EXCESSIVE DAYTIME SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Excessive daytime sleepiness (EDS) is common in patients with obstructive sleep apnea (OSA). Data shows that clinicians infrequently ask their OSA patients about EDS or initiate treatment in these patients. A study was undertaken to evaluate the effectiveness of an online educational intervention to improve the confidence and knowledge of pulmonologists in recognizing and managing EDS in patients with OSA.

**Methods:** The online continuing medical education (CME) activity consisted of a 45-minute text-based program with 2 faculty experts on the management of OSA. The program was divided into 3 modules focusing on recognition, treatment, and a case example showing applicability to clinical practice. Educational effect was determined by comparing responses to 4 identical pre- and post-assessment questions. A chi-square test identified differences between pre- and post-assessment responses. Cramer’s V was used to calculate the effect size of the education. Data from the participants were collected between June 26, 2018 and August 15, 2018.

**Results:** Pulmonologist participation in the CME intervention resulted in a considerable educational effect size (n = 234; V = 0.190; P < 0.05). As a result of their participation in this educational intervention, significant (P < 0.05) overall improvements were observed in the following areas: risk factors for EDS in OSA and the mechanism of action of an investigational therapy for the management of EDS. The education did not improve the competence of pulmonologists regarding the correct assessment of OSA patients suspected of having EDS. Participation in the CME intervention resulted in 47% of pulmonologists reporting an increase in confidence regarding their ability to manage EDS in OSA.

**Conclusion:** The results indicate that the CME-certified, 45-minute text-based activity was effective in improving knowledge and confidence relating to risk factors for and investigational medication for the management of EDS in OSA. Future education should continue to address these themes, in addition to the appropriate assessment of patients with OSA for EDS.

**Support (If Any):** The activity and outcomes analysis was supported by an unrestricted educational grant from Jazz Pharmaceuticals, Inc.

### 0626

**IDENTIFYING SUBTYPES OF HYPERSONOMOLENCE DISORDER: A CLUSTER ANALYSIS**

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**Introduction:** The assessment and treatment of Hypersonomolenence Disorder (HD) is burdened by patient heterogeneity. Data-driven subtyping has resolved problematic heterogeneity across various medical conditions. Clustering exists as a preferred technique for establishing homogeneous subdivisions within clinical disorders. Thus, this investigation employed clustering analysis utilizing the symptoms of excessive sleep duration, daytime sleepiness, and sleep inertia to determine whether distinct subtypes exist within a clinical HD sample.

**Methods:** A sample of 62 patients participating in a larger study evaluating novel hypersomnolence assessments underwent polysomnography (PSG) and multiple sleep latency test (MSLT). Participants were subsequently diagnosed with HD via post hoc chart review. A comprehensive clustering process was performed utilizing self-reported habitual sleep duration (SR TST), Epworth Sleepiness Scale (ESS) score, and Sleep Inertia Questionnaire (SIQ) score. Ward’s D hierarchical clustering technique was determined most appropriate. Resulting clusters were compared across a variety of subjective characteristics and objective measurements.

**Results:** The sample was young-to-middle aged (Age = 31.2 ± 10.2), and predominantly female (90.3%). Two subgroups, HYPA (N = 32) and HYPB (N = 30), emerged from the clustering process. Across clustering variables, HYPA endorsed significantly worse daytime sleepiness (ESS mean difference = 3.36±0.98; p = 0.001) and sleep inertia (SIQ mean difference = 28.2±2.31; p = 0.0001), yet the clusters did not statistically differ in SR TST. Furthermore, HYPA endorsed significantly greater depressive symptoms (Inventory of Depressive Symptomatology - Self Report mean difference = 14.6±2.84; p = 0.0001) and functional impairment (Functional Outcomes of Sleep Questionnaire-10 mean difference = -2.68±0.73; p = 0.0006), while displaying longer sleep duration (PSG Total Sleep Time mean difference = 98.8±24.9 minutes; p = 0.0002) and worse vigilance (Psychomotor Vigilance Task Lapses Transformed mean difference = 1.11±0.50; p = 0.03). Age, body mass index, and MSLT sleep onset latency were not different between clusters.

**Conclusion:** This investigation demonstrates two distinct clusters in HD, delineated by depressive and hypersomnolence symptoms whose severity parallels one another. These results highlight the complex relationships between mood and hypersomnolence symptoms, and the need for improved classification of non-cataplectic disorders of hypersomnolence.

**Support (If Any):** This research was supported by a Strategic Research Award to DTP from the American Sleep Medicine Foundation.

### 0627

**INITIAL USE OF THE SLEEP INERTIA QUESTIONNAIRE IN HYPERSONOMOLENCE DISORDERS**

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**Introduction:** Sleep inertia can be defined as difficulty becoming fully awake after sleep. It has long been described as part of both idiopathic hypersomnia and mood disorders. Recently Kanady and Harvey developed the “Sleep Inertia Questionnaire” (SIQ) and validated it in patients with mood disorders, but not in disorders of hypersomnolence. We assessed SIQ performance in healthy controls and patients with a hypersomnolence diagnosis.
**Methods:** Ninety-eight patients (mean age 37.5 (±14.8), 69.4% women) with diagnosis of narcolepsy type 1 (NT1, n=7), narcolepsy type 2 (NT2, n=14), idiopathic hypersomnia (IH, n=42), obstructive sleep apnea (OSA, n=16), and excessive daytime sleepiness not meeting criteria for a sleep diagnosis (EDSNOS, n=19) were included. Ten healthy controls (mean age 23.2 (±9.2), 80% women) were also included. All participants completed the SIQ and questionnaires assessing sleepiness (Epworth), fatigue (Fatigue Severity Scale), depression (Beck Depression Inventory), and chronotype (Horne-Ostberg). We used T-tests to compare groups, and Pearson correlations to investigate associations between the SIQ and other scales.

**Results:** Patients with a hypersomnia diagnosis scored significantly higher in all four subdomains of the SIQ compared to controls (p≤0.001 for all). They also scored higher on the BDI (9.1 vs. 2.0, p=0.002). IH patients had significantly higher scores on the behavioral subdomain of the SIQ compared to those with OSA (4.4 vs. 3.6, p=0.001), and significantly higher total scores compared to those with NT1 (14.0 vs. 10.8, p=0.03), despite comparable reports of depression on the BDI (OSA p=0.27, NT1 p=0.40). There were no differences between IH and NT2, or EDSNOS in any component of the SIQ (all p’s >0.23). SIQ total score in IH patients showed a significant positive correlation with BDI, FSS, and hours slept per week (all p<0.001), but no correlation with ESS or Horne-Ostberg.

**Conclusion:** SIQ scores may be elevated in all disorders of hypersomnia, but less prominently in NT1 and OSA. The SIQ appears to be effective in detecting sleep inertia separately from sleepiness or chronotype, but may be influenced by concomitant depression.

**Support (If Any):** K23 NS083748, R01 NS089719

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**0628**

**TO WITHHOLD OR NOT WITHHOLD? USE OF PSYCHIATRIC MEDICATIONS ON MSLT OUTCOMES IN 1033 PATIENTS**

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**Introduction:** Although the AASM recommends that REM-suppressing medications be stopped 2-weeks prior to the MSLT, the effect of psychiatric medications (which suppress nocturnal REM) on diurnal REM behavior is relatively unexplored. Because withholding psychiatric medications has ethical and medical implications, the goal of this study is to quantify the prevalence of psychiatric medication withholding and the association between use of these medications and MSLT outcomes.

**Methods:** PSG and 5-nap MSLTs, performed 2008-2015, were extracted from SleepMed’s deidentified clinical repository. Split-night and PAP titration studies were excluded, as were patients working shifts/nights. MSLTs were conducted per AASM criteria and strict quality assurance metrics were employed post-hoc for inclusion. Medication effects on key MSLT parameters (MSL≤8, ≥2 REMs) were assessed with multiple logistic regression. Antidepressants and antipsychotics were categorized as “REM suppressants” [RS], benzodiazepines were categorized “anxiolytics” [ANX], and non-benzodiazepine hypnotics were categorized as “sedative-hypnotics” [SH].

**Results:** The final sample was 1033 patients with mean age 34 years (range 4-82; 69% Caucasian; 62% female). Medication occurrence was as following: RS=38%, SH=9%, and ANX=13%. Only 5.9%, 2%, and <1% of those using RS, ANX, and SH reported refraining from these medications prior to the MSLT, respectively. Use of RS and ANX, controlling for age, sex, and race, was associated with reduced rate of ≥2 REMs (RS= OR: 0.55, p=.02; ANX= OR: 0.42, p=.01) and MSLTs consistent with narcolepsy (MSL≤8 & ≥2 REMs; RS= OR: 0.61, p=.01; ANX= OR: 0.37, p=.01). Neither compound was associated with MSLT sleep latency. SH use was not associated with MSLT outcomes.

**Conclusion:** Despite AASM recommendations, very few patients appear to withhold psychiatric medications prior to MSLT testing. This has important implications for MSLT sensitivity/specificity due to the prevalence of these compounds in sleep patients and the apparent diurnal REM-suppressing effects. Because causal inference can not be made with post-hoc designs, carefully-controlled laboratory studies are needed to more adequately assess the role of these medications on diurnal REM behavior.

**Support (If Any):**
B. Clinical Sleep Science and Practice

0629
SOCIAL JETLAG AND SLEEP DISRUPTION IN DAYSHIFT NURSES
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Introduction: Social jetlag, characterized by later bedtimes and waketimes on off days compared with work days, is associated with adverse mental and physical health outcomes. Given the common use of three 12-hour shifts in nursing schedules, we hypothesized that day shift nurses with a later chronotype would exhibit greater social jetlag and associated sleep disruption compared with day shift nurses with an earlier chronotype.

Methods: Full-time nurses who work day shift (n=140) completed the Biological Clocks Questionnaire for 8 consecutive days and the Standard Shiftwork Index. Hierarchical cluster analysis was used to examine sleep schedules on workdays and off days to identify distinct clusters of sleep schedules.

Results: Three distinct clusters were identified: early bedtime, variable social jetlag (Group A; n=43); later bedtime, no social jetlag (Group B; n=48); and very late bedtime, high social jetlag (Group C; n=49). Nurses with very late bedtimes and high social jetlag (Group C) were younger (p < 0.01), had lower scores on the morningness scale (p < 0.01), and reported being less adapted to their work schedule (p < 0.05). All three groups reported greater sleep disturbance on work days compared with off days (p < 0.001); however, this difference was potentiated for Group C (p < 0.01).

Conclusion: Chronotype should be considered when assigning individuals to working shifts. Additionally, shift workers should be educated on strategies to minimize social jetlag in order and resulting sleep disruption.

Support (If Any): This study was funded by the UAB Center for Clinical and Translational Science (CCTS) Grant Number UL1TR000165.

0630
SLEEP HEALTH OF NURSING STAFF IN AN ACADEMIC MEDICAL CENTER: RESULTS OF A SURVEY STUDY
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Introduction: Nearly 100,000 deaths are estimated to occur each year in US hospitals attributable to medical errors. Sleep deprivation and disorders have been claimed to be significant contributors. Nurses are at increased risk of sleep deprivation and poor sleep behaviors due to job related factors. However, the prevalence of sleep insufficiency and sleep disorders is not well studied among large cohorts of nurses in the United States. The objective of this study was to survey the sleep habits and to estimate the prevalence of shift work disorder, insomnia, restless leg syndrome, excessive daytime sleepiness and risk factors for obstructive sleep apnea in nurses at an academic medical center.

Methods: This was a Cross-sectional institutional adult online survey done at a tertiary care medical center among nurses of age > 18 years. A total of 1165 nurses participated in the survey. The data collected were: demographics, sleep schedule, medications used (to help to sleep, to help to stay wake), medical history of OSA, as well as the STOP-BANG, Epworth sleepiness scale (ESS), insomnia, restless leg syndrome, and shift work disorder questionnaires.

IV. Circadian Rhythm Sleep-Wake Disorders

0631
EFFECT OF TIME-OF-DAY AND TIME-SPENT-AWAKE ON OBJECTIVE AND SELF-REPORTED MEASURES OF PERFORMANCE IN POLICE OFFICERS WORKING ROTATING SHIFTS
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Introduction: Shift work is associated with reduced sleep depending on the type of shift, leading to reduced alertness and increased sleepiness. The aim of the present study was to assess the effect of time-of-day and time-spent-awake on psychomotor performance and self-reported alertness and sleepiness in police officers involved in rotating shift work.

Methods: Seventy-six police officers (20 women, 56 men) aged 32 ± 5.4 years (mean ± SD, range: 23-49) participated in a 35-day field study involving morning, evening, and night shifts (duration: 9- to 12-h). Multiple times per day, objective performance was measured using a 5-minute Psychomotor Vigilance Task (PVT). In addition, participants filled out a visual analog scale (VAS) to assess self-reported alertness and the Karolinska Sleepiness Scale (KSS) to assess self-reported sleepiness. The effect of time-of-day (TOD, 2-h or 4-h bins) and time-spent-awake adjusted for naps (TSAAN, 2-h bins) on all the variables was analyzed using linear mixed-effects modelling.

Results: A significant effect of TOD and TSAAN was found on all dependent measures. Based on TOD, the objective measures’ worst performance levels were observed between 0400 and 0800 hours, whereas for alertness and sleepiness the worst levels were observed between 0000 and 0200 hours. Based on TSAAN, the worst values were found at 17 h and 23 h of time awake, the last time bin used for objective performance and the self-reported measures, respectively.

Conclusion: Our results suggest that time-of-day and time awake influence shift workers’ performance and self-reported alertness and sleepiness levels during shift work, potentially affecting their fitness for duty. Both objective and subjective measures were worst at night, although the specific TOD differed. This suggests that both types of measures address a slightly different aspect of vigilance.

Support (If Any): Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSSST)
0632
TIME OF DAY AND TIME ON TASK EFFECTS ON WORKING MEMORY AND SLEEPINESS OF BUS DRIVERS
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Introduction: Fatigue and sleepiness have direct effects on vigilance, and cognitive functions of drivers. The objective of this study was to analyze individual bus drivers' characteristics and work shift parameters and relation to the working memory performance and sleepiness.

Methods: This prospective study was conducted on 35 inter-city bus drivers by convenience sampling. We collected data during the time span of a 24-hour round trip by using the demographic questionnaire, Epworth Sleepiness Scale (ESS), Karolinska Sleepiness Scale (KSS), and reversed digit span memory test (part of the Wechsler-Adult Intelligence Test). A linear mixed model was used for statistic analysis.

Results: The mean (± SD) of Epworth Sleepiness Scale score was 6.4 (±2.7). 12.5% of drivers had excessive daytime sleepiness according to ESS results. The circadian effect of time on day of the drivers' working memories was statistically significant (P=0.001), and the working memory was minimum at 04:00 am (± 1). Additionally, the differences in sleepiness at different times of day were statistically significant (P=0.001); with the highest score at 04:00 am (± 1). Time on task and time of sleep parameters did not show a significant effect on working memory (p=0.05). Time on task parameter affected sleepiness significantly (p=0.024).

Conclusion: The circadian factor was the most important predictor of cognitive performance compared to time on task (fatigue) and time of sleep. Although, time on task had a significant effect on sleepiness and sleepiness significantly decreased working memory. We conclude that optimizing the drivers' schedule is the most important intervention to optimize drivers' performance and increase road safety.

Support (If Any): Not

0633
PROSPECTIVE SEMESTER-LONG EVALUATION OF COLLEGE STUDENT SLEEP
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Introduction: Sleep duration and regularity are important for learning, development, and mental health. Recent work has revealed that both sleep duration and consistency of sleep timing are suboptimal in many college students. We characterized sleep duration and timing in college students over an entire semester.

Methods: We recruited students through online and in-person approaches, with most enrollment from in-person solicitations outside campus dining areas. Demographic information, sleep habits, external factors affecting sleep and chronotype were assessed via questionnaire. Throughout the semester, daily emails were sent to participants with a link to complete electronic sleep diaries. Incentives were offered for diary completion.

Results: 391 students (55% female) completed 7,390 daily sleep diaries. Most participants (65.7%) expected to graduate within the next one or two years. At baseline, most students (60%) reported sleeping less than they need to feel well-rested. The most common factors influencing sleep related to academic (82%) and social (67%) commitments. Noise was the most commonly reported environmental barrier, with 65% reporting that noise adversely affected their sleep. When class was in session, students averaged 7.2h±1.7h of sleep during the week and 7.7h±1.7h of sleep on weekends. Sleep was significantly increased during spring recess (mean 8.1h±2.0h). Sleep duration varied by chronotype (p<0.001), with morning chronotypes averaging the longest sleep duration (8.0h±1.2h). Overall, there was no change in average sleep duration as collected on daily diaries over the semester. On the post-study questionnaire, over 50% of students reporting sleeping on a more consistent schedule and sleeping longer each night as a result of participating in the study.

Conclusion: Sleep deficiency and circadian disruption are common among college students. Academic, social, and environmental factors limit the opportunity for and foster inconsistent timing of sleep. Morning chronotypes may be more likely to achieve sufficient sleep in the college setting. Appropriate interventions may be possible.

Support (If Any): *Indicates equal contribution to the work. Supported by NIH R01-GM-105018, K24-HL-105664 (EBK)

0634
SLEEP-WAKE RHYTHM AND BRAIN ACTIVITY IN UNIVERSITY STUDENTS
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Introduction: Irregular sleep-wake rhythm is common problems among university students. Short sleep time, later bedtimes, and later wake times may predict poor academic performance. We investigated the effect of sleep-wake rhythm on the cortical oxygenation as measured by near infrared spectroscopy (NIRS) and endothelial function in university students.

Methods: Twenty-two university students (age 20.2 ± 2.0 yrs) were enrolled in this study. All subjects had no history of any neurological disorder, substance abuse, head injury or major physical illness, and were not on any psychotropic medications at the time of the study. The Chubu University Ethics Committee approved all procedures associated with the study. We obtained written informed consent from each participant after fully explanation of the protocol. All subjects filled a questionnaire about their daily sleep schedule. Bedtime, wake-up time, and sleep duration were collected from this questionnaire and median of sleep time was calculated. Peak cortical oxygenated hemoglobin and integral values by a word fluency task were measured with NIRS. Brachial-ankle pulsed wave velocity (baPWV), systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR)
were measured using a plethysmograph. Endothelium-dependent FMD was induced by reactive hyperemia, and high-resolution ultrasound with a 7.5-MHz linear array transducer was used to measure the diameter of the right brachial artery. Percent FMD was computed as: (maximum diameter-baseline diameter) / baseline diameter ×100.

**Results:** Cortical oxygenated hemoglobin value and %FMD were significantly lower in irregular sleep-wake rhythm group (greater than two hours) than in non-irregular sleep-wake rhythm group. There were no significant differences in baPWV, SBP, DBP, HR, and baseline brachial artery diameter between the two groups.

**Conclusion:** Sleep-wake rhythm may play an important role in daytime brain activity and endothelial function.

**Support (If Any):**

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**0635**

**ACUTE NIGHT-TO-NIGHT SLEEP ONSET LATENCY VARIATION WITHIN CONCUSSED COLLEGE STUDENTS: A PILOT STUDY**

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**Introduction:** Greater sleep-wake cycle dysfunction post-concussion might result from night-to-night variation among various sleep outcomes. Recent evidence supports that concussed individuals experience acute sleep variation in their total sleep time and sleep fragmentation, which is cause for concern as it may be associated with prolonged symptom duration. The objective of this study was to determine whether night-to-night sleep pattern variation differs between concussed individuals and matched controls one and two weeks post-injury.

**Methods:** Twenty college students were physician-diagnosed with a concussion. Thirteen concussed individuals with symptom durations ≥14 days (23.5±8.4days) were included in this analysis in order to examine sleep across the initial two weeks post-injury compared to non-concussed controls matched on age, sex, physical activity, and sleep quality. A wrist-worn Actigraph device was provided during initial evaluation (within 72 hours post-injury for concussed) and worn continuously until symptom resolution (duration matched for non-concussed). Intraindividual coefficient of variation (CV) were calculated for each actigraphy sleep outcome (sleep onset latency (SOL), total sleep time (TST), sleep efficiency, and number of awakenings) for weeks 1 and 2 post-injury. Separate 2(group) x 2(time-points) mixed-model ANOVAs were conducted to compare CV of sleep outcomes across week 1 and week 2 post-injury between concussed and non-concussed individuals. Paired samples t-tests were conducted to examine CV within groups between week 1 and week 2 post-injury (α=0.05).

**Results:** Across week 1 post-injury, concussed individuals experienced greater intraindividual variability in SOL (F_{1,24}=10.84, p=0.003) compared to non-concussed individuals. Concussed individuals experienced greater intraindividual variability in SOL across week 1 compared to week 2 post-injury (t(12)=3.35, p=0.006). Intraindividual variability differences did not exist in other sleep outcomes across weeks 1 and 2.

**Conclusion:** Greater night-to-night variation existed in SOL between concussed and non-concussed individuals during the first week post-injury and among concussed individuals between weeks 1 and 2 post-injury. Greater night-to-night variability during the first week post-injury may be a result of the concussion itself and may have clinical implications for the acute management of sleep post-concussion.

**Support (If Any):** None
B. Clinical Sleep Science and Practice

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Introduction: Objective actigraphy is a valid proxy of the criterion standard of sleep (EEG-based polysomnography) in TBI. TBI morbidity precludes guideline-recommended scoring. RAC has been associated with cognitive status during acute care. No study has examined RAC during rehabilitation or compared methods for determining abnormality. This study compared two aggregate measures of RAC abnormality on outcomes to operationalize an evidence-based biomarker of circadian disruption and inform treatment.

Methods: Consecutive VA TBI Model System participants from a single Polytrauma Center from 2013-2016 were examined (n=70, male (92%), middle age (median age=32), with severe injury (median GCS=6). Admissions received a minimum of 3 days of ACG (median=56 days post-TBI) and outcomes (PTA duration, Functional Independence Measurement/FIM, Disability Rating Scale/DRS). Daily RAC was computed using previously reported metrics (daytime activity/24-hour activity; daytime interval defined as 0600-2200). Two criteria for determining RAC normalcy were compared: mean RAC across three days (Mean Method) and presence of RAC<80% on any of the three days (Fluctuation Method).

Results: Greater than 80% of the cohort showed normal RAC (≥80%) each day; however, the participants moved in and out of the normal/abnormal group across the three days. A greater proportion of the sample was abnormal using the Fluctuation Method (31%) compared to the Mean Method (19%). Across both methods, the abnormal and normal groups were comparable on time elapsed since injury to actigraphy assessment and injury severity indices (emergency department GCS, and time to follow commands). Participants with abnormal RAC using the Fluctuation Method had longer duration of PTA (p=0.008) and worse outcomes on rehabilitation admission FIM (cognitive [p=0.27], motor [p=0.01]) and DRS (p=0.037). Participants with abnormal RAC using the mean method only differed on the motor FIM (p=0.01).

Conclusion: A greater proportion of the sample had abnormal RAC when examining consistency across a 72-hour interval and had worse outcomes compared to mean RAC. Findings inform development of an objective biomarker of circadian disruption that informs a precision medicine approach to sleep management in TBI.

Support (If Any): DVBIC

0638

PRIMARY HYPOTHYROIDISM IS ASSOCIATED WITH INDIVIDUAL CHRONOTYPES IN ADULT WOMEN

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Introduction: Introduction: We aimed to determine whether thyroid hormone levels are associated to abnormal chronotypes in a clinical sample of females with hypothyroidism. We also hypothesized that abnormal chronotypes are frequent in hypothyroidism.

Methods: A single center retrospective study conducted at an urban, south Florida ambulatory care clinic during years 2013-2015. Subjects included females with hypothyroidism due to autoimmune or acquired causes. Chronotype was based derived from The Munich ChronoType Questionnaire (MCTQ). The Mann-Whitney U test was used to compare demographic, sleep and thyroid stimulating hormone (TSH) level across chronotype groups (early vs. intermediate/late). Regression analysis was used to evaluate associations between chronotype and TSH levels adjusting for age, BMI, sleep duration and levothyroxine dose. Interaction terms were added to the fully adjusted models.

Results: We evaluated a total of 99 patients with mean age of 56.5±7 years (range 22-65), BMI of 30.3±6.6 and sleep duration of 7.2±1.6. Fifty-eight percent had early onset chronotype, while 42% had intermediate or late chronotype. Multivariable analysis showed that BMI (F=10.46; p=0.002), early chronotype (F=10.6; p=0.002) and the interaction of BMI with chronotype (F=12.7; p=0.006) were associated with TSH adjusting for age, sleep duration and levothyroxine dose.

Conclusion: Early chronotypes were more frequent in this sample of females with hypothyroidism. In particular, early chronotype with higher BMI was associated to increased TSH.

Support (If Any): R21-AG056952 (ARR)

0639

TASIMELTEON EFFECTIVE IN TREATING JET LAG DURING TRANSATLANTIC TRAVEL

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Introduction: Jet Lag Disorder (JLD) affects millions of individuals annually who cross multiple time zones during their travel. JLD symptoms are more severe during eastward travel. It is reported that there are more than 30 million US resident trips each year to overseas destinations. Of these, 60% (approximately 20 million) travel to destinations in Europe, the Middle East and Asia.

Methods: This was a two-phase transatlantic travel study, with an observational travel phase (baseline) followed by a treatment phase. 25 study participants traveled either 5 or 8 time zones from Washington, DC to London and San Francisco or Los Angeles to London, respectively. They stayed in London for 3 nights and 4 days, and during randomization they received tasimelteon 20mg for 3 consecutive nights prior to their bedtime. Efficacy was monitored by polysomnography (PSG) as well as sleep and wake questionnaire scales (PSQ).

Results: Tasimelteon significantly improved the primary endpoint in total sleep time of the first 2/3 (TST/2) on Night 3 as measured by PSG (tasimelteon=76.2; placebo=41.4; p=0.0354). Tasimelteon also demonstrated significant improvement in the total sleep time at night 3 (tasimelteon=111.9; placebo=33.5; p=0.0225), sleep quality at night 3 (tasimelteon=1.31; placebo=0.36; p=0.0198), and sleep latency at night 3 (tasimelteon=20.6; placebo=6.0; p=0.0347) as measured by the PSQ. In addition, Tasimelteon significantly improved the global function as measured by patient global impression of severity (PGI-S) (tasimelteon=-0.71; placebo=-0.07; p=0.0168).

Conclusion: The JET study successfully demonstrated clinically meaningful and statistically significant improvements in both
**B. Clinical Sleep Science and Practice**

objective and subjective sleep measures as well as global functioning after a real-world flight. These results suggest that tasimelteon can be an effective therapeutic tool to treat Jet Lag in the context of 5- and 8-hour time zone transatlantic travel.

**Support (If Any):** This work was supported by Vanda Pharmaceuticals Inc.

**0640**

TASIMELTEON SIGNIFICANTLY IMPROVES REM SLEEP ACCUMULATION DURING AN 8-HOUR PHASE ADVANCE IN THE JET8 STUDY

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**Introduction:** Jet lag disorder is a common circadian disorder frequently observed in millions of travelers who cross multiple time zones. Jet lag disorder is characterized by nighttime sleep disruption, a decrease in daytime alertness and impairment to social and occupational functioning. We have previously shown that tasimelteon significantly increases total sleep time following an 8-hour sleep timing phase advance in the JET8 study. Here we studied how tasimelteon affects REM sleep accumulation, which is strongly regulated by the circadian pacemaker, following the phase advance in the JET8 study.

**Methods:** In the JET8 study, 318 healthy volunteers were admitted to a sleep unit and were subjected to a circadian challenge of an 8 hours advance to their usual bedtime. The JET8 study design induced the circadian challenge experienced by travelers who cross 8 time zones, which leads to jet lag disorder. Sleep was measured using polysomnography.

**Results:** Tasimelteon significantly improved total REM sleep time as measured by PSG (tasimelteon=48.9 min.; placebo=35.2 min.; p<0.0001), and improved the time it takes to accumulate 30 min. of REM sleep (tasimelteon=318.7 min.; placebo=372.0 min.; p<0.0001). Subjects in the tasimelteon group were 47% more likely to achieve time to 30 minutes of REM during the entire sleeping period as compared to the placebo group (tasimelteon=76.1% of subjects; placebo=51.6% of subjects; <0.001).

**Conclusion:** Tasimelteon demonstrated significant improvement in accumulation of REM sleep, which is strongly regulated by the circadian pacemaker, during an 8-hour phase advance in sleep timing. These results suggest that tasimelteon increases sleep during circadian adverse timing at least in part by affecting the circadian pacemaker. These results further support tasimelteon as a novel circadian regulator for the treatment of jet lag disorder.

**Support (If Any):** This work was supported by Vanda Pharmaceuticals Inc.

**0641**

TASIMELTEON DEMONSTRATES EFFICACY IN IMPROVING SLEEP DISTURBANCES OF INDIVIDUALS WITH SMITH-MAGENIS SYNDROME (SMS)

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**Introduction:** Smith-Magenis Syndrome (SMS) is a rare (1/15,000 - 25,000 births) developmental disorder that results from an interstitial deletion of human chromosome 17p11.2, and in rare cases from an RAI1 gene mutation. Patients with SMS present with a number of physical, mental, and behavioral problems. The most common symptoms of SMS is a severe sleep disorder associated with significant disruption in the lives of patients and their families.

**Methods:** This study was a double-blind, randomized, two-period, 4-week crossover study that evaluated the effects of tasimelteon versus placebo on sleep disturbances of individuals with SMS. 25 patients with SMS were enrolled and evaluated for daily diary sleep quality (DDSQ) and for daily diary total nighttime sleep duration (DDTST) via a parental post sleep questionnaire (PSQ). Total nighttime sleep duration was also measured via daily actigraphy.

**Results:** Tasimelteon met the primary endpoint of improvement in the 50% worst sleep quality (tasimelteon=0.67; placebo=0.27; p=0.0139) and showed improvement on the primary endpoint of 50% worst total nighttime sleep duration (tasimelteon=36.1 min; placebo=17.6 min; p=0.0556). Tasimelteon demonstrated significant improvement in overall sleep quality (tasimelteon=0.55; placebo=0.22; p=0.0155) and overall total nighttime sleep duration (tasimelteon=40.9 min; placebo=19.8 min; p=0.0134). Tasimelteon improved the overall total nighttime sleep duration by an average of approximately 41 minutes per night, a highly clinically meaningful effect. Tasimelteon also showed significant improvement in objective measures of total nighttime sleep duration via actigraphy, for 50% worst total sleep time (TST) (tasimelteon=22.3 min; placebo=2.4 min; p=0.0309) and overall TST (tasimelteon=20.1 min; placebo=1.9 min; p=0.0218).

**Conclusion:** Tasimelteon demonstrated clinically meaningful and statistically significant improvements in sleep quality and total sleep time in SMS patients. These results suggest that tasimelteon can be a novel therapy for the treatment circadian dysfunction and sleep disturbance in patients with SMS.

**Support (If Any):** This work was supported by Vanda Pharmaceuticals Inc.

**0642**

THE EFFECT OF BRIGHT LIGHT ON TEMPERATURE, SLEEPINESS, AND SALIVARY MELATONIN IN SHIFT WORK NURSES

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**Introduction:** To assess the effect of bright light emitted by a light-box in nurse station, on sleepiness, oral temperature, and salivary melatonin in night-shift nurses.

**Methods:** In a prospective, interventional, crossover trial 44 healthy female night-shift nurses were allocated into two groups of intervention and control. In the first stage, the nurses in the intervention group were exposed to 10000 lux bright light by a light-box at 11 p.m. for half an hour. The control group were not exposed to bright light. In the next stage (one month later), the control group of the first stage was exposed to bright light as the intervention group of the second stage and vice versa.

**Results:** The Effect of Bright Light on Temperature, Sleepiness, and Salivary Melatonin in Shift Work Nurses

**Conclusion:** Tasimelteon demonstrated clinically meaningful and statistically significant improvements in sleep quality and total sleep time in SMS patients. These results suggest that tasimelteon can be a novel therapy for the treatment circadian dysfunction and sleep disturbance in patients with SMS.

**Support (If Any):** This work was supported by Vanda Pharmaceuticals Inc.
Results: Bright light exposure had significant influence on temperature and KSS over the 24 hours period time (P-value < 0.001 for all). The mean of temperature and KSS in two groups of cases and controls in both periods were significantly different. The trend of changes of temperature and KSS in two groups had opposite directions. The trend of changes in melatonin concentrations was different between case and control group. In the intervention group the mean values were increasing, and in the control group were decreasing (P-value < 0.001). While Bright light exposure resulted in occurrence of the minimum KSS at 4 a.m., and the maximum KSS at 4 p.m., it resulted in decreased concentrations of melatonin in the early morning (compared to the next evening), and maximum temperature at 4 a.m. compared to minimum temperature at 2 p.m.

Conclusion: Bright light exposure at 11 p.m. changes the pattern of sleepiness, oral temperature, and salivary melatonin in night-shift nurses. These effects will help the nurses to better tolerate the shift hours and have better sleep at home.

Support (If Any): Not
Introduction: Rapid eye movement sleep behavior disorder (RBD) is characterized by unpleasant dreams and dream-enacting behaviors that can result in sleep-related injuries. For treatment of RBD, clonazepam has been widely used. The aims of this study were (1) to evaluate the treatment outcome with clonazepam and (2) to explore associated factors related to optimal treatment responses.

Methods: We performed a retrospective medical chart review of 175 RBD patients attending the sleep clinic in Seoul National University Bundang Hospital. The optimal treatment response was defined as the absence of unpleasant dreams or behavioral disruptions including falling out of bed, sleep-related injuries or potentially injurious behaviors during the recent 1-year period of follow-up. All the subjects underwent full-night video-polysomnography and completed self-reported questionnaires regarding demographic information, insomnia and depressive symptoms.

Results: Among the 170 patients with initial symptoms of behavioral disruptions, 130 experienced optimal treatment responses representing a response rate of 76.5%. Compared to non-responders, responders showed later age of diagnosis and lower final dose of clonazepam (all p < 0.05). Regarding unpleasant dreams, among 175 patients with initial symptoms, 85 achieved optimal treatment responses with a response rate of 48.6%. Responders demonstrated later age of diagnosis, less severe symptoms of insomnia and higher prevalence of obstructive sleep apnea (OSA) (all p < 0.05). After multiple logistic regression analysis, age of diagnosis ≥ 75 (OR = 22.63, 95% CI = 2.90-176.70), female gender (OR = 3.51, 95% CI = 1.23-10.06) and presence of synucleinopathies at the last visit (OR = 4.50, 95% CI = 1.05-19.31) were related to the successful elimination of disruptive behaviors. In terms of unpleasant dreams, the presence of OSA at the baseline assessment (OR = 2.80, 95% CI = 1.20-6.52) was associated to the optimal treatment responses.

Conclusion: Clonazepam is effective in alleviating disruptive behaviors and unpleasant dreams in RBD patients. Optimal response of disruptive behaviors in RBD patients with late age of diagnosis, female gender and the presence of synucleinopathies could be associated with sedative and myorelaxation effects of clonazepam.

Support (If Any):

0645 REM WITHOUT ATONIA IN COMBAT VETERANS WITH PTSD AND CO-MORBID OSA

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Introduction: Trauma Associated Sleep Disorder (TSD) may represent a distinct parasomnia induced by trauma exposure. A recent published series demonstrated varying degrees of REM without atonia (RSA, 13-37%). It is unclear if TSD has an overall pathologic increase in RSA versus focal periods of RSA associated with nightmares or disruptive nocturnal behavior (DNB). The purpose of this study is to describe the degree of RSA in patients with PTSD+OSA who are at risk for TSD.

Methods: Retrospective review of initial level 1 attended diagnostic video polysomnography (PSG) for 66 patients with combat related PTSD+OSA who were enrolled in a clinical trial measuring CPAP adherence. RSA was scored in 3-second mini-epochs as having (or not having) “any” EMG activity according to the Sleep Innsbruck Barcelona group method.

Results: Among 66 patients with PTSD+OSA, most were male (86%) with a mean age of 41.4 ± 8.0 years and BMI of 28.6 ± 29.1 kg/m². The median AHI was 18.8 events/hour with a baseline ESS (11.9 ± 5.7 points) and ISI (17.6 ± 5.0 points). During the diagnostic PSG 16 (57.1%) received either eszopiclone or zolpidem. On video PSG the presence of REM without atonia using the “any” EMG activity criteria ranged from 6.2-12.3% and no abnormal motor behaviors were observed.

Conclusion: This is the first study to characterize the degree of RSA among veterans with recently diagnosed PTSD+OSA.
B. Clinical Sleep Science and Practice

As the clinical characteristics and diagnostic criteria of Trauma Associated Sleep Disorder (TSD) are developed it will be important to take into consideration the normative values for RSWA in this unique, at risk patient population.

Support (If Any): n/a

0646

ABNORMAL EVENT-RELATED ELECTROENCEPHALOGRAMS IN PATIENTS WITH RAPID-EYE MOVEMENT (REM) SLEEP BEHAVIOR DISORDER (RBD) DURING INVOLUNTARY VISUOSPATIAL ATTENTION TASK: A POSSIBLE PROGRESSION MARKER IN NEURODEGENERATIVE DISEASE

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Introduction: Rapid eye movement (REM) sleep behavior disorder (RBD) is a sleep disorder characterized by dream enactment behavior and the loss of muscle atonia during REM sleep. Recent studies have investigated the predictive marker of the neurodegenerative diseases in RBD including imaging, genetic, neurophysiological, and autonomic function. A variety of cognitive deficits have been revealed in RBD, but there have little evidence as a progression marker of neurodegenerative disease. Our study identified the electrophysiological progression marker of the neurodegenerative disease in RBD from event-related electroencephalogram (ERP) during a visuospatial attention task.

Methods: Eighteen idiopathic RBD patients participated in the study. Patients were performed the Posner's cueing paradigm during the 60-channel electroencephalogram (EEG) recording. After the task performed, we investigated whether the patients progressed to Parkinson’s disease (PD) or dementia with Lewy body (DLB). As a result of long-term follow-up, two subjects were converted to PD and 2 subject were converted to DLB. Conventional ERP analysis was performed to identify electrophysiological changes with conversion types.

Results: In the 200 ms stimulus onset asynchrony (SOA), RBD without conversion to dementia showed the significantly increased N1 ERP component in valid than invalid condition. However, RBD who converted to dementia showed no significant difference of N1 ERP component between valid and invalid condition. In the 1000 ms SOA, no significant differences of N1 ERP component between valid and invalid were observed regardless of whether the conversion being proceeded.

Conclusion: Abnormal N1 ERP component in the long SOA may reflect the deficit in oculomotor and attentional inhibitory control in RBD patients regardless of conversion to dementia. Abnormal N1 ERP component in the short SOA, which was only observed in RBD who converted to dementia, revealed that facilitation deficit may be considered as a clinical feature of dementia conversion. Our findings suggested that visuospatial attention deficit in RBD may be as a part of prodromal markers of neurodegenerative disease.


0647

THE RELATIONSHIP BETWEEN AMYLOID ACCUMULATION AND POOR SLEEP IN PATIENTS WITH IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: Idiopathic REM sleep behavior disorder (iRBD) is well known as a strong predictor of neurodegeneration, in particular synucleinopathies. Alzheimer’s disease (AD) is also reported as a possible development in patients with iRBD, although it is in a limited number of cases and there are concerns about diagnostic accuracy. Amyloid PET scans allow accurate detection of amyloid plaques. The aim of this study is to investigate the clinical and polysomnographic features of iRBD patients depending on amyloid accumulations.

Methods: A total of 21 patients with iRBD (mean age 63.6y, 16 male) and age-gender matched 5 controls (mean age 64.4y, 3 male) were enrolled in this study. Diagnosis of iRBD was confirmed by polysomnography. Participants have taken brain MRI, questionnaires (BDI, PSQI, ISI, SSS, ESS), and neuropsychological tests.

Results: Currently, 15 iRBD patients and 5 controls completed all studies including amyloid PET scans. Three patients of 15 (20%) had positive amyloid scan while all controls showed negative results. Three iRBD patients with amyloid accumulation (Amy positive) seem to be older than 12 patients without amyloid accumulation (Amy negative) or 5 controls (72.26 vs. 64.54 vs. 64.4, respectively). Disease onset age was 67.0±11.3y in Amy positive and 61.0±6.3y in Amy negative. Mini-Mental State Exam (MMSE) scores looked to be lower in three Amy positive group than Amy negative or controls (24.3±4.0 vs. 28.25±2.0 vs. 27.6±2.5). Neuropsychological tests showed trend of diffuse cognitive dysfunction on all domain in Amy positive group. Patients with Amy positive showed more poor sleep than Amy negative on polysomnography; lower sleep efficiency (58.13±22.35 vs. 83.05±12.02%), more frequent arousal indices (23.93±0.91 vs. 17.95±8.60/h), more N1 sleep (32.06±13.84 vs. 15.57±6.71%) and less N3 sleep (0 vs. 2.42±5.95%).

Conclusion: The positive pattern of Amyloid PET scan in iRBD patients seems to indicate, more poor sleep and cognitive decline than patients without amyloid accumulation or controls. Longitudinal studies with more patients and controls are needed to clarify whether amyloid positivity is an early manifestation of AD and its relationship with poor sleep quality.

Support (If Any): n/a

0648

SLEEP PARALYSIS IN COLLEGE STUDENTS: PREVALENCE, SUBJECTIVE EXPERIENCES, AND CORRELATES

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Introduction: Prior research suggests that approximately 28% of college students have experienced sleep paralysis (SP), a prevalence rate that is considerably higher than in the general population. The current study examined the prevalence, subjective experiences, and correlates of SP in a sample of predominantly Hispanic college students.

Methods: 416 undergraduates (mean age 20.3, 95% Hispanic, 76% female) completed an online survey that contained questions about SP and a number of standardized measures, including insomnia (ISI), sleep quality (PSQI), and stress (PSS and ICSRLE).

Results: Lifetime prevalence of SP in our sample was 35%, with 20% of the sample having experienced SP during the preceding year and 7% during the preceding month. Those who had experienced SP reported significantly greater insomnia, poorer sleep quality, greater life-events stress, and higher self-perceived stress (one-tailed
B. Clinical Sleep Science and Practice

ARE SELF-REPORTED SYMPTOMS OF OBSTRUCTIVE SLEEP APNEA ASSOCIATED WITH INCREASED NIGHTMARE FREQUENCY?

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Introduction: Nightmares involve disturbing images and create distress in many individuals. Approximately 50-80% of the general population reports experiencing regular nightmares or stress dreams. Previous research suggests that lapses in breathing during sleep may induce nightmares. Therefore, the present study examined if obstructive sleep apnea symptoms were associated with greater nightmare frequency in nurses.

Methods: Participants were 461 nurses (91.1% female; 77.7% white, mean age = 39.03 ± 11.07) recruited from two hospitals as part of a larger parent study, “Sleep and Vaccine Response in Nurses (SA V-RN).” Participants completed self-report measures as part of a larger parent study, “Sleep and Vaccine Response in Nurses (SA V-RN).” Participants completed self-report measures to screen for obstructive sleep apnea (OSA; via the STOP) and for nightmare frequency. Linear regression was used to assess the association between each OSA symptom (snoring, daytime fatigue) and nightmare frequency. Assessing and targeting the comorbid OSA symptoms in nightmare disorder may be important for the effective treatment of nightmares and may help reduce daytime fatigue. Future studies should seek to replicate these associations using polysomnography diagnostic criteria for OSA.

Conclusion: Limited data on the experience of SP exists, particularly in Hispanic samples. We found that SP is related to standardized measures of stress and standardized measures of sleep. Additionally, our data provide an expanded perspective on the subjective experiences and beliefs surrounding SP.

Support (If Any): N/A

0649

V. RLS, Movement Disorders and Parasomnias

0650 NORMATIVE EMG VALUES AND ISOLATED RAPID EYE MOVEMENT SLEEP WITHOUT ATONIA FREQUENCY IN ADULTS WITHOUT REM SLEEP BEHAVIOR DISORDER

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Introduction: Normative REM sleep without atonia (RSWA) values remain unclear. In adults without REM sleep behavior disorder (RBD), older age and male sex are associated with greater RSWA. Isolated elevated RSWA has also been reported as a possible prodromal synucleinopathy parallel to, yet distinct from, REM sleep behavior disorder (RBD). We aimed to describe normative RSWA and characterize isolated elevated RSWA frequency in adult patients without RBD seen in our clinical sleep medicine practice.

Methods: We visually quantified phasic, “any”, and tonic RSWA in the submentalis (SM) and anterior tibialis (AT) muscles, and the automated Ferri REM Atonia Index (RAI) during polysomnography in adults without RBD aged 18-88 years old. RSWA percentiles were calculated across sex and age deciles, and RSWA in older (≥ 65) vs. younger (<65 years old) men and women was compared. Isolated RSWA (exceeding previously determined diagnostic RBD cut-offs, or above 95th percentile) frequency was also determined.

Results: Overall 95th percentile RSWA percentiles were: SM phasic, any, tonic=8.6%, 9.1%, 0.99%; AT phasic and “any”=17.0%; combined SM/AT phasic, “any”=22.3%, 25.5%; and RAI=0.85. Most phasic RSWA burst durations were ≤ 1.0 second (85th percentiles: SM 1.07, AT 0.86 seconds). Older men had significantly higher AT RSWA than older women and younger patients (all p<0.04). Twenty-nine (25%, 18 men) had RSWA exceeding the cohort 95th percentile, while 17 (14%, 12 men) fulfilled diagnostic cut-offs for phasic or automated RBD RSWA thresholds.

Conclusion: RSWA levels are highest in older men, mirroring the demographic characteristics of RBD, possibly suggesting altered REM sleep atonia control in older men. These data establish normative adult RSWA values and thresholds for determination of isolated RSWA elevation, potentially aiding RBD diagnosis and discussions concerning incidental RSWA in clinical sleep medicine practice.

Support (If Any): Mayo Clinic CCAATS, and Mayo Clinic Alzheimer’s Disease Research Center

0651 REM SLEEP WITHOUT ATONIA (RSWA) AND NEUROPSYCHOLOGICAL FUNCTION IN REM SLEEP BEHAVIOR DISORDER

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Introduction: REM sleep without atonia (RSWA) and neuropsychological function are important in REM sleep behavior disorder (RBD). RSWA elevation, potentially aiding RBD diagnosis and discussions concerning incident RSWA in clinical sleep medicine practice.

Support (If Any): N/A
B. Clinical Sleep Science and Practice

Introduction: REM sleep Behavior Disorder (RBD) is a parasomnia characterized by the presence of REM Sleep Without Atonia (RSWA) resulting in abnormal and violent behaviors. Evidence from literature demonstrates that Isolated RBD (IRBD) is a prodromal phase of neurodegenerative diseases with high conversion rates in synucleinopathies. The aim of the study is to investigate the relationship between cognitive impairment and RSWA in IRBD patients.

Methods: 35 IRBD patients and 18 healthy controls (HC) were recruited, underwent a complete polysomnography (PSG) as well as a comprehensive neuropsychological evaluation. Moreover, IRBD patients were divided into two groups based on the presence or absence of Mild Cognitive Impairment (MCI). The PSG were analyzed by a scorer, blind to subjects’ diagnosis, to quantify the RSWA of six different indices of muscle activity extracted by phasic and tonic events recorded in different time series (miniepochs of 2 or 3 seconds, or epochs of 30 seconds) and muscle combinations (flexor digitorum superficialis, mentalis and tibialis muscles).

Results: Comparative analyses showed that the percentages of RSWA were significantly higher in the IRBD group than HC. The best discriminative power was obtained by the combination of phasic and tonic events recorded in micro epochs of 3 seconds from the mentalis muscle and flexor digitorum superficialis (IRBD 0.787 ±0.195, HC 0.306±0.183, p<0.001; area under the curve=0.952). The correlation analyses between RSWA indices and neuropsychological measures in the IRBD group showed a significant negative correlation (r(pearson)=-0.374, p=0.029) between the scores at the Mini-Mental State Examination (MMSE) and the phasic events index recorded by the combination of mentalis and bilateral tibialis muscles in micro epochs of 2 seconds. Finally, comparative analyses between MCI and no-MCI with regard to RSWA indices did not demonstrate significant differences. However, MCI indices were systematically higher in comparison to no-MCI for each index taken into account.

Conclusion: These results suggest an association between RSWA and cognitive functioning that may provide an insight on the relationship between the loss of atonia during REM sleep and neurodegenerative processes.

Support (If Any):

0652 INTERIM ANALYSIS FROM THE REM SLEEP BEHAVIOR DISORDER ASSOCIATIONS WITH PARKINSON’S DISEASE STUDY (RAPiDS)

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Introduction: Rapid eye movement sleep behavior disorder (RBD) is a significant risk factor for alpha-synucleinopathies, including Parkinson’s disease (PD); however, there exists no means of predicting prognosis, and a paucity of data regarding further workup. We present an interim cross-sectional analysis of the longitudinal REM Behavior Disorder Associations with Parkinson’s Disease Study (RAPiDS) database and biorepository, which is a protocol to enroll and track 100 patients with RBD and REM sleep without atonia (RSWA).

Methods: Participants with RBD or RSWA were prospectively recruited from the Weill Cornell Center for Sleep Medicine. Those with a diagnosed neurodegenerative disorder were excluded. Evaluations comprised polysomnography, medical history, and standardized rating scales and examination focused on neurologic, psychiatric, and autonomic function, including a validated test for hyposmia/dysosmia, the University of Pennsylvania Smell Identification Test (UPSIT), that is associated with, but not specific for, pre-motor PD.

Results: We evaluated 30 participants with RBD and 3 with RSWA, with mean 2.36±2.0 years since diagnosis. Mean age was 58.2±16.4 years, and 9/33 were women; 36% reported a history of psychiatric illness; 24% were currently taking, and 27% reported ever taking antidepressant medication. Urinary dysfunction was present in 23%, constipation in 23%, and 12/31 (39%) had abnormal Montreal Cognitive Assessment scores. Additionally, UPSIT scores were significantly associated with presence of constipation and urinary dysfunction in these subjects, as well as with slowed gait, impaired balance, and tremor.

Conclusion: Despite excluding patients with neurodegenerative disorders, we detected an unexpectedly high incidence of additional symptoms and signs, prompting the proposed term “RBD-plus”. Our RAPiDS cohort is a step in determining what clinical factors should be evaluated further in RBD patients; screening for potential early indicators of alpha-synucleinopathy would not only improve care for RBD patients, but could eventually facilitate inclusion in trials focused on disease prevention or in slowing progression. While it is too early to detect what exactly is implicated in the conversion to alpha-synucleinopathy, our cohort will allow for improved understanding and characterization of which patients are at risk.

Support (If Any): Private grant.

V. RLS, Movement Disorders and Parasomnias

0653 SLEEP QUALITY IS RELATED TO OBSERVED NIGHTTIME AGITATION IN OLDER ADULTS WITH ALZHEIMER’S DISEASE AND RESTLESS LEGS SYNDROME

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Introduction: Nighttime agitation, also known as ‘sundowning’, is defined as the presence or worsening of behavioral disturbances (e.g., aggression, wandering) in the afternoon and/or evening. Nighttime agitation occurs in up to 66% of older adults with Alzheimer’s disease, often leads to nursing home admission, yet effective treatments are few. We have shown that restless legs syndrome (RLS) is prevalent in older adults with Alzheimer’s disease and nighttime agitation. Given the sleep loss and reduced iron status seen in RLS we sought to determine the relation of these variables to degree of agitation in these patients.

Methods: Data were collected from 42 older adults (mean age 84.2 ± 7.5 years, 70% female) with Alzheimer’s disease, RLS, and caregiver reported nighttime agitation behaviors. Participants were diagnosed with RLS using the validated Behavioral Indicators Test - Restless Legs. Participants’ degree of agitated behaviors was based on the average of the Cohen-Mansfield Agitation Inventory (CMAI) scores obtained from two nights, Night 1 (5-10 pm) and Night 2 (10 pm-7am), of continuous direct observation by research
assistants. Fasting morning blood samples were obtained to measure hemoglobin, serum ferritin, and transferrin saturation. Sleep time was the average minutes slept from 7 nights of wrist actigraphy (Micro-Mini Motionlogger).

**Results:** Total minutes of sleep (mean 321.6 ± 152.2) and iron saturation (mean 26.2 ± 12.1) were correlated with frequency of nighttime agitation behaviors (mean 78.6 ± 40.6), r = -0.45, p < 0.01 and r = -0.34, p < 0.05, respectively. There was no significant relation between serum ferritin (p > 0.2) and CMAI scores.

**Conclusion:** Data from this study provide evidence that sleep disturbances and iron levels should be investigated in older adults with Alzheimer’s disease experiencing nighttime agitation behaviors. Diagnosis and treatment of iron deficiency and RLS may help reduce nighttime agitation, promote better sleep, and improve quality of life for older adults with Alzheimer’s disease.

**Support (If Any):** NIH-NIA R01 AG051588

0654

**TOPIRAMATE IS EFFICACIOUS IN THE TREATMENT OF SLEEP-RELATED EATING DISORDER: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, PARALLEL GROUP STUDY**

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**Introduction:** Sleep-Related Eating Disorder (SRED) is a parasomnia characterized by arousals from sleep, compulsive consumption of food, poor sleep quality, and morning anorexia. Variable levels of awareness are present during episodes, with episodes usually occurring nightly. Small case series have demonstrated efficacy of topiramate in individuals with SRED. We conducted a placebo-controlled randomized clinical trial of topiramate to assess efficacy in SRED.

**Methods:** Forty subjects with an ICSD-2 diagnosis of SRED with >6 months of symptoms were enrolled. Subjects were eligible if sleep diaries showed ≥3 nights/week of nocturnal eating during the 14-day baseline period. Subjects were randomized to placebo or topiramate. The dose was titrated until SRED symptoms were relieved, adverse effects prevented escalation, or the maximum dosage (300 mg) was reached. After 9 weeks of titration, subjects entered a maintenance period at a stable dose for 4 weeks. Data was collected via diaries, in-person visits and telephone calls at weekly intervals. Primary outcomes were percentage of nights with eating and CGI-I. ITT LOCF analysis was conducted.

**Results:** Mean age was 39.8 years and 71% were female, with mean duration of night eating of 13.7 years. Only 9 topiramate and 11 placebo subjects completed the study per protocol. SRED symptoms were significantly reduced in the treatment group, from 72.7% nights/week at baseline to 29.1% at end-of-treatment (n=15), compared to placebo (77.4% at baseline to 56.3% at end-of-treatment, n=17) (p<0.05). For subjects who completed 5 weeks of treatment, there were significantly more CGI-I responders on topiramate (10/14, 71%) than on placebo (4/15, 27%) (p<0.05). The topiramate group lost more weight than the placebo group (-8.5 lbs vs +1.0 lbs, p=0.001). No significant differences between groups were observed for change in HbA1c (topiramate=-0.042 vs placebo=+0.15, p=0.17). The most common side effects were change in daytime appetite, mental fogginess, and paresthesia.

**Conclusion:** This first RCT for treatment of SRED supports preliminary data on the use of topiramate for SRED. Limitations include small sample size and high drop-out rate in both study groups.

**Support (If Any):** NA

0655

**DESCRIPTIVE REPORT ON NIGHTMARE OCCURRENCE AND ASSOCIATED FINDINGS DURING IN-LAB VIDEO POLYSOMNOGRAPHY**

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**Introduction:** Nightmares are characterized as repeated dysorphic dreams with awakening from sleep causing significant distress and impairment. Nightmares are rarely captured in the sleep lab and previous literature highlights subjective nightmare characteristics. The purpose of this study is to characterize nightmares in patients reporting a nightmare during in-lab video polysomnography (PSG).

**Methods:** This is a retrospective review of 2571 PSGs performed in our laboratory between December 2017 and September 2018. Data collected includes patient demographics, PSG variables (including apnea-hypopnea index (AHI), sleep stages, and arousal indices), a post-PSG questionnaire containing questions about the presence of dreams, medications, and comorbid mental health disorders. PSG analysis of REM sleep without atonia, autonomic hyperactivity preceding an arousal in REM sleep, and video analysis for dream enactment is ongoing.

**Results:** A nightmare was reported during 125 PSGs by 123 different patients. Preliminary analysis produced a cohort of 17 males and 13 females with age range 24-65 (mean = 36.6). Of these 30, 16 had OSA (mean AHI = 9.16). The average REM latency = 151.4 min, average REM sleep = 16.6%, and average REM arousal index = 14.4/hr. Eight patients had a diagnosis of posttraumatic stress disorder and eight patients were prescribed prazosin. Eighteen reported dream at least moderately similar to a memory of a traumatic event and nineteen reported the nightmare to be an accurate replay of a traumatic event or a mix of replay/non-replay events. Seven patients reported at least moderate dream enactment in the lab while 15 did not know if they had dream enactment.

**Conclusion:** This is the first study to characterize nightmares occurring during in-lab video PSG. The rate of nightmare occurrence during PSG was 4.86% in our study, which approximates the prevalence of nightmare disorder in the general population. More than half of patients in our largely military cohort reported replicative trauma related nightmares. Our data suggests nightmares may be more common in the monitored setting than previously thought. Analysis of REM sleep may reveal objective evidence of reported nightmares that is often overlooked.

**Support (If Any):**
B. Clinical Sleep Science and Practice

Introduction: The International Restless Legs Study Group (IRLSSG) has developed the IRLS (International Restless Legs Syndrome Severity Scale) and validated it as a clinician/researcher administered scale to be used when both patient and examiner are present. The IRLSSG recognized the need for a self-completing scale that can be used economically in clinical practice to assess patients and evaluate treatment outcomes as well as in large population-based studies. In this study the validity and the reliability of the IRLS as a self-administered scale (sIRLS) is assessed.

Methods: Established RLS patients were recruited by eight centers in four countries and consented to participate in this study. The validity of the sIRLS was assessed by patients completing the sIRLS before a clinician administered the IRLS. The reliability of the sIRLS was assessed by patients completing the sIRLS again, two weeks after the first one, provided no change had occurred.

Results: 173 patients were recruited and 164 of them were included in the analyses. The sIRLS showed satisfactory scaling assumptions and no relevant floor or ceiling effect. One factor explained 61.3% of the variance. Cronbach’s alpha was 0.93 and the item homogeneity index was 0.59. Intraclass correlation coefficient between the sIRLS and the IRLS was 0.94. The sIRLS standard error of measurement was 3.61 (½ SD at baseline=4.11). The results mostly overlapped those of the IRLS analyzed in parallel.

Conclusion: The sIRLS is a reliable, valid and precise instrument that showed tight association with the IRLS. These findings support the use of the sIRLS for self-evaluation of RLS severity. The sIRLS validity and reliability support its use in evaluating the quality of care of RLS patients. The responses obtained on the sIRLS and the IRLS scales varied slightly. Therefore, we recommend that either the sIRLS or the IRLS scale be used as the only scale for serial measures over time.

Support (If Any): Limited financial support for this study was provided by the International Restless Legs Syndrome Study Group (IRLSSG).

V. RLS, Movement Disorders and Parasomnias

Introduction: Restless legs syndrome (RLS) is a sensorimotor disorder that often has a strong impact on sleep quality. Although the etiology and pathophysiology is still unknown yet, what is evident, there is association with iron in RLS. Serum ferritin levels, a marker of whole body iron status is known to be a strong correlation with RLS, but low sensitivity is problematic to diagnosis. Hepcidin is a regulatory hormone handling iron absorption, recycling, tissue storage. Deficit of hepcidin involves in mishandling iron metabolism and may lead to decreased availability of iron even in brain. In the current case-control study, we aim to investigate clinical utility of hepcidin as a biomarker in RLS compared to the healthy control.

Methods: We recruited 19 drug-naïve patients who met criteria for RLS using IRLSSSG and 16 healthy subjects since April 2017 - November 2017. Using face-to face interview, at the first visit, we obtained sociodemographic characteristics, sleep profiles such as habitual sleep duration, sleep quality, daytime sleepiness, and insomnia. We also obtained information about mood status and quality of life questionnaire. Blood test and electrophysiologic test was performed. Serum hepcidin level obtained at the identical time at the first visit (in both control and patient group) and 3 months later after dopamine agonist treatment (in patient group). and It was analyzed by ELISA kit triple times each.

Results: RLS groups was older than the healthy group (46.8 ±11.9 vs 38.4 ± 12.6 years old) but proportion of gender was not different between two group. Initial hepcidin level was comparable between group (716.7.9pg/dL vs. 702.5 ng/dL; p = 0.88) but hepcidin level was significantly associated with disease severity by the negative direction. (beta=-0.82, p = 0.03)

Conclusion: The pathophysiology of RLS is centered on dopaminergic system dysfunction, altered iron hemostasis and decreased CNS iron.

However iron-regulatory hormone. hepcidin can be useful objective tracer for disease severity and effectiveness of pharmacologic treatment even though not significant diagnostic marker.

Support (If Any):

0658

PHENOTYPIC CHARACTERIZATION OF RLS IN AFRICAN-AMERICANS

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Introduction: Knowledge of RLS diagnosis and treatments and its genetic architecture derive almost solely from populations of European background. Sparse knowledge of RLS phenotypes exists in other demographics. We characterize African Americans (AA) with RLS in a specialty clinic.

Methods: Fifty-nine (nine men) patients identifying as AA (≥25% African heritage) where gold standard RLS affection was determined by face-to-face clinical evaluations were recruited. Average age was 50.2 ± 15.1 and BMI (36.3 ±7.96; women). At time of evaluation, only one subject was being treated for RLS.Subjects completed a 29-item RLS phenotype questionnaire, the IRLSSG severity rating scale, and the Insomnia Severity Index (ISI) (N=26). More than 80% had undergone PSG or HST.

Results: The 4 diagnostic criteria for RLS where symptom ≥ 2-4 days/month was met in 71.2%. Symptoms were daylong (39%), restricted to bedtime (27.1%), or also present before and/or during waking hours. More than 80% patients had mixed motor and sensory symptoms. There were no significant differences in demographics between AA and European American RLS patients. However, AA patients were more frequently affected by symptoms of sleep disorders, such as sleep apnea, restless legs, and severe daytime sleepiness. The etiology and pathophysiology is still unknown yet, what is evident, there is association with iron in RLS.

Conclusion: The pathophysiology of RLS is centered on dopaminergic system dysfunction, altered iron hemostasis and decreased CNS iron.

However iron-regulatory hormone. hepcidin can be useful objective tracer for disease severity and effectiveness of pharmacologic treatment even though not significant diagnostic marker.

Support (If Any):

0657

CLINICAL SIGNIFICANCE OF HEPCIDIN AS A BIOMARKER OF RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a sensorimotor disorder that often has a strong impact on sleep quality. Although the etiology and pathophysiology is still unknown yet, what is evident, there is association with iron in RLS. Serum ferritin levels, a marker of whole body iron status is known to be a strong correlation with RLS, but low sensitivity is problematic to diagnosis. Hepcidin is a regulatory hormone handling iron absorption, recycling, tissue storage. Deficit of hepcidin involves in mishandling iron metabolism and may lead to decreased availability of iron even in brain. In the current case-control study, we aim to investigate clinical utility of hepcidin as a biomarker in RLS compared to the healthy control.

Methods: We recruited 19 drug-naïve patients who met criteria for RLS using IRLSSSG and 16 healthy subjects since April 2017 - November 2017. Using face-to face interview, at the first visit, we obtained sociodemographic characteristics, sleep profiles such as habitual sleep duration, sleep quality, daytime sleepiness, and insomnia. We also obtained information about mood status and quality of life questionnaire. Blood test and electrophysiologic test was performed. Serum hepcidin level obtained at the identical time at the first visit (in both control and patient group) and 3 months later after dopamine agonist treatment (in patient group). and It was analyzed by ELISA kit triple times each.

Results: RLS groups was older than the healthy group (46.8 ±11.9 vs 38.4 ± 12.6 years old) but proportion of gender was not different between two group. Initial hepcidin level was comparable between group (716.7.9pg/dL vs. 702.5 ng/dL; p = 0.88) but hepcidin level was significantly associated with disease severity by the negative direction. (beta=-0.82, p = 0.03)

Conclusion: The pathophysiology of RLS is centered on dopaminergic system dysfunction, altered iron hemostasis and decreased CNS iron.

However iron-regulatory hormone. hepcidin can be useful objective tracer for disease severity and effectiveness of pharmacologic treatment even though not significant diagnostic marker.

Support (If Any):
or after dinner (25.4%). The average IRLSSG severity scale score was 22.3 ± 6.8. Symptom onset was ≥ 30 yr old in 71.2%. 25% reported a 1st degree relative with RLS symptoms. Nearly 1/2 (n=27) described their symptoms as painful. Symptoms interfered with falling (54.2%) and staying asleep (40.7%), and 44% met clinical criteria for insomnia (with ISI of 21.68 ± 6.8). The commonest self-reported comorbidities were HTN (55.9%), iron deficiency (40.0%), anemia (45.8%), and depression (35.6%).

Women often reported current (N=11) or resolved (N=15) PICA. OSA was mild (41%), moderate (23%), or severe (20%). PLM index ≥ 5/hour was present in 66% of PSGs. Two in lab evening questions failed to suggest RLS symptoms in ≤ 12% of instances. Majorties did not consume alcohol (78.6%), exercise (55.4%), use OTC sleep-aids (80%), or appreciate RLS worsening with pregnancy (78%). 61.8% had previously mentioned symptoms to a doctor, with 2/3rs of these having sought treatment specifically for RLS, and 89.1% accepting of a prescription medicine.

Conclusion: Despite similarities to RLS in Caucasians, untreated symptoms in AAs exhibit a somewhat less pronounced diurnal preference, and higher rates of pain, insomnia, and comorbid OSA and iron deficiency, that may account for phenotypic differences as well as underdiagnosis in AAs despite positive attitudes and advocacy for treatment.

Support (If Any): Arthur L. Williams Jr. Foundation and grateful patients.

0659
LACK OF ASSOCIATION OF HEART RATE VARIABILITY ON OVERNIGHT OXIMETRY AND PERIODIC LIMB MOVEMENT AROUSALS
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Introduction: Periodic limb movements (PLM) are repetitive movements that typically occur in lower limbs every 20-40 seconds and can be contributing towards insomnia and/or daytime somnolence. Changes in cardiovascular measures have been advocated as sensitive markers of phasic events arising from sleep. Heart rate variability (HRV) identified on normal oximetry has been associated with the diagnosis of obstructive sleep apnea (OSA), on subsequent Polysomnography (PSG). The current study was aimed to analyze if any association exists between HRV on normal oximetry with PLM arousals on PSG.

Methods: Patients who had normal overnight oximetry (ODI <5) and who underwent subsequent PSG due to suspicion for OSA in a period July 1, 2014 to June 30, 2015, were enrolled. The patients were divided based on subjective assignment of presence or absence of HRV on oximetry, which was independently done by a sleep fellow and a research fellow. Consensus was achieved with help of a sleep specialist. A positive PLM arousal index was >5. The association with PLM arousals was adjusted for age, BMI, sex, ODI and use of heart-rate controlling medications.

Results: 110 adult patients were enrolled. Median age was 54 years (interquartile range [IQR] 44, 67). 66% were females and median BMI was 29 (IQR 25, 32). Median ODI was 1.8 (1, 2.7). 39 (35%) patients were taking heart-rate controlling medications (beta or calcium blockers, or antiarrhythmics). Based on consensus agreement, 77 patients (70%) were determined to have HRV on oximetry. There was no significant association between subjectively observed HRV and PLM arousals on PSG (p=1). After adjusting for pertinent demographic and clinical variables, none had statistically significant association between HRV and PLM arousals.

Conclusion: There was no significant association between PLM arousals on PSG. Future studies should address possible association of HRV and PLM arousals in a cohort of patients with suspicion for PLM disorder.

Support (If Any): none

0660
PERIODIC LIMB MOVEMENT DURING SLEEP AND THE INCIDENCE OF CARDIOMETABOLIC OUTCOMES: THE HYPNOLAUS STUDY
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Introduction: Periodic limb movements during sleep (PLMS) are prevalent in the general population, but their association with cardiometabolic disorders is still controversial. This study aimed to evaluate whether PLMS is a risk factor for the incidence of hypertension, diabetes, metabolic syndrome and cardiovascular (CV) events in a middle to older aged general population.

Methods: 2,162 subjects (51.2% women, mean age: 58.8±11.1 years-old) of the population-based HypnoLaus study (Lausanne, Switzerland) underwent a full polysomnography at home and were followed up over 4.1±1.0 years. PLMS index (PLMSI) was determined at baseline, and PLMSI≥15/h was considered as significant. Evaluations at both baseline and follow-up comprised sociodemographic data, laboratory tests, and clinical assessment.

Cardiometabolic outcomes included the incidence of hypertension, diabetes, metabolic syndrome and adjudicated CV events.

Results: At baseline, participants with PLMSI≥15/h (n=620) presented higher rates of men, elderly, obesity, diabetes, hypertension, metabolic syndrome and history of previous CV events. After excluding participants having each respective cardiometabolic outcome at baseline, PLMSI≥15/h group, when compared to PLMSI<15/h group, presented similar incidence rates of hypertension (20.1% vs 16.0%, p=0.121), diabetes (3.7% vs 2.6%, p=0.189), metabolic syndrome (8.1% vs 7.7%, p=0.793) and CV events (4.6% vs 3.5%, p=0.282), respectively. Multivariate analysis adjusting for confounding factors confirmed the lack of association between PLMSI≥15/h and the incidence of hypertension (OR=0.807 [0.38-1.72]), diabetes (OR=0.876 [0.44-1.73]), metabolic syndrome (OR=0.807 [0.49-1.32]), and CV events (HR=0.797 [0.47-1.34]).

Conclusion: In our large middle-age population-based sample, PLMSI≥15/h was not found to represent a risk factor for the development of cardiometabolic outcomes over 4 years of follow-up.

Support (If Any): Leenaards Foundation, FBM, and SNF.

0661
ASSESSMENT OF A GENETIC RISK SCORE FOR PREDICTION OF RESTLESS LEGS SYNDROME IN A COHORT OF WOMEN
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B. Clinical Sleep Science and Practice

Introduction: Restless legs syndrome (RLS) is a movement disorder that negatively impacts sleep and quality of life. Genome-wide association studies have identified numerous single-nucleotide-polymorphisms (SNPs) robustly associated with RLS. We aimed to characterize the association of an RLS genetic risk score (GRS) with RLS, and searched for environmental modifiers of genetic risk.

Methods: Using questionnaire-defined RLS in the Women’s Genome Health Study (WGHS), we tested the association of a weighted 20-SNP GRS with all cases of RLS (n=3,254 cases/19,173 controls) self-reported at 9 or 10 year follow-up, and with cases that were persistently reported across both questionnaires (n=833 cases/19,173 controls). Putative RLS risk factors including body mass index (BMI), hormone replacement therapy, and smoking were investigated for GRS-environment interactions. Predictive metrics were derived from logistic models of persistent RLS using either the GRS or epidemiologic risk factors.

Results: A 1-standard deviation (SD) increase in the RLS GRS had a strong effect on risk of any RLS (OR=1.38, 95% CI 1.33-1.43, p<2E-16), and risk of persistent RLS (OR=1.55, 1.45-1.66, p<2E-16). Compared to the bottom decile, the top decile of the GRS risk score (GRS) with RLS, and searched for environmental modifiers of genetic risk.

Conclusion: Genetic liability measured through a GRS is robustly associated with RLS, particularly for persistent cases and non-obese individuals, and outperforms epidemiologic risk factors in disease prediction. These results inform the use of genetics for personalized sleep medicine.

Support (If Any): R01DK105072 (RS), R01DK107859 (RS), R21NS09296 (DC), R21NS104398 (DC)

R0663

BUPRENORPHINE/NALOXONE TREATMENT OF REFRACTORY RLS

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Introduction: Schedule II opioids are often the final medication class prescribed for refractory RLS, but use is limited by concerns over tolerance, dependence, respiratory depression, prescription monitoring and dispensing. Buprenorphine (B) is a Schedule III partial mu-opioid receptor agonist, with a 24-48 hr half-life, often formulated with the antagonist naloxone (N) to manage opioid dependence. We report our open label experience with B/N.

Methods: Seven subjects (5 men) were prescribed B/N. Average age was 68 ± 2.5 (SD), BMI 31.3 (± 7.7), and RLS disease duration 30.7 ± 18.9 yrs. Over their 10.7 ± 7.5 yr treatment courses, 9.3 ± 1.1 medications (2.4 ± 0.5 of which were opioids) had been tried, and 3 had received iv iron. Dopamine agonist therapy was limited by augmentation (N=6) and impulse control disorders (N=3). OSA was mild (N=2), moderate (N=2), or severe (N=3). Mobilizable iron stores were normal in six.

Results: Treatment inadequacy contributed to loss of employment (N=2), diminished work productivity (N=3), CPAP non-adherence (N=3 of 4), and MVAs (N=2). Opioid therapy was limited by insomnia (N=2), sleepiness (N=2), anxiety (N=2), pruritis (N=1), lack of efficacy (N=1), or waning in dose duration benefit (N=3) manifesting as “withdrawal myoclonus”/waking periodic leg movements (PLM) (N=2). After discontinuing opioids, 2.0/0.5 mg sublingual B/N was prescribed each twelve hours (N=1), or each evening (N=6) concurrent with other RLS.
medications. One subject discontinued B/N secondary to anxiety/insomnia. RLS symptoms and signs (i.e., PLM) were promptly eliminated in two subjects. Dizziness/sleepiness/gait instability necessitated discontinuation or ongoing downwards dose titration. Four subjects (2 retirees) realized a profound/immediate benefit free of AEs for 2-6 months. IRLSSG rating scale severity decreased from 31.3 ± 6.7 to 4 ± 8 and insomnia severity index from 19.8 ± 6.1 to 1.3 ± 1.9. CPAP usage ≥ 4 hr/night increased from 39 to 68%, and 72 to 82%, and by 65 and 45 min/night, respectively, in two subjects. Employment (N=1) and premorbid work productivity (N=1) were regained.

Conclusion: Sleep, CPAP adherence, and quality of life in chronic RLS patients experiencing augmentation, treatment refractoriness, or side effects with traditional opioids can benefit from B/N. Incorporation into treatment algorithms warrants further investigation given B/N's unique pharmacology and DEA schedule status.

Support (If Any): Arthur L. Williams Jr. Foundation and grateful patients

0664

PATIENT CHARACTERISTICS IN RESTLESS LEGS SYNDROME AUGMENTATION: SEROTONERGIC DRUGS AS A POTENTIAL RISK FACTOR

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Introduction: Dopamine agonist drugs for restless legs syndrome (RLS) can cause augmentation. Wider recognition of this problem is needed. Our study identified baseline characteristics in a group of patients with augmentation and correlation of augmentation with other medications used.

Methods: This is a clinic-based study of 23 subjects with augmentation at a university hospital sleep disorders center. Augmentation was determined by symptoms with daytime progression, presence beyond the legs, shorter onset latency, greater intensity, and/or less relief from treatment. Baseline characteristics were gathered at the time of augmentation diagnosis. Comparison between dopamine agonists was standardized using ropinirole equivalent dosing (RED) (ropinirole 1mg = pramipexole 4 mg = levodopa 33.3 mg) proposed by Canovas.

Results: Twenty-three subjects were identified to have augmentation based on report of daytime progression (96%), greater symptom intensity (87%), less relief from treatment (87%), tolerance (100%), and symptoms beyond the legs (39%). Age ranged from 41-79 years old (mean 58.8) with RLS duration 1-40 years. Sixteen were women. Iron levels showed 62% had a low iron saturation (below 25%) and 25% had low ferritin (below 50ng/ml). In addition to DA, 22% were on iron supplements, 43% on alpha-2-delta ligands, 35% on benzodiazepines and 17% on opioids. Forty-eight percent were taking an SSRI or SNRI. The International Restless Legs Syndrome Rating Scale (IRLSRS) ranged 13 to 37 (mean 20). Using RED, total daily doses ranged from 1mg to 21mg ropinirole equivalents (mean 8.1mg). SSRI/SNRI use was correlated with presence of augmentation at a lower RED compared to non-users (4.6mg vs 11.3mg; p < 0.05). Other medication use was not correlated with an RED difference.

Conclusion: Our study showed augmentation is present in individuals with wide ranging ages and DA doses. Notably, SSRI/SNRI use was unique in its correlation to augmentation at a substantially lower RED. This suggests that SSRI/SNRI use might be a risk factor for augmentation and clinically important information in preventing and managing augmentation as the use of SSRI/SNRI can be easily identified and modified.

Support (If Any): None.

0665

MANAGEMENT OF AUGMENTATION IN RESTLESS LEGS SYNDROME: BASED ON A 23 SUBJECT CLINIC COHORT

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Introduction: Restless legs syndrome (RLS) treatment with a dopamine agonist causes augmentation in a subset of patients. There are no clinically practical guidelines for management of augmentation. Our study identifies an augmentation management option and outcomes.

Methods: This is a clinic-based study of 23 subjects with augmentation at a tertiary clinic. Patients were advised to taper off the dopamine agonist, expect severe discontinuation symptoms and anticipate improvement well after the last dose. Patients were offered a benzodiazepine for the discontinuation period only. Outcomes were measured by report of the augmentation symptoms and the International Restless Legs Syndrome Rating Scale (IRLSRS) at augmentation diagnosis and follow up.

Results: Patients were advised to taper off the dopamine agonist over 0-4 weeks (mean 2.7). The time for actual discontinuation ranged 0-8 weeks (mean 3.6). Discontinuation symptoms were mitigated with benzodiazepines in 78% of patients. An alpha-2-delta-ligand was continued or started in 70%. Patients were advised that discontinuation can be “hell on earth.” Patients reported severe symptoms including severe RLS, sleep disturbance, mood alterations, muscle spasms, cold sweats, malaise, disorientation and visual hallucinations. These symptoms continued for 1-6 weeks (mean 2.7) after the last dopamine agonist dose. Follow up visits were 12.3 weeks after consult, 8.7 weeks after discontinuation of dopamine agonists. At follow up, all patients had resolution of daytime symptoms and overall improvement. IRLSSRS improved from a mean of 29.9 (n=15) to 14.7 (n=14). In a paired pre and post analysis (n=11), there was mean decrease of IRLSSRS by 14.7 (p<0.0001). Afterwards, 78% of patients were maintained on an alpha-2-delta-ligand +/- an iron, 9% on iron alone and 13% opted for no maintenance treatment.

Conclusion: Augmentation can be managed assertively with a 0-4 week taper off the dopamine agonist. There should be an expectation of severe discontinuation symptoms, that may be mitigated by a benzodiazepine and will last for 2-4 weeks after the last dopamine agonist dose. Subsequently, there will be improvement in RLS. An alpha-2-delta-ligand, iron or no medication is sufficient for maintenance.

Support (If Any): None.

0666

RLS/WEED IN THE SETTING OF OPIOID WITHDRAWAL

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Introduction: Available evidence suggests opioids are increasingly used in the treatment of chronic pain. With increases in morbidity and mortality associated with prescription opioid use more widely
recognized, opioid discontinuation is a necessary clinical intervention for some patients. Restless legs syndrome/Willis-Ekbom Disease (RLS/WED) may arise or worsen in the setting of opioid withdrawal and serve as a barrier to successful opioid discontinuation; however, this has not been systematically studied. Our study goal was to prospectively analyze presence and severity of restless legs syndrome/Willis-Ekbom Disease (RLS/WED) among 66 patients undergoing physician supervised opioid tapering in the context of a 3-week interdisciplinary pain rehabilitation program.

Methods: Subjects completed validated questionnaires to assess presence and severity of RLS/WED (Cambridge-Hopkins Questionnaire 13 and International Restless Legs Syndrome Study Group Rating Scale (IRLS)) at treatment admission, discharge and follow-up.

Results: 64% of subjects were females. Baseline RLS/WED was present in 36.4% (24/66) of patients with a mean IRLS score of 15.6 (SD +/- 9.9). At midpoint of pain rehabilitation treatment, RLS/WED was present in 40% (20/50) of patients with a mean IRLS score of 20.8 (SD +/- 9.8). At discharge from the treatment program, RLS/WED was present in 42.6% (20/47) of patients with a mean IRLS score of 18.9 (SD +/- 7.9). At 2 week follow-up from discharge, RLS/WED was present in 46.9% (15/32) of patients with a mean IRLS score of 18.8 (SD +/- 9.1). At 4 week follow-up from discharge, RLS/WED was present in 36.4% (12/33) of patients with a mean IRLS score of 17.3 (SD +/- 8.3). At 3 month follow-up from discharge, RLS/WED was present in 36.4% (8/22) of patients with a mean IRLS score of 18.3 (SD +/- 8.5).

Conclusion: Patients withdrawing from chronic opioid use may be at higher risk for RLS/WED than the general population and their disease may be unrecognized. Routine screening for RLS/WED could be considered in patients tapering opioid medications. Identification and appropriate treatment of RLS/WED may be a novel strategy to ease opioid withdrawal symptomatology and potentially lead to lower relapse rates.

Support (If Any): N/A

0667

SLEEP BRUXISM ASSOCIATED WITH RESTLESS LIMBS SYNDROME (RLS): A DOPAMINE RESPONSIVE PARASOMNIA.

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Introduction: Sleep Bruxism (SB) is a common parasomnia and movement disorder, of unknown etiology, affecting approximately 10% of the population. SB is known to cause insomnia, TMJ and dental and periodontal morbidity. Treatment with Occlusal devices does not stop SB or reduce all dental complications. No pharmacological treatments are currently available. Others have suggested an association of RLS and SB in population studies. Both SB and Periodic Limb Movements of Sleep (PLMS), seen in 80% of patients with RLS, occur in light, non-REM sleep. To our knowledge, there has been no study of RLS patients to determine if SB is associated and, if so, if it responds to therapies for RLS.

Methods: Patients meeting the IRLSSG criteria for RLS completed a 35 question survey investigating demographics, symptoms, comorbidities, family history and response to therapy. Charts were reviewed and interviews conducted to complete and clarify the data. The SB patients presented here are a subgroup of an ongoing study of RLS and associated conditions.

Results: 676 patients completed the survey at the time of this analysis. 241 (35.7%) had SB. 105 of 241 (43.6%) noted improvement of SB with dopamine agonists (DA). Excluding incomplete respondents (ie: patients who did not receive treatment or could not recall the response) 105 of 139 (75.5%) with RLS and SB had improvement of SB with DA therapy.

Conclusion: These data support a strong association between RLS and SB, both movement disorders and parasomnias, and suggest that SB, in this population, may respond to treatment with DA. Although retrospective, non-controlled and unblinded, this study should encourage a blinded and placebo controlled trial of DA for SB associated with RLS. Finally, the data suggests that SB may be a manifestation of RLS and, as such, is a dopamine-responsive parasomnia with possible pharmacotherapy in the future.

Support (If Any): No support

0668

THE NATIONAL RLS OPIOID REGISTRY: BASELINE DATA ON THE FIRST 300 PARTICIPANTS

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Introduction: Restless Legs Syndrome (RLS) is a sensory-motor neurological disorder which is associated with sleep disturbance and emotional distress. Low-dose opioid medications are used for patients who are refractory to, or do not tolerate, first-line RLS treatments. This observational longitudinal study will collect outcomes on RLS treatment efficacy and opioid dosages in a national sample of patients. We now report cross-sectional data on the first 300 patients enrolled in this study.

Methods: Patients currently taking an opioid for diagnosed RLS who had a previous therapeutic response to dopaminergic agonists were recruited. A baseline phone interview and online (REDCap) survey collected information on initial and current opioid dosages, side effects, past/current RLS treatments, RLS severity, psychiatric history, and opioid abuse risk factors (Opioid Risk Tool). All data is stored in a secure online database.

Results: Participants (n=300) are primarily white (98%), elderly (mean age=64.9, educated, and retired. Half of all subjects are on opioid monotherapy for RLS, and 21% of subjects are additionally taking gabapentin or pregabalin. Nearly 50% of subjects are taking methadone (mean dose=10.3 mg), and one-third are taking oxycodone formulations (mean dose=25.7 mg). Median IRLS score=13.0; one-fifth of subjects have been RLS symptom-free (IRLS=0) in the past week, and 15% in the past month. More than half of subjects have a history of psychiatric illness, predominantly depression and anxiety disorders. Prior to opioid initiation, 38% of subjects had passive, and 20% active, suicidal ideation, with significant reductions in both (p<0.0001) after opioid initiation. Over three-quarters of this sample is low risk for opioid abuse. Over a median of 3.5 years, 53% of subjects have not increased their opioid dose, and median dose increase in others is 15.5 mg morphine equivalents.

Conclusion: Low doses of opioids are associated with moderate control of RLS symptoms in patients refractory to other treatments, and who commonly have a history of psychiatric comorbidity. Longitudinal data will examine ongoing RLS treatment efficacy, tolerability, and opioid dosages.

Support (If Any): RLS Foundation
0669 PREVALENCE AND CORRELATES OF NIGHTMARES IN ACTIVE DUTY SERVICE MEMBERS

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Introduction: Among active duty service members (SMs), little research has examined the prevalence and correlates of nightmares. The current study aims to expand this research and determine the prevalence and correlates of nightmares in 4,119 United States Army personnel scheduled for deployment.

Methods: Active-duty SMs were recruited at unit-level briefings during pre-deployment processing between November 2010 and June 2011 and completed the following measures: Beck Depression Inventory, Beck Anxiety Inventory, PTSD Checklist-Civilian (which contained the question about nightmare severity), Patient Health Questionnaire, Insomnia Severity Index, Childhood Trauma Questionnaire, Interpersonal Support Evaluation List-Short Form, State Trait Anger Expression Inventory State Anger Scale.

Results: Results indicated that 1642 SMs (39.9%) reported experiencing nightmares. Those with nightmares reported greater mean levels of anxiety symptoms (3.62 vs. 11.26), depression symptoms (4.74 vs. 11.60), PTSD symptoms (20.21 vs. 40.39), insomnia symptoms (5.57 vs. 10.35), anger (13.00 vs. 17.20), physical health symptoms (3.05 vs. 5.91), and number of previous deployments (0.96 vs. 1.39). Those with nightmares also had increased odds of having clinically significant anxiety (OR = 7.15, p < .001), depression (OR = 5.57, p < .001), PTSD (OR = 12.83, p < .001), and insomnia (OR = 5.44, p < .001), as well as elevated odds of having experienced emotional abuse (OR = 2.25, p < .001), physical abuse (OR = 1.99, p < .001), sexual abuse (OR = 1.82, p < .001), emotional neglect (OR = 1.81, p < .001) and physical neglect during childhood (OR = 1.82, p < .001).

Conclusion: Results indicate that nightmares are associated with increased risk for a number of adverse mental and physical health outcomes. These findings highlight the debilitating nature of nightmares in active duty service members and underscore the need for effective treatment options.

Support (If Any): Funding for this work was made possible by the U.S. Department of Defense through the U.S. Army Medical Research and Materiel Command, Congressionally Directed Medical Research Programs, Psychological Health and Traumatic Brain Injury Research Program awards W81XWH-08-02-109 (Alan Peterson), W81XWH-08-02-0110 (Douglas Williamson), and W81XWH-08-02-0114 (Brett Litiz).

0670 SLEEP-RELATED EVENT PHYSIOLOGIC TIMING FOR TRIGGERING NONSUSTAINED VENTRICULAR TACHYCARDIA: A CASE-CROSSOVER ANALYSIS

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Introduction: Periodic limb movements during sleep (PLMS) with arousal and respiratory events are associated with arrhythmogenesis, however, intervals of heightened vulnerability are unclear. We conducted an exploratory investigation to ascertain temporal sleep-related event-nonsustained ventricular tachycardia (NSVT) associations.

Methods: Temporal sleep-related event and NSVT associations in 41 Osteoporotic Fractures in Men Sleep Study participants with in-home polysomnography-identified NSVT during sleep were examined via a bidirectional case-crossover design. For each blindly-annotated NSVT event (n=96), we selected a preceding hazard period (HP) and three randomly-chosen 30-second control periods from sleep at ~5-minute intervals from NSVT within the same 30-minute segment and evaluated for PLMS, respiratory events, and arousals. Univariate conditional logistic regression determined odds ratios (OR) and 95% confidence intervals. Induction time, defined as time between a sleep-related event ending and NSVT initiation, was assessed in 2 ways: (1) varying HP duration 10-150 seconds and (2) timing the 30-second HP start earlier relative to the NSVT event. OR significantly different from 1 defined the induction period.

Results: PLMS with arousals (PLMA), arousals, and PLMS-related arousals were associated with NSVT in male participants (79.8±6.0 years, PLMS index of 40.6 [IQR: 21.6, 67.1], apnea-hypopnea index of 17.1 [IQR: 8.6, 26.1]). The HP duration associated with NSVT based on significant OR was 15-70 seconds for PLMA, 140 seconds for arousal, and bimodal for PLMS-related arousals (0-58 and 119-121 seconds). Based on the timing analysis, NSVT was associated with PLMA at 0-51 and 169-219 seconds and PLMS-related arousals at 0-48 and 160-219 seconds. PLMS, non-PLMS-related arousals, respiratory-related arousals, and respiratory events were not significantly associated with NSVT.

Conclusion: This exploratory study suggests that PLMA and PLMS-related arousals trigger NSVT, PLMS-related arousals have a bimodal physiologic effect, and NSVT episodes are more strongly associated with PLMA than respiratory events in older men.

Support (If Any): Osteoporotic Fractures in Men (MrOS) Study: U01-AG027810, U01-AG042124, U01-AG042139, U01-AG027810, U01-AG042124, U01-AG042139.
**0671** PECULIAR AGE-RELATED CHANGES OF THE PERIODICITY OF LEG MOVEMENTS DURING SLEEP IN RESTLESS LEGS SYNDROME ACROSS THE LIFESPAN

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**Introduction:** We aimed to study the age-related changes of periodic leg movements during sleep (PLMS) using the newest international scoring rules, to expand past analyses, including patients in the pediatric age range, and also to analyze the changes of short-interval (SILMS) and isolated (ILMS) leg movements during sleep across the lifespan.

**Methods:** 165 patients (84 f ) with restless legs syndrome (RLS) were recruited: 16 preschoolers (0-5 years old), 29 school age (6-12), 19 adolescents (13-17), 17 young adults (19-40), 47 adults (41-60) and 37 seniors (>60). Total leg movements during sleep (TLMS), PLMS, SILMS, ILMS, and Periodicity (PLMS/TLMS ratio) indexes were obtained by PSG.

**Results:** TLMS index showed (quartic polynomial interpolation) a peculiar age course with a clear decrease before 10 years of age, followed by a steady increase up to the age of 30 years, a relatively stable period until 60 years, and a final increase up to 80 years (pre-school 24.5±10.13, school age 21.9±13.17, adolescents 22.6±12.24, young adults 45.9±23.64, adults 28.1±18.75, seniors 47.2±42.9). ILMS did not change significantly and SILMS showed only an increase in seniors.

**Conclusion:** Our study indicates that, in RLS, TLMS index shows a peculiar and unique course across the lifespan, mainly due to PLMS. The age-related changes in TLMS/PLMS appear to mirror the changes in dendritic spine density in the cortical layer V of the human prefrontal cortex. This layer contains corticostriatal projection neurons and has the highest expression of all dopamine receptor subtypes in primates. It can thus be speculated that the degree of periodicity of leg movements during sleep in RLS might be correlated with the developmental changes in network complexity of these and other dopaminergic structures. These data further confirm the need to better assess the periodicity of leg movements in sleep during the human development period, in order to obtain clinically useful information.

**Support (If Any):** None.

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**V. RLS, Movement Disorders and Parasomnias**

**0672** TREATMENT OF RESTLESS LEGS SYNDROME LOWERS INCREASED RLS-RELATED CARDIOVASCULAR RISK

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**Introduction:** Previous studies regarding restless legs syndrome (RLS) and future risk of cardiovascular disease (CVD) generated inconsistent results. Whether RLS treatment is associated with altered subsequent CVD risk has not been studied.

**Methods:** This prospective cohort study was based on the 2006-2014 Truven MarketScan data. The study sample included 24,199 non-pregnant participants with RLS diagnosis (16,694 receiving RLS related treatment and 7,505 without treatment) during 2006-2008 and 145,194 age and sex matched participants without RLS. All participants were free of CVD before January 1st, 2009 (analysis baseline). Incident CVD cases (myocardial infarction, angina, stroke, atrial fibrillation, and heart failure) were identified. A Cox proportional hazards model was used adjusting for age, sex, residence, alcohol consumption, obesity, presence of chronic obstructive pulmonary disease (a surrogate for smoking status), depression, obstructive sleep apnea, insomnia, diabetes, hypertension, peripheral neuropathy, arthritis, iron deficiency anemia, Parkinson disease, and chronic kidney disease, and use of antplatelets, anticoagulants, statins, antihypertensive and hypoglycemic treatments.

**Results:** We identified 16,574 incident CVD cases during 2009 to 2014. Presence of RLS at the baseline was associated with higher risk of developing CVD. Relative to the non-RLS group, the adjusted HR was 1.26 (95% CI 1.20, 1.32) for the RLS with treatment, and 1.53 (95% CI 1.42, 1.65) for the RLS without treatment, after adjusting for aforementioned covariates. Significant lower CVD risk was observed for all different RLS treatments (dopaminergics, anticonvulsants, benzodiazepines or opiates; adjusted HR ranged 0.71 to 0.84; P<0.001 for all), except for ergot-dopamine use (adjusted HR=1.01; 95% CI 0.48, 2.15). Results were similar and statistically significant when we excluded patients with sleep disorders, depression and other major chronic conditions.

**Conclusion:** Physician-diagnosed RLS was associated with higher future CVD risk. Treating RLS alleviated this potential harmful impact. The wide variety of agents showing improvement of cardiovascular disease in RLS suggests that this effect is specific to the improvement of RLS.

**Support (If Any):** The IBM Truven Health Analytics (Market Scan) database was obtained through agreement with Penn State and additional funding was from internal Penn State research grants.

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**0673** MULTIMODAL MRI REVEALS ALTERATIONS OF SENSORMOTOR CIRCUITS IN RESTLESS LEGS SYNDROME

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**Introduction:** Integrated information on brain microstructural integrity and iron storage and its impact on the morphometric profile is not available in restless legs syndrome (RLS). We applied multimodal MRI including diffusion tensor imaging, the transverse relaxation rate (R2*), a marker for iron storage, as well as grey and white matter volume measures to characterize RLS related MRI signal distribution patterns and to analyze their associations with clinical parameters.

**Methods:** Eighty-seven patients with RLS (mean age 51, range 20-72, years; disease duration, mean 13 years, range 1-46 years, of those untreated n=30) and 87 healthy control subjects, individually matched for age and gender, were investigated with multimodal 3T-MRI.

**Results:** Volume of the white matter compartment adjacent to the post and precentral cortex and fractional anisotropy of the frontopontine tract were both significantly reduced in RLS compared to healthy controls, and these alterations were associated with disease duration (r=0.25, p=0.025 and r=0.23, p=0.037, respectively). Corresponding, grey matter volume increases of the right primary motor cortex in RLS (p<0.001), were negatively correlated with the right fractional anisotropy signal of the frontopontine tract (r=-0.22; p<0.05). Iron content evaluated with R2* was reduced in the putamen as well as in temporal and occipital compartments of the RLS cohort compared to the control group (p<0.01).

**Conclusion:** Multimodal MRI identified progressing white matter decline of key somatosensory circuits that may underlie the perception of sensory leg discomfort. Increases of grey matter volume of the premotor cortex is likely to be a consequence of functional neuronal reorganization.

**Support (If Any):** The study was funded by a Grant from Translational Research Fund of the government of Tyrol, Austria, to Birgit Högl and in-kind resources of the Medical University of Innsbruck.
ASSOCIATION BETWEEN SLEEP AND MENSTRUAL PROBLEMS IN CHINESE FEMALE UNIVERSITY STUDENTS

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Introduction: Sleep disturbance can impact an individual’s daytime function and emotional well-being. Little is known about the association between sleep and menstruation in young females. We aimed to investigate the association between sleep disturbance and menstrual problems in Chinese female university students.

Methods: A total of 1006 female university students aged 15-38 years (mean age = 21.7 ± 2.8 years) participated in this study. Sleep duration, sleep quality and insomnia symptoms were assessed by the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). Mood disorders were rated using the Self-Rated Anxiety Scale (SAS) and the Self-Rated Depression Scale (SDS). A structured questionnaire was used to assess participants’ demographics and menstrual related problems such as menstrual cycle interval, period irregularity, menstrual flow length, menstrual blood volume, and premenstrual syndrome.

Results: The prevalences of menstrual irregular, more menstrual blood volume, menstrual flow length ≥7 days, period pain, and premenstrual syndrome were significantly higher in participants with sleep disturbance than in those without sleep disturbance (P < 0.05). After adjusting for age, body mass index, smoking status, and mood disorders, poor sleep quality (odds ratio [OR] = 1.81, 95% confidence interval [CI] = 1.23-2.68) and insomnia symptoms (OR = 1.66, 95% CI = 1.12-2.45) were significantly associated with menstrual flow length ≥7 days. Insomnia symptoms (OR = 1.94, 95% CI = 1.29-2.92) were significantly associated with menstrual irregular. Poor sleep quality (OR = 1.75, 95% CI = 1.12-2.72) were significantly associated with more menstrual blood volume. Additionally, poor sleep quality (OR = 1.55, 95% CI = 1.02-2.35; OR = 1.71, 95% CI = 1.30-2.24) and insomnia symptoms (OR = 1.81, 95% CI = 1.22-2.70; OR = 1.88, 95% CI = 1.42-2.49) were significantly associated with period pain and premenstrual syndrome, respectively. However, sleep duration was not significantly associated with menstrual problems.

Conclusion: Our results suggest that sleep disturbance was associated with menstrual problems among Chinese female university students. More attention should be paid to improving the sleep quality and insomnia symptoms in individuals with menstrual problems.

Support (If Any): No

THE ASSOCIATION BETWEEN SLEEP BELIEFS AND SLEEP BEHAVIOUR IN UNIVERSITY STUDENTS

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Introduction: The primary objective of the study was to examine the associations between sleep beliefs and sleep outcomes in Emirati undergraduate university students. Secondary study objectives were to investigate potential relationships between sleep behaviour and physiological health outcomes including obesity and type 2 diabetes mellitus.

Methods: Female university students (n=108) were recruited to a cross-sectional study from poster advertisements placed around the university. The Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16) was used to assess sleep beliefs. Sleep behaviour (duration and efficiency) was objectively estimated using wrist-worn actigraphy over seven consecutive days/nights. Height (m) and body weight (kg) was objectively measured to calculate body mass index (BMI; kg/m²). Internationally accepted cut points for BMI were used to determine underweight, healthy weight and overweight/obesity. Fasting blood glucose levels (mmol/L) were acquired to determine type 2 diabetes mellitus status (healthy, pre-diabetes, type 2 diabetes).

Results: The majority (89.6%) of the sample held dysfunctional beliefs about sleep. The average sleep duration was 7.65 hours. Regression analysis revealed that those with dysfunctional sleep beliefs had longer average sleep duration of 43 minutes, after adjustment (β = 43.1, p<0.05). No significant associations were observed between sleep beliefs and sleep efficiency. Those who were overweight/obese had the shortest average sleep duration compared to underweight and healthy weight, although this was not statistically significant (F(2,99)=1.97, p=0.14). Those with pre-diabetes had significantly shorter average sleep duration compared to those without diabetes, t(96)=2.20, p=0.03.

Conclusion: Those with dysfunctional sleep beliefs had significantly longer sleep duration compared to those holding healthy beliefs. Sleep duration was significantly shorter in those with pre-diabetes compared to healthy participants. A time-lag effect may be possible between dysfunctional sleep beliefs and sleep behaviour, therefore larger prospective studies obtaining regular follow-up data can be used to determine cause-effect relationships and sleep variability over time.

Support (If Any): N/A

SLEEP DISTURBANCE AMONG PREGNANT WOMEN: THE INFLUENCE OF ENVIRONMENTAL AND CONTEXTUAL FACTORS

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Introduction: Disrupted sleep during pregnancy affects nearly 85% of women. This can contribute to psychological distress and antenatal depression. The aims of the current project were to test whether (a) poorer subjective sleep quality contributed to greater depression and anxiety symptoms, and (b) contextual factors predicted clinically significant sleep disturbance after adjusting for socioeconomic status (SES).

Methods: In a mixed-methods study, 418 pregnant women (age: M=32.4 years; gestation: M=28.4 weeks, SD=8.4 weeks; 58% Black) completed the Pittsburgh Sleep Quality Index (PSQI), measures of pregnancy-related physiological factors, and provided details about their sleep environment. They also rated perinatal depression, anxiety, and SES (Hollingshead and MacArthur Ladder). Sixty-two women completed these measures again later in pregnancy (gestation M = 34.2 weeks). A subset of seven women underwent actigraphy (9-nights) during their third trimester. Logistic regressions adjusted for age, BMI, race, sleep disordered breathing, and gestational week.
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**Results:** Subjective sleep quality was significantly poorer among Black women and those with higher BMI. Physiological factors (i.e., restless leg syndrome, nocturnal urination, and acid reflux) explained subjective sleep disturbance after accounting for gestational week ($p<0.01$). Among women with history of psychopathology ($n=221$), sleep disturbance was significantly related to anxiety and depression symptoms ($p<0.01$), with greater sleep disturbance (PSQI score $>5$) predicting clinically significant antenatal depression ($B = 38$, $p<0.05$). However, those who rated their social standing as higher reported lower sleep disturbance throughout pregnancy, even after adjusting for mood and anxiety ($B = 0.86$, $SE = 0.41$; $p<0.05$). There was a dose-response positive association between sleep disturbance and depression severity among Black women only ($B = 0.89$; $p<0.05$). Among lower SES Black women, environmental factors (greater ambient noise and light pollution) partially mediated this effect ($B = 0.45$, $SE = 0.17$; $p<0.01$).

**Conclusion:** Sociocontextual factors may explain sleep disturbance severity among low-income pregnant Black women. Above and beyond traditional metrics of SES. Higher subjective SES may be protective against sleep disturbance and psychiatric distress. Assessments of sleep during pregnancy should account for psychological considerations and environmental disruptions, alongside mood and anxiety.

**Support (If Any):** NIMH (1R36MH118000-01)

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**0677 THE RELATIONSHIP BETWEEN DEPRESSION AND DAYTIME DYSFUNCTION FROM LACK OF SLEEP IN PREGNANT WOMEN**

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**Introduction:** Sleep quality and quantity are vital in pregnancy; sleep deficiency poses higher risks of preterm labor, inflammatory cytokines during pregnancy and labor, and postpartum depression. One additional day-to-day risk of sleep loss is daytime dysfunction, or lack of enthusiasm and trouble focusing during daily tasks. A common finding in pregnancy that may impact sleeping patterns and lead to daytime dysfunction is antenatal depression. Antenatal depressive symptoms may manifest as general depressed mood and/or anhedonia. The aim of this study is to examine the contribution of depressive symptoms in pregnant women to daytime dysfunction resulting from poor sleep.

**Methods:** In an online survey, 303 pregnant women (gestation weeks $\mu=28.4$, $SD=8.8$) completed measures of sleep quantity and quality and mental health. Component 7 of the Pittsburgh Sleep Quality Index (ordinal scale, 0-6) assessed daytime dysfunction by measuring difficulty staying awake (0-3) and lack of enthusiasm (0-3) during daily tasks. The Patient Health Questionnaire-2 (PHQ2) measured anhedonia and depressed mood (ordinal scales, 0-3), comprising overall depressive symptoms (ordinal scale, 0-6). Statistical analyses were performed using SPSS.

**Results:** Of 303 pregnant women, 23.6% reported anhedonia and 21.2% reported depressed mood. There was a positive correlation between the two symptoms (Spearman coefficient $=0.396$, $p<0.01$). Three ordinal regressions were performed examining the relationship between PHQ2 measures and daytime dysfunction, controlling for gestational week, diagnosed sleep disorder, snoring, and sleep apnea. Women who reported increased anhedonic symptoms ($\chi^2=50.495$, $p<0.01$), depressed mood ($\chi^2=45.834$, $p<0.01$), and overall depressive symptoms ($\chi^2=66.239$, $p<0.01$) experienced significantly more daytime dysfunction.

**Conclusion:** Depressive symptoms in pregnancy can manifest in various ways, including general depressed mood or anhedonia. Overall, anhedonia, depressed mood, and combined depressive symptoms are all indicators of daytime dysfunction in pregnant women. This study underscores an important negative consequence of depression: diminished daytime functionality and enthusiasm associated with deficient sleep. This information could help further address causes of lack of focus and energy women may face during pregnancy.

**Support (If Any):** -

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**0678 RACIAL/ETHNIC DISPARITIES IN SLEEP DURATION AND SLEEP DISTURBANCES AMONG PREGNANT AND NON-PREGNANT WOMEN IN THE UNITED STATES**

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**Introduction:** Poor sleep among pregnant women is a growing public health concern that has been linked to adverse maternal and child health outcomes. Most studies examining sleep health during pregnancy have focused on non-Hispanic Whites and/or Hispanics/Latinas, while few have included Blacks, who are most susceptible to poor sleep and adverse pregnancy outcomes.

**Methods:** Using a nationally representative sample of 71,644 (2,349 pregnant) women from the 2004-2017 National Health Interview Survey, we investigated cross-sectional associations between self-reported pregnancy status and various sleep dimensions. Sleep duration per day was defined as short: $<7$ hours; sufficient: 7-9 hours; and long: $>9$ hours. Adjusting for age, other sociodemographic characteristics, health behaviors, and health conditions, we used average marginal predictions from fitted logistic regression models to estimate prevalence ratios (PR) and 95% confidence intervals (CI) for each sleep dimension among pregnant compared to non-pregnant women, stratified by race/ethnicity. We then stratified by pregnancy status, comparing sleep among Blacks and Hispanic/Latinas to Whites.

**Results:** Among 71,644 eligible pregnant (3%) and non-pregnant (97%) women, 69% were White, 19% Black, and 12% Hispanic/Latina. Mean age $\pm$ SD was 28.0 $\pm$ 0.14 (pregnant) and 34.2 $\pm$ 0.07 (non-pregnant) years, and many (66% pregnant, 41% non-pregnant women) were married. When making overall and within-race/
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ethnicity comparisons, pregnant women were less likely than non-pregnant women to report short sleep (PR\text{Overall}=0.74, 95\%CI:0.67-0.81, PR\text{White}=0.72, 95\%CI:0.64-0.81, PR\text{Black}=0.74, 95\%CI:0.61-0.89, PR\text{Hispanic/Latina}=0.76, 95\%CI:0.60-0.96). Only pregnant Whites (PR\text{White}=0.45, 95\%CI:0.31-0.65) were less likely to report sleep medication use, while there was no difference between pregnant and non-pregnant Blacks (PR\text{Black}=0.98, 95\%CI:0.46-2.09) and Hispanics/Latinas (PR\text{Hispanic/Latina}=0.83, 95\%CI:0.38-1.78). Pregnant women had a 2-fold higher prevalence of long sleep (PR\text{Overall}=2.06, 95\%CI:1.74-2.43) and were 34\% more likely to report trouble staying asleep (PR\text{Overall}=1.34, 95\%CI:1.25-1.43). Compared to pregnant Whites, pregnant Blacks had a 31\% higher prevalence of reporting short sleep (PR\text{Black}=1.31, 95\%CI:1.05-1.63) and pregnant Hispanics/Latinas were less likely to report trouble staying asleep (PR\text{Hispanic/Latina}=0.79, 95\%CI:0.64-0.98).

Conclusion: Sleep patterns differed between pregnant and non-pregnant women and by race/ethnicity. Expectant mothers may need additional screening for sleep difficulties during pregnancy, especially racial/ethnic minority women.

Support (If Any): Research supported by grants from NIH: R00-NR013187 and T32HL007713.

VI. Adults: Sleep and Aging, Sleep and Gender

0680

STRESS TO PARENTING COMPETENCE AMONG BLACK MOTHERS OF PRETERM INFANTS: THE ROLE OF SLEEP
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Introduction: Have a preterm infant in the intensive care unit (ICU) is stressful. Mothers are vulnerable for stress-related symptoms and low parenting competence; however, less is known about the associates of these variables. This study aimed to examine the associations of maternal stress with sleep disturbance, depressive symptoms, and parenting competence, and focused on the role of sleep in linking stress to parenting competence among Black mothers with a preterm infant in the ICU.

Methods: Thirty Black mothers participated this study, 14 of them were C-section. A battery of questionnaires measuring their perceived stress, sleep disturbances, depressive symptoms, maternal self-efficacy in nurturing role, and mother-infant bonding were collected at the end of 2\textsuperscript{nd} week postpartum. Wrist actigraph was used to collect total sleep time (TST) and circadian acidity rhythms (CAR). Stress- and sleep-related biomarkers, such as cortisol, alpha-amylase (sAA), TNF-alpha and progestrone were also collected by using saliva.

Results: The maternal stress level and sAA were significantly higher than the norm. Compared to the vaginal delivery mothers, the C-section mothers had significantly higher sAA and less maternal self-efficacy. Nocturnal TST was about 400 minutes, which was one hour less than what they needed to feel refreshed. Those who experienced poor sleep were likely to demonstrate heighten stress, more depressive symptoms, higher progesterone, and less maternal-infant bonding. Moreover, synchronized CAR are associated with better nocturnal TST, less daytime sleep, and higher maternal self-efficacy.

Conclusion: The Black mothers are distressed and experienced sleep disturbances. Poor sleep lead to more depressive symptoms and less parenting competence, which indicating by poor maternal infant bonding and less maternal self-efficacy. As a gateway in regulating the effect of stress on parenting competence, maternal sleep may be a target for intervention. More research is needed to explore the underlying biological and psychological mechanisms that regulate stress and sleep and their contributions to parenting.

Support (If Any): This project was supported by the Center for Contextual Genetics and Prevention Science at University of Georgia from the National Institute on Drug Abuse (P30 DA027827).

0681

Racial/Ethnic Disparities in the Relationship Between Traumatic Childhood Experiences and Suboptimal Sleep Dimensions Among Adult Women: Findings from the Sister Study
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Conclusion: The findings suggest that in pregnancy regardless of abnormal respiratory events and doctor-diagnosed GDM, increased inflammation is more likely associated with more light sleep, whereas more deep sleep is associated with decreased inflammation. The findings underline the complex relationships between peripheral markers of inflammation and sleep in pregnant population.

Support (If Any): Research supported by grants from NIH: R00-NR013187 and T32HL007713.

0679

LIGHT SLEEP IS ASSOCIATED WITH INFLAMMATION IN PREGNANCY
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Introduction: Sleep disturbances are common during pregnancy and linked to inflammation. Emerging evidence suggests that increased inflammation may contribute to adverse pregnancy outcomes, including preterm delivery, gestational diabetes, and preeclampsia. This study aimed to evaluate the associations between sleep parameters and pro-inflammatory biomarkers.

Methods: Pregnant women including healthy women and women with gestational diabetes mellitus (GDM) (n=73, age: 32.3±3.9 yrs) underwent an overnight polysomnogram (PSG) between 24 and 36 wks. Inflammatory cytokines C-reactive protein (CRP), interleukin-6 (IL-6) and soluble IL-6 receptor (sIL-6r) were measured before and after PSG. They also completed questionnaires including MAPI apnea symptom score and Pittsburgh Sleep Quality Index (PSQI). Bivariate linear regression analyses were performed to determine the sleep characteristics that were significantly associated with pro-inflammatory biomarkers. Each biomarker used as the dependent variable in a separate model, sleep parameters and pro-inflammatory biomarkers were also evaluated in full regression models as independent variables.

Results: Women who had a higher percentage of stage 3 sleep had lower CRP [b(SE) = -0.64 (0.23), p = 0.006] at sleep offset, whereas women who had a higher percentage of stage 2 sleep had higher CRP levels at sleep offset [b(SE) = 0.33 (0.13), p = 0.014]. Furthermore, increased percentage of stage 1 sleep was associated with increased IL6 levels at sleep offset [b(SE) = 1.01 (0.29), p = 0.001]. These associations remained significant after adjusting for race/ethnicity, BMI, age, GDM status, nocturnal sleep time and apnea-hypopnea index (AHI). Habitual snoring, AHI, Oxygen Desaturation Index for &lt;3% (ODI3), ODI4 and wakefulness after sleep onset were not associated with any of inflammatory biomarkers.

Support (If Any): Research supported by grants from NIH: R00-NR013187 and T32HL007713.
Introduction: While prior studies have found an association between some adverse childhood experiences and poor sleep in adulthood, few studies have incorporated a broader set of traumatic childhood experiences (TCEs) or investigated potential racial/ethnic differences in the TCE-sleep relationship.

Methods: Using a large national cohort of U.S. women enrolled in the Sister Study from 2003-2009, we investigated the TCE-sleep relationship among White, Black, and Hispanic/Latina women. Self-reported TCEs occurring before 18 years of age included sexual, physical, and psychological/emotional trauma, household dysfunction, and natural disasters/major accidents. Sleep characteristics included average sleep duration per day (short: <7 hours vs. recommended: 7-9 hours), sleep onset latency >30 vs. ≤30 minutes, night awakenings ≥3 times per night ≥3 times per week (no/yes), and napping: ≥3 vs. <3 times per week. Using log-binomial regression to estimate prevalence ratios (PRs) for adverse sleep characteristics, we investigated race/ethnicity-specific associations and if race/ethnicity modified relationships between TCEs and sleep.

Results: Among 40,082 women, 55% reported at least one TCE (White: 54%, Black: 62%, Hispanic/Latina: 57%), 28% reported short sleep; 17% longer onset latency; 14% night awakenings; and 10% frequent napping. Compared to within-race/ethnicity counterparts without TCEs, Whites with a history of any TCE type had a higher prevalence of every sleep characteristic ranging from 8-63%; however, associations were less consistent among Blacks and Hispanics/Latinas. Compared to Whites with no TCEs, women reporting any TCE had a higher prevalence of short sleep: PR Whites = 1.09, 95% Confidence Interval (CI): 1.05-1.13, PR Blacks = 2.14, 95% CI: 2.03-2.25, and PR Hispanics/Latinas = 1.48, 95% CI: 1.36-1.61); longer onset latency: PR Whites = 1.23, 95% CI: 1.17-1.30, PR Blacks = 1.79, 95% CI: 1.64-1.95, and PR Hispanics/Latinas = 1.84, 95% CI: 1.65-2.05); and frequent napping: PR Whites = 1.17, 95% CI: 1.10-1.25, PR Blacks = 1.45, 95% CI: 1.27-1.65, and PR Hispanics/Latinas = 1.61, 95% CI: 1.37-1.90). Across traumas, household dysfunction had the greatest impact on sleep characteristics among Blacks and psychological/emotional trauma appeared particularly strong among Hispanics/Latinas when compared to Whites without TCEs.

Conclusion: TCEs were positively associated with an increased prevalence of multiple sleep dimensions in adulthood. Racial/ethnic minority women with TCEs appear more negatively affected in ways that likely contribute to sleep-related disparities.

Support (If Any):
Results: Hayes’ PROCESS mediation analyses assessed stress eating as a mediator between TST and BMI and role stress as a mediator between TST and BMI. Controlling for covariates, shorter TST was directly associated with higher BMI (95% CI [-0.0191, -0.0064]). Additionally, higher stress eating served as a significant mediator of shorter TST and higher BMI (95% CI [-0.0052, -0.0001]). Higher role stress served as a significant mediator of shorter TST and higher stress eating (95% CI [-0.0024, -0.0003]).

Conclusion: The current study highlighted the connection among sleep, eating behavior, and weight in midlife women. Investigating this pathway is valuable, as this population is at risk for poor sleep and weight outcomes. Additionally, role stress was confirmed as an explanatory link between sleep and eating behavior. As stress, sleep, and stress eating are pathways to development of poor health conditions, current findings can inform clinical recommendations regarding prevention and management of weight-related outcomes in this population.

Support (If Any): NIA (P01-AG020166)

0684 IMPACT OF HOT FLASH-ASSOCIATED SLEEP DISRUPTION ON THE CARDIOVASCULAR SYSTEM IN PERIMENOPAUSAL WOMEN
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Introduction: Hot flashes (HFs) are a common symptom of menopause, occurring across the day and night in up to 80% of women, and persisting for a median duration of 7.4 years. Women with HFs are more likely to have disrupted sleep and insomnia disorder, and night-time HFs account for a significant proportion of total wakefulness. Amongst sleep onset in perimenopausal women. Recent data suggest that HFs are a marker of cardiovascular (CV) disease risk, however, there is little information as to whether HF events themselves impact CV measures, particularly for nocturnal HFs. Here, we investigated CV changes around nocturnal HF events, considering whether or not they were associated with sleep disruption.

Methods: More than 500 objective HFs detected from laboratory-based skin conductance measures and aligned with 30-s epochs of polysomnographic sleep stages were analyzed from 86 healthy women, mostly in the menopausal transition (age: 50.7±3.6 years). Beat-to-beat heart rate (HR), blood pressure (BP), and pre-ejection period (PEP) derived from impedance cardioography and reflecting cardiac sympathetic activity, were sampled and analyzed across HF events.

Results: HFs associated with sleep disturbance (awakenings/arousal) were more common (51.1%) than HFs not associated with sleep disturbance (28.6%). There was a surge in systolic and diastolic BP and a 20% increase in HR in association with HFs accompanied by awakenings/arousals. The CV activation was sustained over a couple of minutes following HF onset. In contrast, systolic BP dropped and HR slightly increased in association with HFs occurring in undisturbed sleep, probably reflecting increased skin vasodilation to dissipate heat. PEP decreased across HF onset, likely reflecting increased cardiac sympathetic activity, regardless of whether the HF was accompanied by an awakening/arousal or not.

Conclusion: Findings suggest that nocturnal HFs affect the CV system differently depending on whether or not they are accompanied by an awakening/arousal. There are significant surges in BP and HR during HF-associated sleep disruption, which could have a detrimental effect on nocturnal CV recovery in women with frequent and persistent nocturnal HFs.

Support (If Any): Grant HL103688 (FCB)

0685 SLEEP PROBLEMS AND SOLUTIONS IN PERIMENOPAUSAL AND MENOPAUSAL WOMEN
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Introduction: The aim of this study was to explore sleep problems and sleep medication usage in perimenopausal and menopausal women.

Methods: 2,793 women (1,145 of perimenopausal and menopausal age, 45-60 years; 1,648, ages <44 and >60 years), recruited through social media, completed a comprehensive online sleep assessment modified for mobile experience, including the Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), anxiety GAD-7, and questions about attempted sleep solutions.

Results: Women in the perimenopausal and menopausal age range had significantly higher ISI (16.3 vs 15.3, p<0.001) and ESS scores than other women (9.1 vs 8.5, p<.001). Anxiety significantly decreased continuously with age, but was not associated with menopausal age group. Women reported that hot flashes disrupted their sleep more frequently in the perimenopause and menopause age group (27% vs 13%). Women of perimenopause and menopause age who experienced hot flashes also reported higher rates of OTC sleeping medication (not including melatonin) current usage 27% compared to women who did not experience hot flashes (20%) and 19% in women in other age groups. Melatonin (43% vs 34% vs 33%) and prescription sleeping medication usage (26% vs 17% vs 16%) had a similar pattern.

Conclusion: Perimenopausal or menopausal women are a unique segment with significantly higher rates of both insomnia and daytime sleepiness. Hot flashes are a common disrupter of sleep, and result in higher use of over the counter and prescription sleeping medication use. Targeted recommendations specific to this unique population are required.

Support (If Any): Johnson & Johnson Consumer Inc., Skillman, NJ, USA, Somn Labs, Philadelphia, PA, USA

0686 ASSOCIATIONS OF MILD TO MODERATE OBSTRUCTIVE SLEEP APNEA ON COGNITIVE FUNCTION IN OLDER ADULTS
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Introduction: Moderate to severe obstructive sleep apnea (OSA) contributes to worse cognitive function and may be associated with Alzheimer’s disease. Prior studies have focused on a limited subset of cognitive domains, primarily executive function and memory. The purpose of this study was to examine the relationship between
OSA severity and a more comprehensive set of 6 cognitive domains and premorbid IQ in older adults with mild to moderate OSA. Cognitive domains were selected to assess risk for cognitive impairment and Alzheimer’s disease.

**Methods:** The sample included 47 older adults (60-85 years), 70.2% college degree or higher, 64% women, and 87% caucasian. Apnea-Hypopnea Index(AHI) measured OSA severity; participants with AHI >20 were excluded. The neuropsychological battery was selected to be highly sensitive to impairments that might indicate early stages of Alzheimer’s disease and included language, visual spatial ability, attention, processing speed, episodic memory, executive function and premorbid IQ. Linear regression with covariates age, sex, race and education were used to investigate relations among AHI and cognitive tests.

**Results:** Mean baseline AHI was 5.5 ± 4.4, range 1-19.2 (mild/ moderate OSA severity). Higher AHI was associated with worse Wechsler Adult Intelligence Scale backward digit span, a measure of attention (p<.058); worse executive function in the Trail Making Test, condition 4, letter sequencing (p = .096); and worse language in the Halstead-Reitan appendix (p = .076). No significant correlations with language, visual/spatial ability, attention, processing speed, episodic memory, executive function and premorbid IQ (p > .05).

**Conclusion:** These preliminary data suggest weak associations between AHI and cognitive function in participants with mild to moderate OSA and no history of cognitive impairment. The small sample size, low apnea severity, and relatively young age of the sample may have mitigated against stronger findings. Future studies should include comprehensive measures of cognitive function within all domains in larger samples with a wider range of OSA severity.

**Support (If Any):** Sleep, Circadian Rhythms, and Cardiometabolic Risk in Retired Shift Workers NIH R01 AG047139 (PI: Buysse/Hall); Translational Research Training in Sleep Medicine NIH ST32HL082610-12 (PI: Buysse);

**0687 SLEEP DISORDER SYMPTOM ENDORSEMENT BY AGE**

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**Introduction:** It is widely held that the likelihood of having a sleep disorder increases with age and that this is especially true of Insomnia, OSA, and RLS. Few studies, however, have been conducted that concurrently assess how symptoms vary with age while simultaneously taking into account multiple sleep disorders. The present analysis evaluates the prevalence of ten sleep disorders symptoms across four age cohorts.

**Methods:** An archival analysis was conducted on an existing database of 4,206 individuals who completed an on-line screening survey at www.sleeplessinphilly.com. Subjects were grouped into four age categories (matched for race, BMI, and gender): Young Adults (YA[18-29]), Adults (A[30-44]), Middle Aged Adults (MA[45-65]) and Older Adults (OA[65-89]). The sleep disorders symptoms assessed were for insomnia (problems with SL, WASO or EMA), snoring, witnessed apneas, gasping, AM headaches, EDS, sleep attacks, muscular weakness with strong emotion, nightmares, and unpleasant sensations in the legs near bedtime. Contingency and Chi-Square analyses were used to assess for age group differences.

**Results:** Each age group was comprised of 180 subjects (total n=720, ~55% female). There were significant age related differences (and linear trends) for: Insomnia ([All:85.8%]; [YA:73.3%]<[A:87.8%];[MA:88.3%]<[OA:93.9%], p < 0.001); Snoring ([All:44.2%]; [YA:26.7%]<[A:41.1%]<[MA:55%]<[OA:53.9%], p < 0.001); and Witnessed apneas ([All: 28.1%]; [YA:17.8%]<[A:27.2%]<[MA:33.3%];[OA:33.9%], p = 0.002). There were age group differences (but not linear trends) for: Nightmares ([All: 50.7%]; [YA:57.2%]<[MA:57.2%]<[A:48.3%]<[OA:40%], p = 0.002); Headaches ([All:31.4%]; [YA:43.3%]<[A:32.2%]<[MA:29.4%]<[OA:20.6%], p < 0.001); and Muscular weakness ([All: 25.7%]; [YA:30.6%]<[A:28.9%]<[MA:25.6%]<[OA:17.8%], p = 0.028). There were no significant age differences for EDS (All:53.6%, gasping (All:20.6%), RLS symptoms (All:22.1%), or sleep attacks (All:17.2%).

**Conclusion:** While sleep disorders symptoms vary with age, linear trends appear to be evident only for insomnia and the OSA symptoms of snoring and witnessed apneas. Note: One limitation of the present analysis is that the sample was populated by subjects with sleep complaints. This resulted in higher overall prevalence than is typical in population data.

**Support (If Any):** Perls NIH:R01AG041783;K24AG055602; R01AT00332

**0688 IS SLEEP CONTINUITY DISTURBANCE AND PROBLEM ENDORSEMENT UNIFORMLY WORSE WITH AGE?**

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1Department of Psychology, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA; 2Behavioral Sleep Medicine Program, Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, USA; 3Center for Healthful Behavior Change, Department of Population Health, NYU School of Medicine, New York City, NY, USA; 4Sleep and Health Research Program, Department of Psychiatry, University of Arizona, Tucson, AZ, USA; 5Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA; 6Northumbria Center for Sleep Research, Northumbria University, Newcastle, United Kingdom; 7Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, USA.

**Introduction:** Older adults are thought to be particularly prone to insomnia. What is less clear is the extent to which this general observation 1) applies to specific measures and 2) corresponds to sleep dissatisfaction. The aim of the present analysis was to...
evaluate how sleep continuity disturbance (SCD) and problem endorsement vary by age.

**Methods:** An archival analysis was conducted with an existing database of 4,206 individuals who completed an online screening survey (www.sleeplessinphilly.com). Subjects were grouped into four age categories (matched for race, BMI, and gender): Young Adults (YA[18-29]), Adults (A[30-44]), Middle Aged Adults (MA[45-65]) and Older Adults (OA[65-89]). One-way ANOVAs were utilized to evaluate differences between groups for sleep latency (SL), number of awakenings (NWAK), wake after sleep onset (WASO), early morning awakenings (EMA), and total sleep time (TST). Problem endorsements (i.e., “do you consider this a problem?”) were assessed with Contingency and/or Chi-Square analyses for each SCD variable.

**Results:** Each group was comprised of 180 subjects (total n=720, ~55% female). Sleep initiation problems did not become more severe with age. In contrast, sleep maintenance problems worsened with age (> WASO, > EMA, < TST). Problem endorsements appeared to parallel severity trends. Mean severity data are as follows.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (Mean ± SD)</th>
<th>YA (Mean ± SD)</th>
<th>A (Mean ± SD)</th>
<th>MA (Mean ± SD)</th>
<th>OA (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL</td>
<td>42.2 ± 10.1</td>
<td>44.3 ± 10.2</td>
<td>41.2 ± 9.9</td>
<td>43.1 ± 10.1</td>
<td>40.9 ± 9.9</td>
</tr>
<tr>
<td>NWAK</td>
<td>2.0 ± 0.5</td>
<td>2.2 ± 0.5</td>
<td>2.1 ± 0.5</td>
<td>2.1 ± 0.5</td>
<td>2.1 ± 0.5</td>
</tr>
<tr>
<td>WASO</td>
<td>37.0 ± 5.0</td>
<td>38.0 ± 5.0</td>
<td>36.0 ± 4.5</td>
<td>37.0 ± 5.0</td>
<td>34.0 ± 4.5</td>
</tr>
<tr>
<td>EMA</td>
<td>60.9 ± 5.0</td>
<td>62.0 ± 5.0</td>
<td>59.0 ± 4.5</td>
<td>60.0 ± 5.0</td>
<td>57.0 ± 4.5</td>
</tr>
<tr>
<td>TST</td>
<td>341.1 ± 60.5</td>
<td>334.7 ± 60.5</td>
<td>334.7 ± 60.5</td>
<td>326.3 ± 60.3</td>
<td>342.1 ± 60.5</td>
</tr>
</tbody>
</table>

Percent problem endorsement data are as follows.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (%)</th>
<th>YA (%)</th>
<th>A (%)</th>
<th>MA (%)</th>
<th>OA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL</td>
<td>342.1</td>
<td>365.7</td>
<td>334.7</td>
<td>326.3</td>
<td>342.1</td>
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<tr>
<td>NWAK</td>
<td>61.8</td>
<td>53.1</td>
<td>57.5</td>
<td>63.8</td>
<td>71.2</td>
</tr>
<tr>
<td>WASO</td>
<td>42.2</td>
<td>43.2</td>
<td>45.6</td>
<td>39.9</td>
<td>40.0</td>
</tr>
<tr>
<td>EMA</td>
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<td>53.1</td>
<td>57.5</td>
<td>63.8</td>
<td>71.2</td>
</tr>
<tr>
<td>TST</td>
<td>341.1</td>
<td>334.7</td>
<td>334.7</td>
<td>326.3</td>
<td>342.1</td>
</tr>
</tbody>
</table>

More sophisticated analyses are on-going to determine the degree to which SCD symptom severity predicts the likelihood of report satisfaction, and what other factors may influence the report of satisfaction, and whether these vary with age. Support (If Any): Perlis NIH:R01AG041783;K24AG055602;R01AT003332

0690

**ENLARGED BASAL GANGLIA PERIVASCULAR SPACES AND SLEEP PARAMETERS. A POPULATION-BASED STUDY.**

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**Introduction:** Perivascular spaces (PVS) are involved in mechanisms of brain interstitial fluid and metabolic waste clearance. Since most of this clearance occurs during sleep, it is plausible that sleep-related disorders favor PVS dilatation. Knowledge on the association between enlarged basal ganglia (BG) PVS and sleep disorders is limited. Here, we aimed to assess the association between sleep parameters and enlarged BG-PVS in older adults.

**Methods:** Community dwellers aged ≥60 years were interviewed with the Pittsburgh sleep quality index and underwent MRI for identification of enlarged BG-PVS and other neuroimaging signatures of cerebral small vessel disease. Then, a representative random sample of the study population underwent a single-night polysomnography (PSG). Using logistic regression models, we evaluated whether sleep quality, sleep efficiency and the apnea-hypopnea index (AHI) associate with enlarged BG-PVS, after adjusting for demographics, cardiovascular risk factors, neuroimaging signatures of cerebral small vessel disease and other relevant confounders.

**Results:** The association between sleep quality and enlarged BG-PVS, assessed in 338 individuals, was significant in the univariate model, but the significance was taken away by the effect of cerebral small vessel disease and other relevant confounders.

**Support:** MIDUS-II was funded by the National Institute on Aging (P01-AG020166).

**B. Clinical Sleep Science and Practice**

**VI. Adults: Sleep and Aging, Sleep and Gender**

**0689**

**HIGHER INTERNAL HEALTH LOCUS OF CONTROL PREDICTS LESS DIFFICULTY FALLING ASLEEP AND LESS DAYTIME SLEEPINESS**

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**Introduction:** Individuals with an internal health locus of control (HLOC), or a belief of primary control over their own health, are more likely to engage in preventative health behaviors and experience better overall health. It is less clear, however, whether an internal HLOC impacts sleep quality. Although an internal HLOC may be associated with a greater sense of self-efficacy over sleep-leading to better outcomes- internal HLOC may also place greater responsibility on the individual, causing anxiety that inhibits their sleep. As dispositional optimism has been positively associated with an internal HLOC, as well as with positive sleep outcomes, the current study examined 1) the association between internal HLOC, difficulty falling asleep, and daytime sleepiness and 2) the role of optimism as a mediator in this association.

**Methods:** An archival analysis was conducted using data from the Midlife in the United States-II study (MIDUS-II), Project 1. The sample consisted of 3,976 adults (Mage = 55.43, SD = 12.45; 53.3% female). Participants responded to items regarding sleep difficulties (trouble falling asleep, daytime sleepiness), self-oriented HLOC, and optimism via the Life Orientation Test-Revised.

**Results:** Internal HLOC was associated with less difficulty falling asleep (95% CI [-.09, -.01]) and less daytime sleepiness (95% CI [-.15, -.07]). Dispositional optimism significantly mediated the associations between internal HLOC and difficulty falling asleep (95% CI [.06, -.04]) and internal HLOC and daytime sleepiness (95% CI [.09, -.06]).

**Conclusion:** The current study supports the idea that an internal HLOC is associated with more positive sleep outcomes. Dispositional optimism served as an explanatory mechanism for this association. Individuals who had a higher internal locus of control reported greater optimism, which, in turn, was associated with less difficulty falling asleep and less daytime sleepiness. Current findings can inform clinical interventions that target the specific beliefs and attitudes associated with sleep health. Future research should address the specific sleep health behaviors associated with an internal HLOC.

**Support (If Any):** MIDUS-II was funded by the National Institute on Aging (P01-AG020166).
Introduction: Older adults are a growing segment of the population who experience disturbed sleep. Researchers have found that there is a discrepancy between actigraphy and self-report in older adults with co-morbid medical conditions and that this discrepancy is affected by individual characteristics. However, this relationship and discrepancy is unclear in healthy older adults. The purpose of this study was to determine the difference between actigraphy and diary estimates of sleep onset latency (SOL) and total sleep time (TST), and to determine how sleep quality, depressive symptoms, and memory are associated with the difference between actigraphy and sleep diary self-reports from actigraphy sleep estimates.

Methods: Data were gathered from 78 participants ($M_{age}=74.06$ years-old, $SD=6.65$). A majority were female (69%) and White/Caucasian (96%). Participants completed sleep diaries (i.e., subjective sleep), questionnaires (Geriatric Depression Scale, Pittsburgh Sleep Quality Index, immediate and delayed recall tasks), and wore actigraphs (i.e., objective sleep) for 4-7 nights ($M_{nights}=6.88$, $SD=0.46$). Differences between total sleep time (TST) and sleep onset latency (SOL) were calculated by subtracting sleep diary self-reports from actigraphy sleep estimates.

Results: Multiple Wilcoxin Signed-Rank tests were conducted to examine the discrepancy between self-reported and actigraphy measured SOL and TST. Self-reported SOL was significantly greater than actigraphy measured SOL ($z=6.95$, $p<.001$). Self-reported TST was greater than actigraphy measured TST ($z=2.51$, $p=.014$). Multilevel regression models revealed that participants who reported worse sleep quality had a greater discrepancy between their sleep diary and actigraphy estimated SOL ($\gamma=1.69$, $SE=0.42$, $p<.01$).

Conclusion: Results demonstrated that healthy older adults perceived taking longer to fall asleep and sleeping more than what was indicated from actigraphy data. Worse sleep quality predicted a greater incongruence between self-reported and actigraphy estimated sleep onset latency. Future studies should continue to investigate how psychological and physiological functioning and processes impacts the discrepancy between self-reported and actigraphy estimated sleep in healthy older adults and explore the longitudinal pattern of this discrepancy.

Support (If Any): Study supported by Universidad Espíritu Santo - Ecuador, Guayaquil - Ecuador.
Introduction: Disparities have been observed in studies examining sleep duration and quality among blacks and whites. Using the National Health and Aging Trends Study (NHATS), we examined association of sleep health (duration and quality) with cognitive impairment among black and white individuals.

Methods: We performed a cohort analysis of sub-group of participants in the NHATS study who provided responses to sleep questionnaires and data on cognitive impairment (n=969). Of the sample, 78.9% were white (n=895) and 21.1% were black (n=240). Of note, 60.3% were female (n=684) and 39.7% were male (n=451). Respondents were classified as having no dementia (n=888, 78.2%) and either possible or probable dementia (n=293, 21.8%). Adjusted logistic regression examined association of sleep health (duration and quality) with cognitive impairment (no dementia vs. possible or probable dementia), contrasting blacks and whites using validated inventories. We controlled for effects of age, sex, and chronic conditions.

Results: Those who reported sleeping <5 hours represented 12.9% of the sample (n=146). Those who reported sleeping 5-7 hours represented 47.6% (n=530) of the sample; those sleeping 7-8 hours, 25.8% (n=293); and those sleeping >8 hours, 14.6% (n=166). Compared to whites, blacks were at greater risk for reporting very short sleep (defined as <5 hours) [OR=1.76, 95%CI: 1.10-2.81], but not short sleep duration (5-7 hours) [OR=1.14, 95%CI: 0.79-1.64] or long sleep duration [OR=1.36, 95%CI: 0.86-1.2]. Compared to whites, blacks were not at greater risk for reporting poor sleep quality. Compared to whites, blacks were at greater risk for reporting poor sleep quality. Compared to whites, blacks were at greater risk for reporting poor sleep quality. Compared to whites, blacks were at greater risk for cognitive impairment [OR=2.58, 95%CI: 1.79-3.70]. Black short sleepers (5-7 hours) were significantly more likely to have cognitive impairment compared to whites [OR=2.35, 95%CI: 2.13-4.89]. However, no significant differences were noted regarding very short or long sleep.

Conclusion: Results showed cognitive impairment was more prevalent among blacks compared to whites. Results also showed that short sleep may moderate these associations. It was not apparent that sleep quality would play such a moderating role.

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0695

SLEEP AND NEUROCognitive CHANGE IN THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (IHCSh/SOL)

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Introduction: To prospectively determine whether sleep-disordered breathing (SDB), sleep duration, insomnia and daytime sleepiness predict neurocognitive (NC) decline based on a representative sample of U.S. Hispanic/Latino adults.

Methods: We evaluated data from SOL-INCA (2016-2018) an ancillary to HCHS/SOL (Visit 1; 2008-2011). SOL-INCA (n=6,377) enrolled Hispanic/Latinos (45-74y) 5-7 years after baseline evaluation. The primary exposures were baseline measures of SDB (AHI≥15), insomnia assessed with the Women’s Health Initiative Insomnia Rating Scale score ≥10, self-reported sleep duration categorized into short ≤6 hours (h), average >6-9 h, long >9 h and sleepiness with the Epworth sleepiness scale ≥10. NC outcomes measured change in episodic learning and memory (SEVLT-sum and SEVLT-Recall), language (WF; word fluency), processing speed (DSS; Digit Symbol Substitution), and a global cognitive impairment screener (SIS; Six-item Screener). We also considered cross-sectional associations with NC performance obtained in SOL-INCA. We used survey-based regression analyses to model sleep as a risk factor for NC performance and change. All NC measures were age-education adjusted z-scored. Models were further adjusted for sex, insurance, depression symptoms, vascular risk scores, study site and follow-up time.

Results: The mean age was 62±8 years, 54% were females; 7% were Central American, 25% were Cuban, 9.3% were Dominican, 35.6% were Mexican, and 14.1% were of Puerto Rican background. SDB was seen in 17% of the target population, while 6.4% had short sleep, 14.6% long sleep, 33.4% insomnia and 20% had sleepiness. Longer sleep, compared to >6-9h, was associated with worse NC outcomes at follow-up, and insomnia with worse memory. Compared to >6-9h, longer sleep was also associated with 6-year decline in global cognition (β_{SIS}= -0.140 [SE=0.06]; p<0.05), episodic learning and memory (β_{SEVLT-sum}= -0.218 [se=0.06]; p<0.001; β_{SEVLT-Recall} = -0.123 [se=0.06]; p<0.05) and verbal fluency (β_{WF}= -0.182 [se=0.06]; p<0.05), but not processing speed. We found no associations between SDB, short sleep, sleepiness and cognitive performance at follow-up or change.

Conclusion: In a large, diverse community-based cohort of middle-aged and older U.S. Hispanic/Latinos, long sleep was related to worse cognitive performance and predicted neurocognitive decline over 6-years of follow-up.

Support (If Any): AG056952, AG048642

0696 RESILIENCE, RACE/ETHNICITY AND SLEEP DISTURBANCE AMONG HYPERTENSIVE FEMALES

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Introduction: Stress level has been associated with both sleep disturbance and high blood pressure. The protective effect of psychological resilience against stress has been extensively studied. However, there remains a paucity of data on which sub-populations benefit most from the buffering effects of resilience against sleep disturbance, specifically among at-risk older females. This study examined the relationships between resilience and sleep disturbance in a sample of older women with a history of hypertension.

Methods: Sample includes 700 females from a community-based study in Brooklyn, NY with a mean age of 60.7 years (SD=6.52), Of the participants, 28.1% were born in the U.S.; 71% were black, 17.4% where white and 11.6% were Hispanics. Data were gathered on demographics and sleep disturbance (five items that reflect the most frequent insomnia symptoms), using the Comprehensive Assessment and Referral Evaluation and the Stress Index Scale. A linear composite score was created with the Index of Self-Regulation of Emotion and 14 religious health beliefs items to measure resilience. Higher scores indicated greater resilience. Student t-tests and multilinear regression analysis were conducted to explore associations between resilience and sleep disturbance. Interaction effects between resilience and potential moderators (race/ethnicity and place of birth) were conducted to examine which populations benefitted most from the buffering effects of resilience.

Results: As hypothesized, resilience was an independent predictor of sleep disturbance (β = -1.18 [SE=0.04]; p< 0.001). Resilience accounted for a significant amount of variance in sleep disturbance (R2 change=0.27; p<.001) even after adjustment for race/ethnicity, age, place of birth, household income, and BMI. The association between resilience and sleep disturbance was stronger among black women compared with Hispanic (β(SE)=0.028 (0.01); p=0.01) and white women (β(SE)=0.020 (0.009); p<0.05). Place of birth did not significantly moderate the association between resilience and sleep disturbance (β(SE)=0.01 (0.01); p=0.077).

Conclusion: Results of our study suggest that resilience might be a more important protective factor for sleep disturbance among older black women relative to older white or Hispanic women. Additional research is required to examine how race/ethnicity and resilience may influence treatment of sleep disturbance.

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0697 GENDER BIAS WITH CENTERS FOR MEDICARE AND MEDICAID SERVICES SCORING CRITERIA WHEN DIAGNOSING OBSTRUCTIVE SLEEP APNEA.

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Introduction: Women with obstructive sleep apnea (OSA) have less hypoxemia during sleep and a lower apnea-hypopnea index (AHI) when compared to men. Therefore, symptomatic women may be less likely than men to meet the Centers for Medicare and Medicaid Services (CMS) criteria for the diagnosis of OSA. We hypothesized that utilizing CMS criteria for diagnosing OSA, as compared to AASM scoring criteria, underestimates the prevalence of OSA in women and precludes symptomatic women from receiving therapy.

Methods: We reviewed retrospective data on 741 subjects (219 men and 522 women) who underwent a diagnostic polysomnography at an urban academic sleep center from January to November 2018. Included subjects were >18 years of age and had both a CMS and AASM AHI documented. A univariate logistic regression was performed to evaluate the association between the outcome (CMS score <5 and AASM score ≥5) with three predictors including age,
gender and body mass index (BMI). A multivariate logistic regression was then performed to evaluate the association between the outcome and the three predictors in the same model.

Results: The mean age and BMI were 50 years and 36 kg/m² respectively. Median CMS AHI and Epworth Sleepiness Score were 6.1 and 8 respectively. The odds of CMS scoring criteria missing OSA (CMS AHI <5 and AASM AHI ≥5) in women were twice the odds of a CMS miss in men [OR 2.05, CI 1.45 - 2.88]. The association persisted after including age and BMI, [OR 2.39, CI 1.67-3.43]. When the AASM AHI was included in the logistic regression model, the association with age and BMI became insignificant, but a trend was seen with regard to gender association [OR 1.51, CI 0.97-2.33, p=0.065].

Conclusion: Using CMS scoring criteria, women with an AASM AHI ≥5 were twice more likely than men of comparable age and BMI to not be diagnosed with OSA. This indicates that CMS scoring has a strong gender bias against women and likely prevents a significant number from receiving appropriate treatment.

Support (If Any): None

0698  
SLEEP QUALITY DURING IN-LABORATORY POLYSOMNOGRAPHY

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Introduction: Sleep quality during clinical in-laboratory polysomnography (PSG) is assumed to be poor due to the obtrusive nature of intense monitoring. However, there is little research regarding sleep quality or the determinants of sleep quality during PSG. This study aimed to examine in-laboratory sleep quality and to evaluate potentially associated factors.

Methods: We included patients who underwent clinically indicated in-laboratory diagnostic PSG at a single academic sleep center over a 10-year period. Total sleep time (TST) and sleep efficiency (SE) were used as proxies for sleep quality. Text-mining software was used to retrieve sleep data metrics from PSG reports in an automated fashion. We then employed principal component analysis (PCA) - a machine learning dimensionality reduction technique - to evaluate predictors with a novel outcome measure that accounted for variability across 24 of our initial response variables.

Results: A total of 3549 patients were analyzed (58.80% female, mean age 51.6). Mean TST and SE were 5.68hrs (SD 1.50) and 76.65% (SD 14.51%) respectively. Of all characteristics examined, age and sex had the strongest associations with sleep duration/efficiency. Both TST and SE decreased with age (mean TST max 6.39hrs in <30yos [SD 1.27], min 5.11hrs in >70yos [SD 1.31]). Further, females demonstrated better quality sleep than males across all age groups. For PCA, the first component accounted for 26% of variability across responses (first two components: 45%). More influential first component loadings included efficiency, supine time, awakenings, and non-REM apnea-hypopnea index. The strength of associations between previously mentioned predictors and the first component were consistent with above findings.

Conclusion: This analysis of PSG data challenges the assumption that in-laboratory sleep quality is poor, demonstrating relatively high average sleep times/efficiencies. Results indicate better sleep quality in females and the young when compared to other groups, specifically for in-laboratory sleep. However, analysis of in-laboratory sleep studies is limited by their one-time nature; results may not represent average sleep quality. Future studies should consider including different patient populations or home sleep study environments, and exploring the health implications of sleep quality.

Support (If Any): UVa Engineering in Medicine grant
B. Clinical Sleep Science and Practice

**Introduction:** Evidence suggests that insomnia and obstructive sleep apnea (OSA) frequently coexist. It is unclear whether the impact is different between younger and older adults. This study compared sleep outcomes between younger and older adults with comorbid OSA and insomnia.

**Methods:** Using a cross-sectional design, baseline data from the *Diabetes Sleep Treatment Trial*, an ongoing randomized placebo-controlled trial evaluating the effect of OSA treatment on glucose control and diabetes self-management, was used to examine a subsample of participants with OSA (determined by ApneaLink Plus®), apnea-hypopnea index [AHI] ≥5) and insomnia (Insomnia Severity Index [ISI] ≥10). Sleep outcomes were measured using the Pittsburgh Sleep Quality Index (PSQI; global and factor scores [Sleep Efficiency, Perceived Sleep Quality, and Daily Disturbance]; higher scores = worse sleep quality), and the Functional Outcomes of Sleep Questionnaire (FOSQ; total score and 5 subscales [Activity Level, Vigilance, Intimacy and Sexual Relationships, General Productivity, and Social Outcomes]; higher scores = better functional status). Chi-square and Mann-Whitney U tests were used to compare sleep outcomes between younger (<65 years [73.2%, n=71]) and older adults (≥65 years [26.8%, n=26]).

**Results:** The sample (*N*=97) was 35.1% non-White, 45.4% female, and on average, 57.6±10.6 years of age with a mean of BMI 36.6±2.7kg/m² and mean A1C 7.9±1.5%. No significant differences were found between older and younger adults regarding sex, marital status, race, education level, financial status (all *p*-values >.05). There were no significant differences for any of the following in insomnia, OSA severity, or PSQI global scores between groups. PSQI Daily Disturbance factor score were higher, on average, in younger adults (*p*=.03). Younger adults had significantly lower FOSQ total scores (*p*=.03) and lower General Productivity (*p* =.001), Activity Level (*p*=.01) and Vigilance (*p* =.012) subscales scores.

**Conclusion:** The impact of impaired sleep due to comorbid OSA and insomnia may be expressed differently between younger and older adults. Further examination of the impact of severity of comorbid OSA and insomnia on outcomes in both younger and older adults is needed.

**Support (If Any):** R01-DK096028; ApneaLinks: ResMed.

0701

**ONE YEAR OF CPAP ADHERENCE IMPROVES COGNITION IN OLDER ADULTS WITH MILD APNEA AND MILD COGNITIVE IMPAIRMENT**

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**Introduction:** Mild cognitive impairment (MCI), which is considered an “at risk” state for Alzheimer’s disease (AD), comorbid with obstructive sleep apnea (OSA), is prevalent in older adults. Little is known about the effect of adherence to continuous positive airway pressure (CPAP) treatment on cognition in older adults with mild OSA and MCI. We aimed to explore whether long-term CPAP use may improve cognition in this population.

**Methods:** We conducted a secondary analysis of data from Memories 1, a 1-year quasi-experimental trial of the effect of CPAP adherence in older adults with MCI and OSA. Seventeen participants with MCI and mild OSA (AHI 10-14, mean age 72.1±8.9 years) were divided into 2 groups based on their CPAP adherence over 1 year: 1) CPAP adherent group (CPAP+): with average CPAP use ≥4 hr per night, *n*=7; and 2) CPAP non-adherent group (CPAP-): with average CPAP use <4 hr per night, *n*=10. Descriptive analyses, along with general linear and logistic regression models were utilized to examine the changes in cognition and everyday function from baseline across 1 year between groups.

**Results:** Baseline demographics, clinical and sleep characteristics were largely comparable between groups. Those in the CPAP+ group compared to CPAP- demonstrated a significant improvement in psychomotor/cognitive processing speed (PE=1.94, SE=0.70, 95%CI=0.44-3.44, *p*<0.005) with an effect size of 1.39. Eight participants improved on the clinical dementia rating scale (CDR), while 6 worsened or unchanged. Twelve participants rated themselves improved on the Alzheimer’s Disease Cooperative Study-Clinical Global Impression of Change Scale (ADCS-CGIC), while 3 reported their status worsened or unchanged. While not statistically significant (likely due to the small sample size), the CPAP+ group had greater than 8-fold increased odds of improving on the CDR (OR=8.33, 95%CI=0.63-110, *p*=0.11) and greater than 9-fold increased odds of improving on the ADCS-CGIC (OR=9.55, 95%CI=0.33-278.83, *p*=0.19), compared to the CPAP- group.

**Conclusion:** Long-term CPAP use may be a potentially effective intervention to improve cognition in older adults with mild OSA and MCI.

**Support (If Any):** NIH-NIA R01AG054435; NIH-NIA R01AG034682

0702

**PROLONGED SLEEP DURATION PREDICTS POORER COGNITIVE FUNCTION IN HOSPITALIZED OLDER ADULT SURVIVORS OF CRITICAL ILLNESS**

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**Introduction:** The aim of this study was to explore the relationship between sleep duration and cognitive function among previously mechanically ventilated older adults recently transferred out of an intensive care unit (ICU).

**Methods:** We enrolled 30 subjects, ages 65 and older, who were functionally independent prior to admission, required mechanical ventilation, and transferred out of ICU within the last 24-48 hours. Actigraphy monitored nighttime sleep continuously between 9:00PM to 9:00AM over two nights. Using the Actiwatch Spectrum, we analyzed mean total sleep time (TST). Using selected measures from the National Institutes of Health Toolbox.
B. Clinical Sleep Science and Practice

Cognition Battery [Flanker Inhibitory Control and Attention Test (FICAT; a measure of attention)] and the Dimensional Change Card Sort Test (DC CST; a measure of cognitive flexibility), we analyzed cognitive function and its relationship to post-ICU sleep duration.

Results: Subjects’ mean TST was 7.55 ± 2.52 hours. FICAT fully-corrected T-score was 29.65 ± 7.33, and DCCST fully-corrected T-score was 38.81 ± 9.20. In regression analyses, TST was significantly and negatively associated with attention (β = -0.505, p = .043). This relationship persisted after adjusting for potential confounding factors, including sex, history of obstructive sleep apnea (OSA), self-reported sleep quality, sleep medication administration, severity of illness, surgical admission, ICU readmission, and length of hospital stay. Longer sleep duration predicted poorer performance on attention. TST was also significantly and negatively associated with attention (β = -0.437, p = .028). This relationship persisted after adjusting for age, sex, history of OSA, self-reported sleep quality, sleep medication administration, pain medication administration, severity of illness, and length of hospital stay. Longer sleep duration predicted poorer performance on cognitive flexibility.

Conclusion: This cohort of hospitalized older adult ICU survivors experienced prolonged sleep, which independently predicted poor cognitive function after adjustment for relevant covariates. Future research should explore associations between prolonged sleep and actigraphy-observed inactivity periods with post-ICU cognitive outcomes among older adult ICU survivors.

Support (If Any): N/A

0703

DETRIMENTAL EFFECTS OF SHIFT WORK ON COGNITIVE FUNCTIONING: PRELIMINARY EVIDENCE IN RETIRED ADULTS
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Introduction: Night shift workers experience sleep disturbances and circadian misalignment, which has long-term consequences for cognitive functioning. Poor cognitive functioning may be one mechanism linking sleep/circadian disruptions in shift workers with the development of Alzheimer’s Disease. Cognitive functioning has not been extensively tested in retired shift workers compared to retired day workers who, in retirement, have similar sleep schedules and circadian rhythm patterns. We hypothesized that retired shift workers would have poorer cognitive functioning compared to retired day workers.

Methods: Participants were 26 retired day workers and 17 retired night shift workers aged 60-82. Shift workers were defined as regularly working the majority of hours overlapping the interval of 12:00am and 6:00am for seven years or more. Day work was defined as having no more than 18 months of shift work. A standardized neuropsychological battery was used to assess IQ and current cognitive functioning across executive function, episodic memory, and verbal ability domains; these domains have consistent associations with Alzheimer’s Disease. Analysis of covariance was used to test the hypothesis that shift workers have worse neurocognitive function than day workers in these domains, after adjusting for education.

Results: There was no difference between groups on IQ (p=.30). Retired shift workers performed worse than retired day workers on an executive function task (DKEFS Trail Making Test; p=.01) a measure of episodic memory (California Verbal Learning Test-II short delay free recall; p=.04), and a measure of verbal ability (DKEFS Verbal Fluency-Category Fluency; p=.05). Eight other tasks were not significantly different (p>.07).

Conclusion: Retired shift workers performed significantly worse than retired day workers on several neuropsychological domains and cognitive processes that are associated with preclinical Alzheimer’s Disease. These data are consistent with the hypothesis that shift workers may be at an elevated risk of developing Alzheimer’s disease. Because all participants were retired and currently sleeping at night, these preliminary results suggest that shift work has long-term detrimental effects on cognitive functioning.

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0704

EFFECTS OF AROMATHERAPY ON SLEEP AND COGNITIVE FUNCTION IN THE ELDERLY
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Introduction: The incidence of sleep disorder increase with age. Insomnia is often attributed to the presence of psychiatric disorders and age-related physiological changes in sleep-wake regulation. Poor sleep has been associated with deficits in cognitive performance. In healthy people, essential oil of rosemary and lavender are used, which influence feelings about a person’s surroundings. However, the effects of aromatherapy on both sleep and cognitive function in the elderly remain unclear. Here, we examined whether aromatherapy improved sleep and cognitive function in elderly volunteers.

Methods: The study included consecutive 10 volunteers aged 65 and over. Participants were non-smokers, and did not use psychotropic drugs. There were no problems with social life in any subjects. The Chubu University Ethics Committee approved all procedures associated with the study. We obtained written informed consent from each participant after fully explanation of the protocol. Aromatherapy was performed over a period of 4 weeks. Aromatherapy comprised the use of rosemary and lemon essential oils in the morning, and lavender and orange essential oils in the evening. The actigraphy and sleep diary were performed for 7 consecutive days for all participants. The actigraph (Ambulatory Monitoring Inc., New York, NY, USA) was worn around the wrist of the non-dominant hand. We analyzed actigraphy data using the algorithm supplied by the ActionW-2 clinical sleep analysis software package for Windows (Ambulatory Monitoring Inc.) and sleep diary. We also evaluated sleep quality using questionnaires. Cognitive function was evaluated with Touch Panel-type Dementia Assessment Scale (TDAS) and a revised version of Hasegawa’s Dementia-Scale (HDS-R).

Results: Total TDAS scores significantly decreased after 4 weeks of aromatherapy than at baseline. There were no significant differences in HDS-R scale and total sleep time between baseline and after 4 weeks of aromatherapy. The number of days of difficulty
maintaining sleep was significantly lower after 4 weeks of aromatherapy than at baseline.

**Conclusion:** Our findings suggest that 4 weeks of aromatherapy may have beneficial effects on sleep and cognitive function in the elderly.

**Support (If Any):**

0705  ASSOCIATION BETWEEN INSOMNIA SYMPTOMS AND HYPERGLYCEMIC CLAMP-DERIVED INSULIN SENSITIVITY IN ELDERLY MEN

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**Introduction:** Insomnia-related sleep disruptions such as short and disturbed sleep have been linked to systemic insulin resistance in young adult populations. However, in older adults, a population with both higher prevalence of sleep disturbances and increased risk of type 2 diabetes, whether insomnia symptoms are associated with impaired insulin sensitivity is not clear. We therefore sought to investigate this link in a Swedish population of elderly men.

**Methods:** Cross-sectional data from 980 men who participated in the age 70-year investigation of the Uppsala Longitudinal Study of Adult Men was utilized. Self-reported insomnia symptoms including difficulty initiating sleep, early morning awakenings, and frequent use of hypnotics (>3 times/week) were acquired by questionnaire. Participants underwent the gold-standard hyperinsulinemic-euglycemic clamp technique to assess the insulin sensitivity index (M/I). Differences in M/I between men with and those without insomnia symptoms were determined by analysis of covariance, adjusted for age, body mass index, waist circumference, blood pressure, diabetes, smoking, alcohol intake, and level of leisure time physical activity.

**Results:** Our analysis yielded no difference in M/I between men with and without insomnia symptoms (mean difference: -0.20 100 x mg/kgbw/min/mU/L; 95%CI: -0.92, 0.53; P=0.59). Results in non-diabetic and diabetic sub-samples were consistent with the negative finding in total cohort (mean difference: -0.01 100 x mg/kgbw/min/mU/L; 95%CI: -0.84, 0.81; P=0.97 and mean difference: -0.31 100 x mg/kgbw/min/mU/L; 95%CI: -1.25, 0.62; P=0.51, respectively).

**Conclusion:** These results suggest that insomnia symptoms may not have an impact on measures of insulin sensitivity in elderly men. Given the mono-gender observational design of our study, future investigations are needed to determine whether experimental sleep manipulations influence systemic insulin sensitivity in both elderly men and women, as has previously been shown in young adult populations.

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0706  EXAMINING SLEEPING MEDICATION AND INSOMNIA SYMPTOMS BY COGNITIVE IMPAIRMENT AMONG OLDER AMERICANS IN THE U.S. USING THE NATIONAL HEALTH AND AGING TRENDS STUDY

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**Introduction:** Using the National Health and Aging Trends Study (NHATS), we examined use of sleeping medication, difficulty falling asleep, and trouble falling back asleep among individuals with and without cognitive impairment.

**Methods:** Binomial logistic regression examined sleep medication use and insomnia symptoms (difficulty falling asleep or falling back asleep after awakening) by cognitive impairment (no dementia and possible or probable dementia). Sleep-related variables were collected on frequency scales ranging from 1 (every day) to 5 (never). Of the sample, 71.1% were White (n=3,369), 20.7% were Black (n=982), 5.0% were Hispanic (n=235), and 2.4% other (n=113); 60.4% were female (n=2,662) and 39.6% were male (n=1,875).

**Results:** Respondents were classified as having no dementia (63.7%), possible dementia (8.5%), or probable dementia (12.9%). Of the sample, 10.7% reported medication use every night, 2.5% 5-6 nights/week, 5.7% 2-4 nights/week, 6.6% once/week and 59.4% reported no use. Of the respondents, 8.3% reported difficulty sleeping every night, 8.0% reported 5-6 nights/week, 21.4% reported 2-4 nights/week, 22.9% reported rarely, and 23.5% reported never experiencing difficulty sleeping. Regarding difficulty falling back asleep, 4.9% reported difficulty every night, 7.4% reported 5-6 nights/week, 26.0% reported 2-4 nights/week, 20.4% reported rarely, and 24.3% reported never. Compared to individuals who reported never using sleep medications, those reporting nightly use were significantly more likely to be cognitively impaired (OR=1.44,95%CI: 1.14-1.82). Compared to individuals reporting never having difficulty falling asleep, those reporting difficulty falling asleep nightly were not more likely to have cognitive impairment (OR=0.74 95%CI: 0.67 to 1.19). Compared to individuals reporting never having difficulty falling back asleep after awakening, those frequently reporting difficulty falling back asleep were less likely to be cognitively impaired (OR=0.44,95%CI:0.22 to 0.64).

**Conclusion:** Cognitive impairment was positively associated with sleep medication use in adjusted models, but not with trouble falling back asleep or difficulty falling back asleep after awakening. Our findings are consistent with the literature on deleterious consequences of sleep medications.

**Support (If Any):** 1K07AG052685

0707  FACTORS ASSOCIATED WITH SLEEPINESS AND VIGILANCE IN A COGNITIVELY NORMAL ELDERLY POPULATION

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**Introduction:** Assessment of habitual sleep duration and obstructive sleep apnea (OSA) severity and their relationships with
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subjective sleepiness and vigilance in cognitively normal older subjects is limited.

Methods: Data are from subjects participating in an ongoing longitudinal study of sleep and Alzheimer’s disease biomarkers in cognitively normal elderly subjects (CDR=0, MMSE≥24). Demographic data, comorbidities, medications and Apolipoprotein E4 (ApoE4) genotype were collected. Habitual nocturnal sleep duration was measured by 7-day actigraphy. OSA was evaluated from in-laboratory nocturnal polysomnography (NPSG) and/or 2-night home-sleep test (HST). Excessive daytime sleepiness (EDS) was determined from Epworth Sleep Scale (ESS), and vigilance by 20-min psychomotor vigilance test (PVT). OSA was defined by Apnea hypopnea Index 4 (AHI4)≥5 and/or respiratory disturbance index (RDI)≥15.

Results: Among 267 subjects (age 68.4±8.1 years, BMI 26.3±5 kg/m², 36.4% male), 185 underwent HST alone, 11 NPSG alone, and 71 both HST and NPSG. 58.7% of subjects had OSA. Of these, 67.3% had AHI4<15/hr and 32.7% had AHI4≥15/hr. Sleep duration was 7±1.1 hours. Median ESS was 5 (IQR 5), with 16.4% subjects having ESS≥10. Median PVT lapses was 3.2 (IQR 2.7). ESS and PVT showed no relationship (r=0.093, p-value 0.14). There was a significant inverse correlation between actigraphy sleep duration and ESS (r=-0.348, p-value<0.01), but not lapses. AHI4 (r=0.188, p-value<0.01) and RDI (r=0.166, p-value 0.01) from HST were correlated with ESS but not PVT. Sleep duration explained 12% of variance in ESS even after adjusting for AHI4. In 82 subjects with NPSG, we found no correlation between ESS or PVT and in-lab total sleep time, sleep stages or OSA severity. No differences in sleepiness were seen in ApoE4 carriers compared to others.

Conclusion: Our data confirm that OSA is highly prevalent in cognitively normal elderly subjects. We found limited subjective sleepiness, even in those with OSA. Typical sleep duration measured in the home was the main predictor of sleepiness. To date, conventional NPSG metrics do not explain the lack of EDS in OSA in this group.

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0708

THE ROLE OF COMBINED SUBJECTIVE SLEEP QUALITY AND OBJECTIVE SLEEP EFFICIENCY VARIABILITY IN FRAILTY STATUS.

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Introduction: Frailty is prevalent in older adults and associated with common risk factors related to mortality. Previous studies showed an association between sleep disturbances and frailty in older adults; however, this association might not be presented by the discrepancy between subjective and objective measures of sleep. Thus, this study aimed to investigate the impact of combined perceived sleep quality (SQ) and objective sleep efficiency (SE) variability on the frailty status.

Methods: Data from Midlife in the United States for 108 individuals aged between 65-85 years was utilized. Participants were grouped into four categories based on Pittsburgh Sleep Quality Index and Coefficient of Variance (CV) of 7 nights of ActiWatch measure for SE. The median of CV for SE was chosen as a cutoff score for low and high sleep variability. The sample was divided into: Good Sleep Quality Low Sleep Variability (GSLV), Poor Sleep Quality Low Sleep Variability (PSLV), Good Sleep Quality High Sleep Variability (GSHV), and Poor Sleep Quality High Sleep Variability (PSHV). Frailty status was measured including low physical activity, exhaustion, weight loss, slow gait speed and muscle weakness. A multinomial regression analysis was used to determine the strength of association between groups to predict the frailty status at 0.05 significant level.

Results: A total of 29 participants in GSLV group, 26 participants in PSLV group, 24 in GSHV group, and 29 in PSHV group. People in the PSHV group were most likely to have frailty (odds ratio =7.42; 95% confidence interval = [1.03, 53.17], p=0.046) after controlling for age, gender and Waist-Hip ratio. No significant associations were found after separating the subjective measure and objective measure.

Conclusion: People with poor SQ and high SE variability were about seven times more likely to be a frail compared to other groups. The finding suggests the need to assess both subjective and objective sleep of several nights for older adults. A prospective longitudinal study with larger sample size is needed to confirm such relationship.

Support (If Any): N/A

0709

SELF-REPORTED AND ACTIGRAPHIC SHORT SLEEP DURATION IN OLDER PERSONS

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Introduction: Short sleep duration (SSD), i.e., lasting ≤56 hours, is associated with adverse health outcomes. The epidemiology of SSD has not yet been established in older persons including the distinction between self-reported vs. actigraphy measured sleep time and the presence or absence of coexisting poor sleep quality.

Methods: Using data on 5,717 older persons from the Study of Osteoporotic Fractures and the Osteoporotic Fractures in Men Sleep Study, we calculated the prevalence of self-reported and actigraphic SSD with and without poor sleep quality, respectively. The Pittsburgh Sleep Quality Index (PSQI) evaluated self-reported sleep duration and poor sleep quality (PSQI score >5), whereas results from wrist actigraphy were averaged over approximately 5 days. Next, we examined the agreement between self-reported and actigraphic SSD and the correlates associated with discordance, using multivariate logistic regression. Correlates included age, sex, race, poor sleep quality, and impairments in cognition (MMSE <24 in women; Teng 3MS <82 in men) and physical function (inability to do a chair stand).

Results: Mean age was 80 years (SD 5.8); 50% were female and 90% were white. Self-reported and actigraphic SSD were established in 767 (13.4%) and 1,617 (28.3%) participants, respectively. Among those with self-reported SSD, 728 (94.9%) reported poor sleep quality. Among those with actigraphic SSD, 812 (50%) reported poor sleep quality. The correlation between self-reported and actigraphic SSD was poor (k=0.11). In particular, a total of 1,294 (22.6%) participants had actigraphic SSD but not self-reported...
SSD, whereas a total of 444 (7.8%) participants had self-reported SSD but not actigraphic SSD. The odds of discordance in self-reported vs. actigraphic SSD were significantly higher among males (1.19 [1.02, 1.39]), non-whites (1.67 [1.36, 2.06]), and participants with poor sleep quality (1.68 [1.48, 1.90]) or physical impairment (1.28 [1.06, 1.54]).

Conclusion: In older persons, self-reported and actigraphic SSD were poorly correlated, most evident in participants who were male, non-white, or had poor sleep quality or impaired physical function. Hence, the epidemiologic evaluation of SSD in older persons, including associations with adverse health outcomes, should include actigraphy-measured sleep duration.

Support (If Any): None

0710
THE ASSOCIATION OF LATE-LIFE DEPRESSION, COGNITIVE FUNCTIONING, AND SLEEP DISORDER IN AGING
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Introduction: Late-life depression is common in aging and has strong association with cognitive impairment and neurological diseases, including Alzheimer’s Disease (AD). In this ongoing study, we hypothesized that participants with depression or depressive symptoms would exhibit sleep disorder and fragmentation when compared to aged-matched participants without depression.

Methods: Independently living older adults, age 65-85 (M=72.76, SD=6.56), were recruited from a geriatric psychiatry clinic and the community. Participants who endorsed depression in interview were considered positive. Sleep was examined in the home with standard wrist actigraphy (Mini Actiwatch, Cambridge Neurotechnology) for 7 nights. Self-report sleep questionnaires (e.g., Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Stanford Sleepiness Scale (SSS)) were used to identify subjective sleep quality, daytime sleepiness, and sleep efficiency. On the second night, overnight memory consolidation (ONMC) was tested before sleep and after wake with a brief procedural memory task. At one-month follow-up, neurocognitive assessment battery was administered.

Results: 44.44% of 18 participants in this pilot study were positive for mild cognitive impairment (MCI), which was used as a covariate in ANCOVA analyses. Results from actigraphy reveal that self-reported depression was associated with longer sleep latency (p=0.004) and poorer sleep efficiency (p=0.001). PSQI scores reveal that depression status predicted longer sleep latency (p=0.043) and a trend toward lower sleep efficiency (p=0.055). No significant associations were found between depression and subjective sleepiness as measured by the SSS and ESS. No significant associations were found between depression status and neurocognitive measures, including overnight memory consolidation and 30 day, follow-up neurocognitive assessment.

Conclusion: In this ongoing study, we found that sleep disturbance was more common in aging participants with self-report of depression, independent of MCI status. Both actigraphy and self-report on the PSQI confirm that sleep latency and sleep efficiency were different in depressed compared to non-depressed participants, with more insomnia in the depressed cohort. Contrary to expectations, impaired memory and cognition were not associated with depression self-report. In this cohort of older adults, depression affected sleep quality independent of cognitive performance and MCI status.

Support (If Any): None

0711
SUBJECTIVE AGE AFFECTS POOR SLEEP QUALITY
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Introduction: Poor sleep is prevalent among older adults. Approximately half of elderly have a complaint about their sleep. In addition to chronological age, subjective age has received as biopsychosocial marker that is related to poor mental and physical health, impaired cognition, and mortality. In this study, we aimed to examine whether subjective age is associated with sleep characteristics and quality.

Methods: We included 2501 subject (mean age 47.92±16.36, male 49.46 %) from a nationwide, cross-sectional, and population-based survey of sleep and headache in Korean from September 2018 to December 2018. Experienced researcher employed by Gallup Korea conducted structured interviews using a questionnaire through door-to-door visit and face-to face interview. Subjects were asked to report, in years, how old they felt. The proportional discrepancy scores were calculated by follow formula: chronological age - subjective age/chronological age. Whereas a negative value indicates a younger subjective age, a positive value denotes an older subjective age. The total subjects were divided into two groups according to the proportional age discrepancy: younger or same, and older. The effect of subjective age on sleep quality was analyzed with controlling for chronological age, sex, anxiety, depression, insomnia, and daytime sleepiness.

Results: Of the sample, feeling younger, same, and older compared to their chronological age reported 65.9, 15.9, and 17.9 %, respectively. The distribution of men and women differ between two groups. The Generalized Anxiety Disorder-7 (GAD-7), Patient Health Questionnaire-9 (PHQ-9), Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), and Epworth Sleepiness Scale (ESS) scores kept significantly higher in the younger or same group than older group after adjusting for sex (GAD-7 1.11±2.13, 1.52±2.73, p=<.001; PHQ-9 3.02±3.74, 3.07±3.88, p=.330; PSQI 3.89±2.48, 4.52±2.88, p=.023; ISI 5.00±4.54, 5.63±5.12, p=.005; ESS 6.52±3.90, 7.29±4.28, p=<.001). Older group had longer sleep onset latency (SOL) and lower sleep efficiency (SE) than younger or same group (SOL 15.45±14.70, 16.77±13.19, p=.039; SE 89.82±7.80, 88.95±7.79, p=.023). After controlling for covariates, feeling older was associated with poor sleep quality (PSQI 3.89±2.48, 4.52±2.88, p=<.001).

Conclusion: The present study reveals that subjective age affects poor sleep quality, beyond chronological age.

Support (If Any):
B. Clinical Sleep Science and Practice

Introduction: A possible role for sleep apnea (SA) in Mild Cognitive Impairment and Alzheimer’s Disease remains controversial. We screened for SA using ambulatory pulse oximetry in a Memory Clinic population.

Methods: 332 patients (X [SD] age = 71.9 [9.4]; 167 M, 165 F; 302 Caucasian, 30 non-white; X [SD] BMI = 26.1 [4.7]) underwent single night in-home pulse oximetry (Nonin Model 2500 PalmSAT). APOE4 genotype was present in 156 (47.0%). Mini Mental State Exam (MMSE) indicated considerable cognitive impairment (X [SD] = 24.1 [5.0]). Oxygen Desaturation Index (SaO2I) (X [SD] = 5.97 [9.78] was defined as # of ≥ 4% drops per recording hour (n = 107 [32.2%] with ≥ 5.0). BMI was divided by quartiles. The primary logistic model shown below predicted MMSE ≤ 25 (n = 162, 48.8 % with MMSE ≤ 25).

Results: Odds Ratios (ORs) and 95% Confidence Intervals were as follows: Sex (male risk), 0.94 (0.56-1.47); Race (non-white risk), 1.25 (0.49-3.21); Age (≥ 73), 3.54 (2.17-7.59); APOE4, 2.02 (1.27-3.23); BMI, Q2 1.06 (0.55-2.06), Q3 1.09 (0.54-2.20), Q4 0.74 (0.36-1.52); and SaO2I (> 5.0/hr), 1.003 (0.60-1.69) We performed sensitivity analyses and repeated the above model varying SaO2I thresholds at ≥ 10.0 (n = 58, 17.5%), ≥ 15.0 (n = 34, 10.2%) and ≥ 20.0 (n = 20, 6.0%), as well as systematically varying MMSE thresholds to ≤ 24, ≤ 23, ≤ 22, ≤21, and ≤ 20. Results were nearly identical.

Conclusion: In this clinic population enriched for dementia, single night in-home pulse oximetry was unrelated to dementia severity, whereas the often-replicated association between APOE4 genotype and dementia was robust. These data may call into question both the strength and the nature of relationships between SA and dementia reported in other populations.

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0713
SLEEP HEALTH AND HEALTHCARE COSTS AND UTILIZATION IN OLDER WOMEN
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Introduction: Previous studies have suggested that specific sleep disorders (insomnia, sleep apnea) may be associated with higher utilization of healthcare services. We examined the association of an aggregate measure of sleep health dimensions with subsequent total healthcare costs and utilization.

Methods: We linked 1,468 community-dwelling women (mean age 83.7 years) participating in the Study of Osteoporotic Fractures Year 16 (Y16) examination (2002-2004) with their Medicare claims. An aggregate index (ranging from 0 to 3) was created from five dimensions of self-reported sleep health at Y16 including sleep satisfaction, daytime sleepiness, mid-sleep timing, sleep onset latency, and sleep duration. Total direct healthcare costs and utilization were ascertained during 36 months after Y16.

Results: Mean (SD) total annualized healthcare costs (2017 dollars) increased in a graded manner across the sleep health index ranging from $11,022 (16,276) among women with no sleep health impairment up to $15,672 (22,941) in women with impairment in 3-5 dimensions (p <0.004). After adjustment for age, race and site, women with impairment in 3-5 sleep health dimensions vs. those with no impairment had greater mean total costs (cost ratio (CR) 1.34, 95% CI 1.13-1.60) and higher odds of hospitalization (odds ratio (OR) 1.39, 95% CI 1.01-1.92). Of the individual dimensions, daytime sleepiness (CR 1.23, 95% CI 1.01-1.49) and short or long sleep duration (CR 1.20, 95% CI 1.07-1.35) were each associated with higher total health care costs. After further accounting for number of comorbid medical conditions, functional status and depressive symptoms, impairment in 3-5 sleep health dimensions was no longer related to total costs (CR 1.03, 95% CI 0.86-1.22) or hospitalization (OR 0.96, 95% CI 0.68-1.35). Multidimensional sleep health was not associated with outpatient costs or odds of a stay in a skilled nursing facility.

Conclusion: Older women with poor sleep health have higher subsequent total healthcare costs and an increased risk of hospitalization attributable to their greater burden of comorbid medical conditions, functional limitations and depressive symptoms.

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0714
SLEEP AND SPEECH OUTCOMES OF SECONDARY SPEECH SURGERY FOR CHILDREN WITH VELOPHARYNGEAL INSUFFICIENCY
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Introduction: Velopharyngeal insufficiency (VPI) results in hypernasality because air escapes through the nose during speech. VPI is common in children with craniofacial clefting. Surgical interventions designed to limit airflow through the nose during speech include: Furlow palatoplasty, pharyngeal flap, or sphincter pharyngoplasty. However, narrowing the nasopharyngeal airway can cause sleep apnea. Hypothesis: Careful attention to pre-operative speech evaluation data and sleep disorders can maximize speech outcomes while minimizing sleep disordered breathing. Objectives: The purpose of this study is to describe the speech and sleep outcomes of patients with craniofacial clefting who have undergone secondary speech surgery.

Methods: This was a retrospective chart review including 484 unique patients who attended craniofacial clinic between January 1, 2016 and May 31, 2018. Of these, 179 underwent polysomnography, and secondary speech surgery occurred in 20. A detailed speech evaluation was performed before and after surgery. Resonance was assessed using the parameters defined by Henningsson et al. (2008), and placed on a non-parametric scale ranging from -1 (hyponasal) to 3 (severely hypernasal). Polysomnography results were used to quantify sleep disordered breathing. A statistical program (SPSS) was used to statistically analyze results, with a paired sample t-test used to compare pre- and post-operative values.

Results: Post-operative hypernasality (-0.25 ± 0.43) was significantly improved from pre-operative (1.90 ± 0.7, p<0.05). Other speech variables (visible nasal air emission, audible nasal air emission, compensatory articulation error, speech understandability, and speech acceptability) were not significantly impacted by the surgery. Polysomnographic measurements of obstructive sleep apnea-hypopnea index, oxygen saturation nadir, wake time after sleep onset, and sleep efficiency were not significantly impacted by surgery.

Conclusion: Secondary speech surgery can significantly improve the hypernasality of patients with VPI. With careful attention to pre-operative sleep evaluation, secondary speech surgery can be performed without negative impacts on sleep.

Support (If Any): 

0715
ASSOCIATION OF OBSTRUCTIVE SLEEP APNEA SYNDROME AND SPEECH DELAY IN CHILDREN: A CASE-CONTROL STUDY.
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Introduction: There is a paucity of evidence regarding the association between OSA in children and speech delay (S/D). Speech is a complex developmental process requiring proper function of phonatory structures, the neural processes behind verbalization and the auditory acquisition of phonemes. Our hypothesis was that OSA was associated with S/D through a potential impairment of all these pathways.

Methods: All patients aged 1 - 18 years referred to our sleep laboratory for polysomnography (PSG) with history of S/D, between 9/2003 and 12/2018 were included. We expected the frequency of OSA in the S/D group to be 70% and 50% in controls. In order to guarantee a 5% significance level with 80% power, they were paired 2:1 with age-sex matched controls. The controls were selected consecutively from the same database, starting in 9/2003. We excluded patients presenting with congenital malformations of the upper airway (not including cleft palate), autism, tracheostomy, CNS lesions, mitochondrial disorders and any other congenital or acquired conditions expected to cause S/D. The odds ratio (OR) of OSA, Hypoventilation and Snoring in the presence of SD were calculated.

Results: We found 123 cases (63% males, median age 3, range 1-11 years). They were matched (age-sex) per protocol to 246 consecutive controls. We found a significant difference in the frequency of OSA in the S/D group 73.9% and the controls 44.3%, OR 3.56 CI:2.22-5.78, p<0.001. The OR for S/D and snoring or hypoventilation are not statistically significant. Thirteen of the 91 (14%) S/D subjects with OSA did not snore.

Conclusion: OSA is strongly associated with S/D in a manner independent of snoring or hypoventilation. It is plausible that this association may be causal. PSG should be considered in children with S/D even in the absence of other clinical risk factors for OSA. Prospective studies are needed to evaluate prevention or improvement of S/D with treatment of OSA.

Support (If Any): 

0716
PAP ADHERENCE POST 1 YEAR INITIATION WITH DOWN SYNDROME PATIENTS IN A PEDIATRIC SLEEP CLINIC
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Introduction: Adherence to positive airway pressure (PAP) therapy is a challenge in individuals with obstructive sleep apnea (OSA), particularly in children with Down Syndrome who have an increased risk of OSA. We performed this study to assess PAP adherence in our pediatric Down syndrome population.

Methods: The Sleep Clinic at Arkansas Children’s follows a large number of children with Down syndrome. We aim to assess average adherence amongst this population. Most payers consider adherence of PAP to be used 4 hours per night and/or 70% of use. We plan to evaluate adherence (average nightly use > 70% of nights) at 1 year following PAP initiation. We hypothesize that our population of children with Down syndrome PAP adherence will be >70%. If the above hypothesis is true then this can help future patients, parents and caregivers have a positive outlook at the PAP initiation visit instead of feeling overwhelmed with fear and doubts.

Results: From 2005-2018, 103 children with Down Syndrome were seen in our Sleep Clinic. Of these, 56 subjects met our inclusion criteria. The mean age was 13.1 years. Sixty-six percent (n) of subjects were male and 34% (n) were female. Adherence in all subjects at 1 year post PAP initiation averaged 61.61%. We divided adherence at 1 year into categories. Ten (17%) did not use it at all (group A): 2
(4%) subjects used it for 1-49% of the nights (group B); 5 (9%) used it for between 50-74% of nights (group C) and 39 (70%) used it for >75% of nights (group D) for >4 hours each. At 18 months there was no change in groups A and D. In group B, 1 used it for > 80% nights. In group C, 2 subjects’ adherence increased to 88%.

Conclusion: We determined that the majority of children with Down Syndrome followed in our clinic were adherent 1 year post PAP initiation. In our experience, children with Down Syndrome can be successful with PAP therapy.

Support (If Any): None

0717
LONG-TERM EXPERIENCE OF POSITIVE AIRWAY PRESSURE FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME IN YOUTH WITH DOWN SYNDROME.
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Introduction: Individuals with Down syndrome (DS) are at increased risk for obstructive sleep apnea syndrome (OSAS), which may not completely resolve after adenotonsillectomy. This has led to an increase in referral for treatment with positive airway pressure (PAP). Treatment with PAP in this group may be challenging. The purpose of this study is to describe the experience of youth with DS and OSAS (DS-OSAS) referred for PAP at a tertiary pediatric sleep center.

Methods: Retrospective study of youth with DS-OSAS prescribed PAP between 01/01/14 and 12/31/16. Inclusion criteria: youth with DS-OSAS treated with continuous-(CPAP), bi-level-(BLPAP) or auto-PAP and followed for at least two years after initiation by an interdisciplinary team (physicians, psychologists, nurse practitioners, nurses, and respiratory therapists). Demographic and clinical characteristics were examined. Adherence to PAP at 0-6, 6-12, 12-18, and 18-24 month intervals after initiation was analyzed. Data are presented as mean±SD, median[IQR] or percent. Friedman repeated measures analysis of variance on ranks were performed.

Results: 441 children were initiated on PAP. Of these, 61 had DS-OSAS (8.9±5.5 years; 53% females; 56% White), 72% received CPAP and 16.3%, BLPAP. Most completed a titration study (77%). 36% were discharged from the program (transitioned to adult care, moved or resolved); 7% sought alternative treatments; 15% did not tolerate PAP or were lost to follow up. PAP adherence expressed as percentage of nights used and minutes used on nights used was 42.1±17.1-78.6% and 126[31.8-358.5]mins at 0-6 (N=50); 63.6[14.3-92.4]% and 237[77.0-438.5]mins at 6-12 (N=37); 64.[7.7-96.4]% and 268.[8.8-423.2]mins at 12-18 (N=32); and 66[29.0-97.4]% and 219.[60.0-474.5]mins at 18-24 months (N=26). Of those with adherence data at each interval (N=21), the median minutes used was 184 mins at 0-6, 290 mins at 6-12, 321 mins at 12-18, and 219 mins at 18-24 months (p=0.008).

Conclusion: Most children with DS-OSAS tolerated titration polysomnogram and treatment with PAP. A third of patients could be safely discharged. Few children were lost to follow up. Of those with complete data, adherence improved over time.

Support (If Any): None

0718
THE ROLE OF POLYSOMNOGRAPHY IN TRACHEOSTOMY DECANNUALATION OF CHILDREN WITH CRANIOFACIAL ABNORMALITIES
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Introduction: Patients with craniofacial abnormalities are at high risk for upper airway obstruction requiring tracheostomy. While guidelines for care of children requiring tracheostomy exist, decannulation practices vary amongst centers. The use of polysomnography (PSG) is one important variable in which best practices are not established. We hypothesized that tracheostomy dependent children with craniofacial abnormalities who had a pre-decan- nulation PSG in our institution have a higher decannulation success rate than those without a pre-decan- nulation PSG.

Methods: This is a retrospective cohort study comparing decan- nulation outcomes between children with craniofacial abnormalities who underwent pre-decan- nulation PSG and those who did not between Jan 1, 2007 and June 1, 2017. Data on patient demographics, PSG results and medical comorbidities was abstracted from medical records.

Results: Forty-five patients with craniofacial abnormalities were considered for tracheostomy decannulation. Twenty-five patients (55%) had a pre-decan- nulation PSG while twenty (45%) did not. Of those who had PSG, 4 (16%) did not undergo decannulation attempt despite the presence of obstructive sleep apnea (OSA); 9 (36%) had OSA and were decannulated successfully after medical or surgical intervention; 4 (16%) had evidence of OSA, but were successfully decannulated without intervention; and 8 (32%) had normal PSG findings. One (4%) patient with normal pre-decan- nulation PSG failed decannulation. One (5%) patient without pre-decan- nulation PSG failed decannulation. There were no statistically significant differences observed in decan- nulation success rates between patients with pre-decan- nulation PSG and those without.

Conclusion: While no significant differences were observed in the decannulation success rate of patients who had pre-decan- nulation PSG compared to those who did not, significant OSA was noted in a large proportion of patients, influencing their decannulation process. While decision to obtain a pre-decan- nulation PSG is made on an individual basis, it is likely that a significant proportion of those children have undiagnosed OSA. These results suggest that while successful decannulation can be achieved in those with OSA, there is an important role for pre-decan- nulation PSG in children with craniofacial abnormalities due to the high prevalence of OSA in this population.

Support (If Any): n/a

0719
DOES OBSTRUCTIVE SLEEP APNEA AFFECT DEVELOPMENT IN CHILDREN WITH DOWN SYNDROME?
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Introduction: In typically developing children, obstructive sleep apnea (OSA) is associated with adverse neurocognitive outcomes. Children with Down Syndrome are at increased risk for OSA and...
have varying degrees of developmental delay, yet minimal data exists on the impact of OSA on the developmental trajectory in children with Down Syndrome. Our objective is to evaluate the relationship between the presence and severity of OSA and developmental outcomes in children with Down syndrome.

**Methods:** Retrospective cohort study of pediatric Down Syndrome patients who have been seen in the Oregon Health and Science University Down Syndrome Clinic between 11/2007 and 1/2015. Retrospective review of polysomnogram (PSG) data (Apnea Hypopnea Index, AHI) and developmental screening data, stratified by age: Peabody Fine Motor Quotient, Gross Motor Function Measure, Rossetti Infant-Toddler Language Scale (ages 0-3yo), Peabody Picture Vocabulary Test (ages 3-6yo), and the Expressive Vocabulary Test (ages 6yo and up). The cohort was stratified by degree of delay on these developmental measures compared to published norms for the general pediatric population. ANOVA was used to compare AHI across categories of developmental delay. The relationship between developmental scores and AHI was assessed using linear and logistic regression for continuous and categorical variables respectively. Exclusion criteria include patients without polysomnogram (PSG) data, developmental screening data, or those without developmental screening data within one year of PSG.

**Results:** Total N = 565. 167 (30%) children underwent PSG, and 60 (11%) underwent PSG within one year of their initial developmental testing. Preliminary analysis did not reveal significant associations with AHI when stratified by age group and degree of developmental delay. Descriptive analysis suggests that there may be an association between AHI and developmental delay in the infant/toddler age group with mild degrees of developmental delay. Further subgroup analysis is in progress.

**Conclusion:** OSA may be associated with negative developmental outcomes in young children with Down syndrome. Evaluation of and treatment for obstructive sleep apnea has the potential to impact developmental trajectory of a vulnerable patient population.

**Support (If Any):** Repository Sharing Agreement (IRB 00010774). OHSU Redcap.

**0720**

**CHILDREN WITH DOWN SYNDROME AND MILD OSA: TREATMENT WITH MEDICATION VERSUS OBSERVATION**

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**Introduction:** Children with Down Syndrome (DS) have a high prevalence of obstructive sleep apnea (OSA). Anti-inflammatory medications have been shown to be an effective treatment for mild OSA in otherwise healthy children. However, efficacy of medication in children with DS has not been investigated. Our aim was to examine the polysomnographic changes of children with DS and mild OSA treated with medication.

**Methods:** A retrospective chart review was performed in children with DS (<18 years) and mild OSA (obstructive apnea-hypopnea index [oAHI] ≤5 events/hour) diagnosed by polysomnography (PSG) between 2006 and 2018. Patients were included if they had treatment with medications (nasal steroid and/or montelukast) or observation with a duration of at least 3 months and had baseline and follow-up PSGs. Demographic data, co-morbid diagnoses and PSG data were collected. Baseline and follow-up PSG parameters were analyzed.

**Results:** Forty-five children met the criteria. In the medication group, 29 children were identified. The median age was 7.4 (IQR 4.9-9.3) years. In the observation group, 16 children were identified. The median age was 4.0 (IQR 3.2-5.3) years. The median time from baseline to follow-up PSG was 14.0 (IQR 10.0-22.9) months for the medication group and 10.5 (IQR 6.5-33.5) months for the observation group. There were no significant changes in the oAHI from the baseline[pre] to follow-up[post] PSG in either the medication group (2.8 (IQR 2.2-3.6) [pre] vs 3.5 (IQR 1.4-4.8) [post]; p=0.25) or the observation group (2.3 (IQR 1.3-3.1) [pre] vs 2.9 (IQR 1.9-6.8) [post]; p=0.12). Similarly, there were no significant differences in AHI, oxygen nadir or ETCO₂ between the groups (p=0.07-1).

**Conclusion:** Based on PSG parameters, our study indicates that medication therapy is not effective in children with DS and mild OSA. Several anatomical factors besides adenotonsillar hypertrophy such as hypotonia and relative macrogliaxia may explain the ineffectiveness of medical therapy for OSA in this population. Further prospective studies are necessary to confirm these results and to evaluate a sub-group of DS children who may benefit from medical therapy.

**Support (If Any):** Funded by the Cincinnati Children's Research Foundation

**0721**

**PEDIATRIC SPINA BIFIDA AND SLEEP DISORDERED BREATHING: SHOULD PSG BE ROUTINE?**

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**Introduction:** Data documenting sleep disordered breathing (SDB) in the pediatric myelomeningocele (MMC) population is limited. We sought to prospectively explore SDB in patients with MMC and Chiari II malformation by referring a cohort of patients seen from 3/2016-12/2018 in a multidisciplinary MMC clinic for polysomnography (PSG).

**Methods:** Of 348 MMC patients followed in a multi-disciplinary clinic, we screened a cohort of 86 patients with routine PSG regardless of symptoms or clinical concerns for SDB. None of the patients had undergone previous PSG. We assessed age, gender, hydrocephalus, shunt status, functional level of lesion (FLLOL), apnea/hypopnea index (AHI), and type of apnea, if present. Descriptive analysis used frequency counts, mean, and median to look at rate of apnea. Odds ratio (OR) and confidence interval (CI) assessed if any variables were predictive of SDB.

**Results:** Of the 86 patients, (43 male, 43 female), 90.7% had hydrocephalus, of whom 85.9% had a VP shunt, and 14.1% had ETV/CPC only. The age range was 0.8-21.082 years, mean 9 years. The AHI range was 0-23.2, mean 3.06. Overall, 57% had AHI>1.5
Introduction: Currently there are no standardized guidelines for diagnosis and management of obstructive sleep apnea (OSA) in infants. Symptoms and disease pathophysiology differ from older children and are poorly understood. Herein we attempt to characterize clinical and polysomnographic predictors of severe OSA in infants.

Methods: A retrospective, 5-year, single-institution, study of all infants aged ≤12 months who underwent a diagnostic polysomnogram (PSG). Infants were categorized into two groups: severe OSA and no OSA based on their obstructive apnea-hypopnea-index (AHIo). Severe OSA infants had AHIo≥10 and no OSA had AHIo≤1. PSG parameters, clinical, and demographic variables were evaluated. To determine statistical significance (two-sided, p≤0.05), two-sample Wilcoxon rank‐sum (Mann-Whitney) tests were used for continuous variables or t-tests (with equal variances) were used for discrete variables. Variables were evaluated. To determine statistical significance (two-sided, p<0.05), two-sample Wilcoxon rank‐sum (Mann‐Whitney) or t-tests (with equal variances) were used for continuous variables and chi-square or Fisher’s exact tests were used for categorical variables.

Results: Forty-nine infants were included (28 severe OSA, 21 no OSA) with mean age (SD): 6 ± 3 months. There were significant differences in AHIo [median (IQR): 13.8 (11.6, 17.4) vs. 0.6 (0.4, 0.8); p<0.0001], oxygen saturations [median (IQR): 96% (95%,97%) vs. 98% (97%,98%); p<0.0001], central AHI [median (IQR): 2.4 (1.0,5.9) vs. 1.1 (0.6,1.8); p=0.0053], time spent with SpO2≤90% [median (IQR): 0.5 (0.2,1.8) vs. 0 (0,0); p<0.0001], percent of REM sleep [mean±SD: 30±9 vs. 24±8; p=0.0236], and age in months [mean±SD]: 5±3 vs. 8±3; p=0.0065] between severe OSA and no OSA infants respectively. There were no statistically significant differences in sex (64% male vs. 57%; p=0.612), race (75% white vs. 57% non-white; p=0.187), history of prematurity (29% vs. 10%; p=0.155), history of brief resolved unexplained event (7% vs. 19%; p=0.381), failure to thrive (29% vs. 10%; p=0.155), presence of a cleft palate (25% vs. 5%; p=0.115), adenotonsillar enlargement (39% vs. 19%; p=0.210), laryngomalacia (21% vs. 33%; p=0.350), micrognathia (21% vs. 5%; p=0.214) in severe OSA vs. no OSA infants.

Conclusion: Risk factors for severe OSA in infants remain poorly understood. These clinical factors, although not statistically different, may be of clinical relevance. Further research is needed to better understand the pathophysiology of infant OSA.

Support (If Any): Department of Pulmonary and Sleep Medicine.
Methods: RCREC was computed in five frequency bands (delta, theta, alpha, sigma, beta). Children aged >=5 and <10 with sufficient data quality were selected. Cases were randomized subjects with baseline AHI>2 (N=335). Controls were nonrandomized subjects with AHI<2 (N=447). Follow-up data were available for 277 cases.

Results: At baseline, AHI had statistically significant correlation with theta and sigma RCREC (Pearson r=0.09, p=0.001, both bands). Cases differed from controls in delta (Wilcoxon Rank Sum Test, p=0.005) and theta RCREC (p=0.01). Adjusting for covariates of sex, age, race, ethnicity, and body-mass index, cases differed from controls in delta (logistic regression, p=0.008), theta (p=0.01) and sigma (p=0.04) RCREC. Longitudinal analyses showed changes in AHI (Wilcoxon Sign Rank Test, p=0.006) and theta RCREC (p<0.02) in both study arms: Watchful Waiting with Supportive Care (WWSC) and Early Adenotonsillectomy. Correlations between baseline and follow-up values emerged in the WWSC arm for AHI (Pearson r=0.4, p=2x10^-6) and delta RCREC (r=0.3, p=2x10^-4). Regression models including covariates and baseline AHI and RCREC were not predictive of longitudinal change in AHI or RCREC.

Conclusion: In this sizable cohort, RCREC and AHI showed only limited correlation. RCREC in delta, theta, and sigma differed, after adjustment, in children with and without obstructive sleep apnea. Only baseline delta RCREC correlated, as did AHI, with follow-up values in WWSC arm. As baseline AHI does not predict sleep apnea outcomes in CHAT, the possibility remains that a largely divergent but physiologically relevant metric such as RCREC might perform better.

Support (If Any): NIH K01-ES026839, TL1-TR002242, HL083075, HL083129, UL1-RR024134, UL1-RR024989.
**Conclusion:** Passive MFT for one year can improve the upper airway morphology in both the nasopharynx and oropharynx as well as nasal breathing during sleep without causing negative compensatory changes in other facial skeletal measurements. Patients' quality of life also improves significantly after MFT.

**Support (If Any):** No

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**0727**

**A PILOT STUDY EVALUATING HEAD ELEVATION DURING SLEEP ON MILD OBSTRUCTIVE SLEEP APNEA IN TYPICALLY DEVELOPING PRE-PUBERTAL SUBJECTS.**

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**Introduction:** Obstructive sleep apnea (OSA) is a common condition in the pediatric population (2-4%). Treatments vary according to the severity of the underlying OSA including both surgical and non-surgical options. In adult populations it has been shown that head elevation is successful in reducing the severity of OSA (AHI). The hypothesis of this study is that head elevation (30°) would improve OSA in a typically developing pre-pubertal pediatric population.

**Methods:** Typically developing children, aged 4-13, presenting to the sleep clinic at Texas Children’s Hospital were screened for enrollment into the study (n=21; 11 male). Subjects were excluded if they had chronic medical conditions other than obesity, allergic rhinitis, or a history of tonsillectomy and adenoidectomy. Subjects were randomized to begin a diagnostic polysomnogram with either the head of the bed flat (0°) or elevated (30°). Head position was alternated every 2 hours during the study. Studies were performed in an AASM pediatric sleep center by a registered PSG technologist. Studies were scored using AASM pediatric scoring rules. Data was analyzed using paired student t-tests. Each subject served as their own control.

**Results:** There was no significant difference in AHI (p=0.54), RDI (p=0.51), O2 nadir (p=0.95), total sleep time (p=0.39), sleep efficiency (p=0.12), time in REM sleep (p=0.09) or arousal index (p=0.54) when the head of the bed was flat (0°) versus elevated (30°). The study shows that head elevation is not successful in significantly reducing obstructive sleep apnea in a typically developing pre-pubertal pediatric population.

**Conclusion:** In a typically developing pre-pubescent pediatric population, aged 4-13, referred for a diagnostic sleep study, there is no improvement in OSA due to head elevation (30°) when compared to sleeping flat (0°). These findings were independent of if the subject started with the head of the flat or elevated. Other cofounders were eliminated as each subject served as their own control.

**Support (If Any):** Internal funding supported this study.

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**0728**

**POSITIVE AIRWAY PRESSURE ADHERENCE IN CHILDREN WITH NEURO-DEVELOPMENTAL DISORDERS.**

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**Introduction:** Obstructive sleep apnea (OSA) contributes to a myriad of behavioral, neuropsychological, and cognitive problems. Children with neurodevelopmental disorders (NDD), already vulnerable to these problems, are even more at risk if they have coexisting OSA. In those children with OSA refractory to surgical treatments, improving positive airway pressure (PAP) adherence (and therefore reducing sleep disturbance) is a novel avenue to mitigate these problems. Despite the increased prevalence of OSA in some NDDs, data are lacking on which children with NDD become adherent to PAP, and which struggle. The purpose of this study was to assess PAP adherence in patients with NDD and identify associations to PAP adherence.

**Methods:** A retrospective chart review was conducted in patients with NDD and residual OSA after adenotonsillectomy (TA), who were treated with PAP therapy. Patients were seen in the Vanderbilt Pediatric Sleep Disorder clinic from January 2012 to January 2017. Patients were grouped as either adherent or non-adherent. Adherence was defined as 70% of the nights with an average usage of ≥ 4 hours per night. Medical comorbidities such as multilevel airway surgery after TA, comorbid sleep disorders, genetic diagnosis, verbal ability, psychiatric disorders and the diagnosis of autism spectrum disorder were also recorded. Associations were assessed using Pearson chi-square test.

**Results:** A total of 54 patients were identified. Forty-two percent were adherent to PAP therapy. Of all medical comorbidities assessed, only the presence of secondary multilevel airway surgery showed a significant association with adherence (p <0.03). Patients who had secondary upper airway surgery after adenotonsillectomy were more likely to be non-adherent to PAP therapy.

**Conclusion:** Our study demonstrates that adherence to PAP therapy in patients with NDD is similar to what has been reported in prior studies (40 to 49%). However, multi-level airway surgery after TA is associated with decreased adherence in this population, in contrast to what has been reported in the neurotypical adult literature. Factors associated with multi-level airway surgery and poor adherence warrant further study.

**Support (If Any):**

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**0729**

**THE ACCURACY OF AHI OBTAINED FROM PAP DOWNLOAD IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA.**

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**Introduction:** Positive airway pressure (PAP) is the mainstay of treatment of OSA. The PAP machine can assess its efficacy by estimating the residual AHI which is commonly used to manage patients with OSA. There are a few studies that assessed the accuracy of residual AHI downloaded from a PAP machine (machine-AHI) in adults with OSA. The aim of this study was to compare the machine-AHI with the AHI obtained from PAP.
titration-polysonmography (PSG-AHI) at the optimal pressure in children with OSA.

Methods: This was a retrospective study of children with OSA who underwent a PAP titration-PSG at CHCMC between January 2010 and August 2013. Only children with PAP data within 6 months of titration-PSG were included. Demographics, body mass index (BMI), comorbid diseases, PAP-machine data, PSG parameters from the diagnostic and PAP-titration PSGs were collected.

Results: 251 children (152 male) met the criteria. The median age at PAP-titration PSG was 12.8 years (IQR: 5.5-21) with 145 children (58%) were ≥12 years old. The average BMI was 28.2±13.1 kg/m²; 61 children (24%) had a BMI >35 kg/m². Almost half of the children (N=125, 49%) had a co-morbid disease. The average obstructive AHI (O-AHI) determined by the diagnostic PSG was 18.5±23.5 events/hour; 91 children (36%) had an O-AHI ≥15 events/hour. The average machine-AHI and PSG-AHI at the optimal pressure were 4.4±4.6 and 2.2±4.4 events/hour respectively (average difference of -2.3±5.9, p-value: <0.0001). Overall, there was a strong correlation between machine-AHI and PSG-AHI (r=0.23; p-value: 0.0002). The sub-group analysis revealed a better correlation in children ≥12 years old (r=0.27; p-value: 0.0099), children with a diagnostic O-AHI <15 events/hour (r=0.23; p-value: 0.002) and BMI of ≤35 kg/m² (r=0.20; p-value: 0.006). Multiple regression analysis showed that BMI (p-value: <0.0001) and PSG-AHI (p-value: 0.02) were significant predictors for the machine-AHI.

Conclusion: In our study, the PAP machine tended to report a higher AHI in children. Overall, there was a strong correlation between machine-AHI and PSG-AHI. However, the correlation was weak in younger children, and children with higher BMI and more severe OSA.

Support (If Any):
nights, 6.6 hours/night worn), although changes were not statistically significant.

**Conclusion:** Preliminary results demonstrate feasibility of integrating BSMC into pediatric multidisciplinary O/CSA care. Subjective reports of sleep onset difficulty as well as behavioral, affective and cognitive PAP treatment barriers predicted poorer adherence. Adherence trends improved following BSMC, however current findings are tentative due to limited sample size at follow-up intervals. Findings highlight the importance of evaluation and treatment of patient/caregiver reported sleep disturbance and PAP barriers in the context of pediatric care for O/CSA. Future directions include ongoing examination of the clinical effectiveness of BSMC on adherence and sleep quality over time.

**Support (If Any):** NIH T32HD068223

**0732 EVALUATION OF UVULOPALATOPHARYNGOPLASTY AS A TREATMENT OF OBSTRUCTIVE SLEEP APNEA IN NON-OBESE AND OBESE CHILDREN.**

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**Introduction:** Adenotonsillectomy (T&A) is the first line treatment for children with obstructive sleep apnea (OSA). Positive airway pressure and oxygen are often utilized when OSA persists. For some children, tolerance to these therapies can be difficult. Limited studies exist of other interventions such as uvulopalatopharyngoplasty (UPPP) in children. In addition to crowded upper airway anatomy, obesity is a known risk factor for OSA. Objective: Evaluate the improvement in OSA severity and sleep architecture following UPPP in obese and non-obese children with T&A.

**Methods:** Retrospective chart review of pre- and post-operative in-laboratory polysomnograms (PSG) of thirty-three children with history of previous T&A aged 1 to 17 years who underwent UPPP between 2000 and 2016 was performed. Many children had underlying chronic medical conditions such as cerebral palsy. We assessed apnea hypopnea index (AHI), Obstructive Apnea Hypopnea Index (OAIH), in addition to percentage of slow wave sleep and rapid eye movement (REM) sleep prior to and after UPPP.

**Results:** Overall, children demonstrated improvement in AHI after UPPP and previous T&A (17.0 (SD-18.1) to 11.8, (SD-18.1)). AHI decreased in both non-obese (17.7 (SD 19.4) to 12.7 (SD 20.2)), and among obese children (14.8 (SD 15.1) to 8.9 (SD 9.0)). OAIH also improved after surgery among both the non-obese (16.7 (SD 19.0) to 11.5 (SD 19.9)) and in the obese group (13.1 (SD 13.5) to 7.3 (SD 8.0)) with greater change noted among obese children. A similar increase in Stage N3 sleep was noted after UPPP in non-obese (35.3 (SD 22.5) to 38.9 (SD 23.7)) and obese (28.9 (SD 16.3) to 31.9 (SD 14.9)) groups of children. Due to the small sample size, these trends were not of statistical significance.

**Conclusion:** UPPP in children with previous T&A is potential adjuvant treatment for obstructive sleep apnea. Further study with a higher-powered sample may provide further insight into this treatment option.

**Support (If Any):** Nothing to disclose

**0733 DRUG INDUCED SLEEP ENDOSCOPY DIRECTED SURGICAL INTERVENTIONS IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** While adenotonsillectomy (T&A) is the first-line treatment for pediatric obstructive sleep apnea (OSA) there is a 34-40% likelihood of residual OSA following this procedure. Drug induced sleep endoscopy (DISE) enables evaluation of airway obstruction and can guide the surgical management of children with OSA. This study was designed to compare surgical interventions and outcomes using DISE in children with and without prior history of T&A.

**Methods:** Retrospective chart review of children (<18 years of age) presenting for evaluation of obstructive sleep apnea. All children underwent pre-operative polysomnogram (PSG) followed by DISE directed intervention. The cohort was categorized by 1) age (≤ 2 years and >2 years) and 2) history of prior T&A. Analyses were performed using Fisher’s Exact tests for categorical variables and Wilcoxon non-parametric tests for continuous variables. Surgical interventions were compared by age and past history of T&A. Pre and post polysomnogram findings were also compared.

**Results:** 104 [median age=20.5 months (range: 0-179), 74 (71%) male] children were included in the analysis. 33 (32%) had a history of prior T&A. 31 (29.8%) of children had a post-operative polysomnogram at a median duration of 105.5 days. In children ≥2 years of age with past history of T&A, lingual tonsillectomy was the most common surgical intervention (56.7%) followed by revision adenoidectomy (33.3%). In surgically naïve children <2 years of age, adenoidectomy (53.9%) was the most common intervention. In surgically naïve children >2 years of age, adenotonsillectomy (60%) were the most common interventions. There was a significant improvement in sleep efficiency (p=0.03), nadir desaturation (p=0.03), total sleep time spent in REM stage (p=0.04) in post intervention PSG in children with past history of T&A. There was a significant improvement in AHI (p<0.01), nadir desaturation (p<0.01), total sleep time spent in REM stage (p=0.01) respiratory arousal index (p<0.01) in post intervention PSG in children without a history of T&A.

**Conclusion:** DISE directed surgical intervention resulted in improvement of polysomnogram findings in children with and without a history of prior T&A.

**Support (If Any):** N/A

**0734 INTER-RATER RELIABILITY OF PEDIATRIC DRUG INDUCED SLEEP ENDOSCOPY USING THE VOTE SYSTEM**

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Introduction: Obstructive sleep apnea (OSA) has an estimated prevalence of 1-4% in children. While polysomnography allows for the assessment of severity of OSA, it does not provide insight to the location of upper airway collapse, and subsequent surgical decision-making. Drug induced sleep endoscopy (DISE) allows for the visualization of the upper airway during sleep-like conditions, thereby identifying the sites and mechanisms of obstruction. DISE usage has increased, but currently there is a lack of a universally accepted scoring system limiting both external validity and reproducibility between physicians and institutions. Further, it hampers research by not allowing for a standardized method of reporting findings. The VOTE scoring system is the most popular, although it was not designed for usage in pediatric patients. Several pediatric scoring systems have been proposed. The aim of this study was to compare the inter-rater reliability of the VOTE scoring system in pediatric OSA patients.

Methods: In this study, two otolaryngologists (JN and MB) and two pulmonologists (DL and RB) independently and blindly scored 30 DISE videos using the VOTE scoring system. Included were all patients that underwent DISE between 1/1/2010 and 2/28/2018. Interrater reliability was calculated using weighted kappa agreement statistics on SAS 9.4.

Results: We report preliminary findings for the VOTE system. Interpretation of the kappa estimates varies, but overall agreement by the pairs chosen in the vote can be considered as weak to moderate (Kappa score 0.48-0.32). Agreement by site of obstruction/configuration varied by pair groups. The otolaryngologists reported stronger agreement in areas related to the velum (Kappa 0.54). The pulmonologists reported higher areas related to the tongue base (Kappa 0.5).

Conclusion: The VOTE scoring system had weak to moderate agreement in this study. This study illustrates the limitation in reporting VOTE scores as comparisons in pediatric otolaryngology. Additional DISE scoring systems including pediatric focused scoring systems will be similarly evaluated and we plan to compare each scoring system in an attempt to identify or compose a scoring system with higher levels of interrater reliability and external validity.

Support (If Any): none

VII. Pediatrics

0735
LONGITUDINAL ASSOCIATION OF THE NATURAL COURSE OF CHILDHOOD OVERWEIGHT WITH SLEEP DISORDERED BREATHING IN THE TRANSITION TO ADOLESCENCE: THE PENN STATE CHILD COHORT
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Introduction: Although being overweight is a known risk factor for sleep disordered breathing (SDB), including obstructive sleep apnea (OSA), it remains unknown 1) whether childhood SDB predicts the incidence or persistence of overweight in the transition from childhood to adolescence and 2) whether the natural course of overweight predicts the incidence of SDB in adolescence.

Methods: We studied the Penn State Child Cohort, a general population sample of 421 children (5-12y) at baseline followed-up as adolescents (12-23y, 46.1% female, 17.5% minority). Overweight was defined as a BMI percentile for sex-and-age ≥ 85 and four natural course groups were identified: normal weight and incident, persistent and remitted overweight. Apnea/hypopnea index (AHI) was obtained from 9-hour, in-lab polysomnography and was categorized as no SDB (AHI<2), SDB (2≤AHI<5) and OSA (AHI≥5). Multivariable statistical analyses adjusted for sex, race and age.

Results: Neither AHI, SDB nor OSA in childhood predicted the incidence of overweight (e.g., OR =1.5, 95%CI=0.5-4.8, p=0.495) or the persistence vs. remission of childhood overweight (e.g., OR=0.5, 95%CI=0.2-1.3, p=0.151) in adolescence. Incident overweight in adolescence and persistent overweight since childhood showed a similar AHI (3.4±4.4 vs. 3.5±5.0) and significantly greater incidence of OSA (14.9% and 21.3%, p<0.005) in adolescence. Remitted overweight showed a similar AHI and incidence of OSA in adolescence (2.3±6.3 and 5.7%) when compared to those who had been normal weight since childhood (2.0±1.8 and 6.3%).

Conclusion: This longitudinal study showed that overweight children with SDB are not more likely to persist as overweight into adolescence, while the remission of childhood overweight leads to improved SDB outcomes. Interestingly, the incidence of OSA in adolescence was similar whether the overweight had been persistent since childhood or new-onset. These data indicate that early prevention of SDB should focus on childhood overweight, while new-onset overweight in adolescence should not be regarded as a less severe form in terms of its increased risk of OSA.

Support (If Any): NIH (R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499)

0736
BMI Z-SCORE CHANGES FOLLOWING TONSILLECTOMY IN ADOLESCENTS AGED 12-18 YEARS
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Introduction: Adenotonsillectomy (T&A) is the first line treatment for obstructive sleep apnea (OSA) in childhood. While in pre pubertal children OSA is usually associated with underweight which is improved following T&A, in adolescents OSA is commonly associated with obesity, and the BMI following T&A is only sparsely studied. Thus, we sought to examine the BMI z-score change following T&A in adolescents.

Methods: Clalit Health Services is the largest health maintenance organization in Israel, insuring over 4 million population. It keeps a very strict registry of physician visits and surgeries. Of this registry, adolescents aged 12-18 who underwent T&A in between 2006-2015 were retrospectively investigated for BMI z-score change from up to 3 months prior to T&A, and compared to serially BMI measures every year in the 5 consecutive years. 242 adolescents who had a BMI measurement 3 months prior to T&A and at least one measure in the 3 years following it were included.

Results: There was a small increase in BMI Z-score with a median of 0.79 prior to and 0.83 following T&A, albeit this change
was only a trend (P=0.26). There were changes to all directions, i.e. BMI z-score reduction, unchanged, and increased. 30% of the children had changed their BMI category following the surgery, in an inconsistent and unpredictable way. Interestingly, overweight children (n=74) significantly reduced their BMI z-score from 1.508 to 1.48 following T&A (p<0.001), and in obese children (n=33) BMI z-score decreased from 2.288 to 2.00 accordingly (P<0.001).

**Conclusion:** Adolescents following T&A show variable and unpredictable change in BMI z-score. In this regard, they resemble the change seen in adults and not in young children. In the subgroups of overweight and obese adolescents, T&A resulted in significant BMI z-score reduction.

**Support (If Any):**

**0737**

**PARENT-REPORTED SNORING COMPARED TO OBJECTIVELY MEASURED SNORING AS PREDICTORS OF PEDIATRIC SLEEP DISORDERED BREATHING (SDB)**

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**Introduction:** Parent-reported snoring is commonly used to assess pediatric SDB risk. However, reports have identified variable associations between parent-reported snoring and polysomnography findings. Since sound sensors may improve snoring measurement, we assessed: 1) The correlation between parent-reported and objective snoring; 2) How each snoring measurement predicted SDB.

**Methods:** The sample included 42 children of an ongoing cohort study of pediatric SDB in Boston, Environmental Assessment of Sleep in Youth. Participants underwent assessments including an in-home sleep apnea study (WatchPAT 200U; Itamar Medical). The apnea-hypopnea index (AHI) was estimated from peripheral arterial tonometry and oxygen desaturation (3%), and snoring was captured by the device’s acoustic decibel detector. Objective snoring was measured by percent total sleep time (TST) with snoring over three thresholds (40/45/50 dB). Parents reported child snoring using three questions regarding occurrence, loudness and frequency of snoring over the last month. Mild and moderate SDB were defined as AHI ≥2 and ≥5, respectively.

**Results:** This sample included 62% boys and 68% ethnic minorities and had an average age of 10.0 years (6-12). Mild and moderate SDB were identified in 71% and 12% of the sample, respectively. Snoring 3-7 times per week was reported for 24% of children. The median percent TST with snoring over 50 dB was 3.4% (IQR: 2.8-4.0). Parent-reported snoring had moderate correlations with snoring over 50dB (Spearman’s correlation: 0.31-0.43, p<0.05). None of the parent-reported snoring measures predicted SDB (C-statistics: 0.54-0.59). Objective measures of snoring weren’t associated with mild SDB but snoring over 50dB was predictive of moderate SDB (p = 0.03, C-statistic: 0.81). Under the optimal cutoff of snoring over 50dB ≥ 2.8% TST, the sensitivity and specificity for moderate SDB were 0.80 and 0.84, respectively.

**Conclusion:** These analyses suggest that 1) Parent-reported snoring only modestly correlates with objective snoring; 2) Percent TST with snoring over 50 dB predicts moderate but not mild SDB; 3) Parent-reported snoring is not associated with SDB. Assessment of SDB risk may benefit from objective corroboration of parent-reported snoring.

**Support (If Any):** NIH R01HL137912
B. Clinical Sleep Science and Practice

0739
COMPARISON OF PARENT AND CHILD TREATMENT PREFERENCES FOR OBSTRUCTIVE SLEEP APNEA
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Introduction: Obstructive sleep apnea (OSA) is common in children and is associated with negative neurocognitive and behavioral effects. While adenotonsillectomy is typically the first-line recommended therapy for OSA in children, other therapeutic options include medication therapy with montelukast (with or without intranasal steroid) and positive airway pressure therapy (PAP). To our knowledge, no prior studies have examined parent and child treatment preferences for OSA. Given this, our objective was to compare OSA treatment preferences between parents and children.

Methods: Children with a new diagnosis of OSA (obstructive apnea-hypopnea index ≥1) were recruited from the pediatric sleep medicine clinic. Parent and child separately rated each available treatment option (adenotonsillectomy, medication, PAP or watchful waiting) on a scale from 0-100. A percent preference for each treatment was created by dividing the rating for each individual treatment by the sum of the ratings for all treatments. Intraclass correlation coefficients (ICC) were used to determine the level of agreement between parent and child preference for each therapy, and t-tests were used to compare the overall differences between parent and child preference for each therapy.

Results: Eighteen children, mean age 11.1 ± 2.8 years, participated in the study. 61% selected adenotonsillectomy, 11% chose medication therapy, 22% chose PAP and 6% chose watchful waiting. Parent-child agreement was excellent for adenotonsillectomy (ICC=0.798, p=0.001) and PAP (ICC=0.816, p=0.001). Limited agreement was seen for watchful waiting (ICC=0.342, p=0.20) and medical therapy (ICC=0.335, p=0.21). Comparison of parent and child mean preference showed no significant difference in parent vs. child preference for adenotonsillectomy (mean preference 36% vs 35%, p=0.89), PAP (mean 29% vs 26%, p=0.43), medication therapy (mean 23% vs 26%, p=0.55) or watchful waiting (mean 12% vs 13%, p=0.81).

Conclusion: Parents and children have similar preferences for OSA treatment. There was a high level of agreement for adenotonsillectomy and PAP therapy between parents and children, with lesser agreement for medical therapy and watchful waiting. Based on these results, parent treatment preference appears to be a good proxy for child preference.

Support (If Any): Grant from the AASM Foundation

0740
PREVALENCE OF OBSTRUCTIVE SLEEP APNEA AMONG OVERWEIGHT ADOLESCENTS AND CHILDREN IN KOREA: A SINGLE-CENTER, RETROSPECTIVE STUDY
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Introduction: Prevalence of obesity in children in Korea is estimated to be 10.0% in 2013 and NAFLD is 5.9% in 2015. Prevalence of habitual snoring in 12-17 years was 4.0%. Obstructive sleep apnea increase the obesity related comorbidities. We compare the prevalence of OSA in adolescents and children according to obesity and the effect of OSA among obese and nonobese children on the prevalence of NAFLD, insulin resistance and hyperlipidemia.

Methods: Retrospective study on 242 children with overnight PSG between 2012 and 2017. Overweight was defined by a BMI of ≥ 85th percentile for age and gender. OSA was diagnosed if apnea-hypopnea index (AHI) was higher than 1/hr. Non-alcoholic fatty liver disease (NAFLD) is defined if ultrasonography findings and ALT over 30 U/L (Male) and 19 U/L (Female). Homeostatic model assessment insulin resistance (HOMA-IR) was calculated.

Results: Male to female is 172:70 and 40.7% of boys and 58.6% of girls is overweight. Among 153 in 0-6 years, 62 in 7-12 years and 27 in 13-18 years, mean AHI is higher in overweight children(7.78 vs 2.8, 3.15 vs 2.43 and 9.79 vs 1.71/hr). For lipid profile, TG and TG/HDL is higher in OSA than non-OSA. Prevalence of NAFLD is 29.9% in overweight OSA and 1% in nonoverweight OSA and none in non OSA. HOMA is higher in overweight OSA than non OSA.

Conclusion: OSA more frequent and severe in obese children and OSA and obesity is independently associated with increased incidence of NAFLD and higher HOMA and hyperlipidemia.

Support (If Any):
severity independently of age, gender, and BMI z-score in these patients.

**Conclusion:** OSA severity is associated with an increase in fasting insulin, blood glucose, and HOMA-IR even after controlling for age and gender in Hispanic children.

**Support (If Any):** The study was supported by the Faculty Practice Plan Grant (F931179. PI-Bhushan B).

**0742**

**PAST MEDICAL HISTORY OF OBSTRUCTIVE SLEEP APNEA PREDICTS THE DEVELOPMENT OF TYPE 2 DIABETES IN OBESE GIRLS WITHIN TWO YEARS OF DIAGNOSIS OF POLYCYSTIC Ovary SYNDROME**

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**Introduction:** Both polycystic ovary syndrome (PCOS) and obstructive sleep apnea (OSA) are independently associated with obesity, insulin resistance (IR), and type 2 diabetes (T2D). It was unknown if women with both diagnoses had an increased risk of T2D relative to women with PCOS but no OSA. Our goal was to quantify the potential added risk for T2D in a cohort of overweight/obese adolescents with PCOS whom also had a documented diagnosis of OSA.

**Methods:** A retrospective chart review of the electronic medical records system was performed from records collected at a tertiary care referral center. Overweight or obese girls (BMI percentile ≥ 85th percentile for sex and age) aged 11-21 years diagnosed with PCOS in the last five years were identified. Demographic, medical and family history data from time of diagnosis of PCOS was abstracted for each identified patient as well as a diagnoses of T2D (which may have occurred before, after, or same time as PCOS diagnosis). Logistic regression analysis was used to examine the odds of T2D diagnosis if OSA was present.

**Results:** A total of 600 cases of PCOS accompanied by overweight/obesity were identified, of which 54 had a diagnosis of both PCOS and T2D (mean age of 15.2 ± 1.8 and 15.1 ± 1.8 years, respectively). Of the PCOS cases, 17% had a diagnosis of OSA whereas 32% of the PCOS/T2D cases had OSA. Girls with PCOS and OSA were twice as likely to be diagnosed with T2D compared to girls with PCOS without OSA (OR 2.19 95% CI 1.18-4.06; p=0.01).

**Conclusion:** Obese patients with PCOS and OSA are at an increased risk for T2D compared to girls with PCOS and obesity and no OSA. Providers are strongly encouraged to screen their obese PCOS patients for OSA to identify those at high risk for T2D. Future work is needed to determine if treating OSA decreases the risk for developing T2D in girls with PCOS.

**Support (If Any):** NA

**0743**

**CLINICAL APPLICATION OF POLYSOMNOGRAPHY IN THE ACCURATE TREATMENT OF CHILDREN WITH SNOARING**

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**Introduction:** To explore the clinical application of PSG in children with snoring.

**Methods:** From January 1, 2014 to December 31, 2016, a retrospective analysis of 316 children in the Department of ENT.

**Results:** Primary snoring children use nasal spray hormone and oral Montelukast Tablets. After 3 months, the clinical symptoms disappeared in 6 cases, 36 cases were relieved or obviously improved, and 20 cases were aggravated or without obvious change. 5 cases had no obvious change or aggravation after the treatment, and the adenoidectomy was performed. Mild to moderate OSAHS 218 cases, 182 cases accepted adenoidectomy with or without tonsillectomy, the symptoms disappeared in 106 cases, alleviated or obviously improved in 68 cases, no obvious change or aggravation of 8 in cases. 36 cases of mild to moderate OSAHS children were treated with medication, including nasal spray hormone and oral Montelukast Tablets. After 3 months of treatment, 2 cases were cured, 15 cases were relieved or improved, 19 cases were aggravated or no obvious change, and 3 cases had no obvious change or aggravation after treatment, and the he adenoidectomy was performed. 30 cases of severe OSAHS, 22 cases of children with CPAP treatment, 8 cases of children can not cooperate with continuous positive pressure ventilation treatment, 2 cases with postoperative anesthesia resuscitation of hypoxemia, of which 1 cases were transferred into intensive care unit treatment, all the children were all successful discharge with no serious complications were founded. 6 children with Central apnea. 3 cases were relieved after 3 months of CPAP treatment. 3 cases were treated with nasal spray hormone and oral Montelukast Tablets for 3 months because of Intolerance with CPAP. The symptoms of 2 cases were relieved, and 1 children had no obvious changes of symptoms.

**Conclusion:** PSG is the gold standard for the diagnosis of children OSAHS, not only can differentiating primary snoring, OSAHS and central sleep apnea, but also can reveal the severity. PSG can provide more objective basis for doctors design therapy.

**Support (If Any):** NO

**0744**

**RISK FACTORS FOR PAP ADHERENCE IN CHILDREN WITH SLEEP APNEA: RESULTS DERIVED USING A BIG DATA APPROACH**

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**Introduction:** Pediatric Obstructive Sleep Apnea (POSA), affects up to 10% of children. Adenotonsillectomy, the recommended therapy for POSA, is modestly effective in adolescents and obese children. Subsequently, children are often prescribed positive

**VII. Pediatrics**

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airway pressure (PAP) therapy. Published studies of small cohorts have identified risk factors associated with pediatric PAP non-adherence. Using a Big Data approach, we assessed “real-world” PAP adherence in children, and evaluated specific predictive factors associated with adherence.

**Methods:** Analysis of the AirView database (ResMed Corp) from October 1st 2014 to August 1st 2018 was conducted. AirView stores data derived from active PAP devices on a nightly basis to the cloud to help providers remotely monitor adherence. Data collected includes nightly PAP usage (total duration), efficacy of PAP including residual apnea hypopnea index (rAHI), and mask leak (L/min). US patients with an age <18 and >4 years at time of device activation were included. Children using only continuous PAP (CPAP) and auto-titrating PAP (APAP) were evaluated. Children using noninvasive ventilation were excluded. CMS adherence criteria were used. The study was reviewed by an institutional review board (IRB) and deemed exempt from IRB oversight.

**Results:** PAP device data were available from 20,533 children. Overall mean reported adherence in children was 45.1±33.3% (mean±SD) of days of usage for ≥4 hours with 9504 (46.3%) children meeting CMS adherence criteria after 90 days. Mean nightly usage was 3.9±2.8h. A rAHI < 5 events (p<0.001), 95th percentile pressure ≥ 8 cmH2O (p<0.001), median leak < 12 L/min (p<0.001) were all significantly associated with a higher likelihood of longer term adherence.

**Conclusion:** This analysis from the AirView database represents the largest analysis of children using PAP therapy. Our study shows room for improvement with PAP adherence and confirms several predictive factors associated with improved adherence in children. Several modifiable factors such as mask leak could be addressed to optimize adherence. Additional analysis will include the effect of age and early monitoring of AirView on long-term adherence.

**Support (If Any):** This study was supported by ResMed.

**0746**

**TWO YEAR FOLLOW-UP OF THE SHIP (SLEEP HEALTH IN PRESCHOOLERS) RANDOMIZED TRIAL: TRAJECTORIES OF CHANGE**

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**Introduction:** While multiple interventions for behavioral sleep problems in young children show short-term effectiveness, less evidence is available demonstrating long-term impact.

**Methods:** The Sleep Health in Preschoolers (SHIP) study is a randomized, active-controlled trial of a behavioral sleep intervention for preschool-aged children (30-71 months) from community settings screening positive on the CSHQ. After a 3 month acute phase of weekly intervention contact, the monthly maintenance phase lasted 9 months. Assessments at each timepoint included parent report of the Child Sleep/Wake Scale (CSWS). Children with ≥3 datapoints between baseline and 24-months were included in this analysis (N=346); t-tests compared CSWS between groups at each timepoint, trajectory analysis identified CSWS patterns over time agnostic of intervention assignment, and multinomial logistic regression examined the impact of intervention assignment on CSWS trajectory.

**Results:** Mean age at baseline was 43.5 months (SD 10.25), 46% female. Although CSWS total scores were equivalent at baseline (3.63 control and 3.64 intervention, SD 0.57), we see significant improvements in intervention vs. control at 3 months (Cohen’s D=0.80 SDs, p<0.001), 6 months (0.61 SDs),
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PARENT SATISFACTION WITH SLEEP EDUCATION DELIVERED BY COMMUNITY THERAPISTS FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS: A QUALITATIVE STUDY

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Introduction: Sleep education to address insomnia in children with autism spectrum disorder (ASD) and their parents can be effective but often inaccessible. In conjunction with a quasi-experimental pilot study, we assessed parent reaction to and satisfaction with a multi-week sleep education program delivered by community providers trained and supported by sleep specialists. We also investigated chaos and order among families who participated in the sleep education program.

Methods: At the conclusion of the sleep education program, we conducted a telephone interview with at least one parent in each of 26 families who completed the program. Interviews were transcribed verbatim then coded and analyzed using an inductive/deductive qualitative methodology. Transcripts were coded using a hierarchical coding system and analysis of the coded data was used to create a conceptual framework.

Results: Four themes and multiple sub themes emerged from the parent interviews. Themes include: 1) factors related to disrupted sleep; 2) program implementation; 3) intermediate outcomes, and 4) impacts. Factors related to disrupted sleep included sub-themes of environmental, parent and child factors. Program implementation included sub themes of facilitators and barriers. Intermediate outcomes included family harmony and family engagement. Impacts included improved sleep and parental increase in sleep literacy. One parent noted: “We have … a visual schedule and we even have timers. We have sort of looked at bedtime a little bit differently.”

Conclusion: Families of children who have ASD and sleep problems are able to identify sources of sleep problems, articulate effects of child disrupted sleep, and appreciate benefits of community-based sleep education programs that offer research-based strategies for improving child sleep. Families may benefit from support aimed at structuring family routines. Our framework identifies barriers and facilitators that may be useful in enhancing the impact of sleep interventions.

Support (If Any): American Sleep Medicine Foundation

0749  

BEHAVIORAL SLEEP EDUCATION IN CHILDREN WITH AUTISM AND INSOMNIA: PARTNERSHIP WITH COMMUNITY PRACTICES

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Introduction: Insomnia is common in children with autism spectrum disorder (ASD). Due to time constraints, pediatricians may

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MEDICATIONS PRESCRIBED FOR SLEEP PROBLEMS IN CHILDREN AND ADOLESCENTS WITH PSYCHIATRIC DISORDERS

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Introduction: Up to 90% of children and adolescents with a psychiatric diagnosis also suffer from sleep disorders, thus worsening their diurnal symptoms. Most of these children are prescribed medications to help them cope with their sleep difficulties. We analyzed the medical files of patients referred to the sleep clinic of a pediatric mental health hospital.

Methods: The medical charts of 401 patients diagnosed with or being evaluated for a psychiatric disorder and referred to the sleep clinic of a pediatric mental health hospital were reviewed by two judges with full access to the complete hospital file of each patient.

Results: The mean age of patients was 8.4 ± 4.7 years and 67% were boys. The most frequent primary diagnoses were Autism Spectrum Disorder (ASD, 39.4%) and Attention Deficit Hyperactivity Disorder (ADHD, 28.7%). A majority of patients (81.2%) was either referred by a pediatrician (42.8%) or a psychiatrist (38.4%). At intake, all diagnoses being combined, 78.5% of patients were taking melatonin, a product available over-the-counter in Canada. Antipsychotics (18.9%), antidepressants (10.7%) and clonidine (also 10.7%) were the most prescribed medications at bedtime. In ASD and ADHD more specifically, antipsychotics were the most prescribed medication at bedtime, with 23.4% and 29.6% of patients, respectively.

Conclusion: Melatonin was reported as the most frequent sleep aid taken by patients upon their arrival at the sleep clinic but dosage and timing varied greatly, pointing toward a knowledge gap in parents, prescribers, providers and/or advisors. The use of antipsychotics at bedtime in children and adolescents is alarming, given the fact that there is no published scientific evidence to support their use.

Support (If Any):
impair only limited information to parents on sleep education. Building the capacity of community therapists to provide sleep education within the context of their ongoing care is practical and time-effective for families. We describe a collaborative program whereby academic sleep physicians and psychologists provide training to community therapists in behavioral sleep interventions. These therapists then deliver education to parents of children with ASD and insomnia, who, in turn, implement behavioral strategies with their children.

**Methods:** Pilot pre/post behavioral study examining the effectiveness of providing sleep education to parents of children with ASD with sleep onset delay (30 minutes or longer). Pediatricians referred families to community therapists we had trained in sleep education. The intervention consisted of a 90-minute in-person session followed by two shorter weekly sessions conducted in-person or by phone. Parents completed baseline and post-intervention surveys including the Children’s Sleep Habits Questionnaire (CSHQ; standard and four-factor modified for ASD) and the Family Inventory of Sleep Habits (FISH). Children wore actigraphy at baseline and post-intervention. Wilcoxon signed rank tests were performed to determine change with the intervention.

**Results:** 31 children completed the intervention (mean age = 6.6 years; standard deviation, SD = 2.7). FISH improved from 46.1 (SD = 5.6) to 50.0 (SD = 3.7; p = 0.000). Standard CSHQ showed improvements in sleep onset delay (p = 0.000), bedtime resistance (p = 0.001), night wakings (p = 0.002) and sleep duration (p = 0.007). Four-factor CSHQ showed improvements in sleep initiation and duration (p = 0.000) and sleep anxiety and co-sleeping (p = 0.001). Sleep latency (minutes) measured by actigraphy improved from 55.9 (SD = 19.9) to 44.8 (SD = 16.9; p = 0.04).

**Conclusion:** Improvements were documented in sleep habits and parent-reported and objective measures of sleep in children with ASD after receiving sleep education. This work demonstrates a successful partnership among parents, community pediatricians, community therapists, and academic sleep physicians and psychologists.

**Support (If Any):** American Sleep Medicine Foundation

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**0750**

**EFFECTS OF A BRIEF PARENT-BASED SLEEP INTERVENTION ON SLEEP AND CLINICAL SYMPTOMS IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER, AND PARENTAL SLEEP AND MENTAL HEALTH**

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**Introduction:** Sleep problems are common in children with attention deficit hyperactivity disorder (ADHD), with a prevalence rate as high as 73%. Sleep difficulties are strongly associated with increased behavioural problems and impaired daytime functioning in ADHD children, and often pose significant challenges and stress to the families. The aims of this pilot study were to explore the effects of a brief parent-based behavioural sleep intervention on sleep and clinical symptoms as well as parental sleep and mental health in children with ADHD.

**Methods:** Eighteen families with a child aged 5-12 years with ADHD and parent-reported sleep problems participated in this study. The intervention involved two one-to-one consultation sessions and one telephone follow-up with the trained clinicians, during which parents were provided with sleep education and behavioural strategies of managing their child’s sleep problems. A battery of questionnaires were completed by the participating parents at baseline and post-intervention to assess their child’s sleep and daytime functioning (Children’s Sleep Habits Questionnaires, CSHQ). Strengths and Weakness of ADHD symptoms, SWAN; Children Behaviour Checklist, CBCL; Pediatric Quality of Life Inventory, PedsQL), as well as their own sleep and mental wellbeing (Insomnia Severity Index, ISI; Parental Stress index-Short Form, PSI-SF).

**Results:** The intervention resulted in a significant improvement in the child’s sleep as measured by CSHQ (p < 0.01) and daytime behaviours, particularly externalizing symptoms as measured by CBCL (p < 0.05). There was no significant difference in ADHD symptoms as measured by SWAN. Furthermore, there was a significant improvement in parental sleep (as measured by ISI: p < 0.01) and a significant reduction in parental stress (as measured by PSI-SF, p < 0.05) following the intervention.

**Conclusion:** These preliminary findings support the efficacy of a brief parent-based sleep intervention for improving sleep and clinical symptoms in ADHD children as well as parental sleep and mental wellbeing. Further follow-up and more rigorous controlled trials are needed to examine the efficacy of the intervention.

**Support (If Any):** The study was supported by Health Care and Promotion Fund (ref. 30160604).
sleep problem trajectories over time on child functioning. This study examined whether distinct sleep problem trajectories from infancy through middle childhood are associated with variation in child psychosocial, behavioral, and academic functioning at ages 10-11 years.

Methods: Data were from the first six waves of the Longitudinal Study of Australian Children - Birth Cohort (5,107 children recruited at birth). Caregivers reported on child sleep problems at each time point. Child functional outcomes at ages 10-11 years included the caregiver- and teacher-reported Strengths and Difficulties Questionnaire (SDQ), the caregiver-reported Pediatric Quality of Life Questionnaire (PedsQL), and the teacher-reported Academic Rating Scale (ARS; literacy/language and mathematics) and Approach to Learning. Sleep problem trajectories were used to predict these outcomes in regression models with covariates (child sex, indigenous status, and sleep behaviors).

Results: Latent profile analysis identified five distinct sleep problem trajectories from ages 0-1 years to 10-11 years: persistent sleep problems through middle childhood (7.66% of the sample), limited infant/preschool sleep problems (9.03%), increased middle childhood sleep problems (17.02%), mild increases over time (14.43%), and no sleep problems (51.85%). Compared to those with no sleep problems, the persistent sleep problems and mild increases over time sleep problems trajectories were associated with impaired functioning across all outcomes. The limited infant/preschool trajectory was associated with poorer outcomes except for the language/literacy ARS. The increases in middle childhood group was only associated with poorer caregiver-reported PedsQL and SDQ scores. Those with persistent sleep problems had the greatest impairments, with moderate to large effect sizes (0.46 to 1.06).

Conclusion: Distinct sleep problem trajectories predict child psychosocial, behavioral, and academic functioning at 10-11 years. Having persistent sleep problems over time is linked to having the greatest functional impairments in middle childhood, underscoring the importance of identifying and intervening on sleep problems early in childhood.

Support (If Any): Sleep Research Society Foundation; National Institute of Child Health and Human Development (K23HD094905-01A1); National Health and Medical Research Council Practitioner Fellowship (1136222).

0752
DEVELOPMENT AND PSYCHOMETRIC VALIDATION OF A BRIEF SCREENING MEASURE OF ADOLESCENT INSOMNIA: THE ADOLESCENT INSOMNIA QUESTIONNAIRE
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Introduction: Insomnia is a highly prevalent sleep disorder that impacts adolescents in the community and those with co-occurring health conditions. However, there are currently no brief, developmentally-informed self-report screening measures to assess insomnia symptoms in adolescents to guide treatment decisions. We aimed to develop and validate a brief, developmentally appropriate screening measure (the Adolescent Insomnia Questionnaire; AIQ) to assess insomnia in adolescents with and without co-occurring medical conditions. We hypothesized that we would identify evidence supporting reliability, convergent/divergent validity, and criterion validity and that factor analysis would reveal subscales consistent with diagnostic criteria for insomnia. We also aimed to identify clinical cut-off scores for the presence and severity of insomnia symptoms.

Methods: Adhering to psychometric tool development requirements, a team of experts in pediatric behavioral sleep medicine developed a 13-item screening measure (AIQ). We evaluated its psychometric properties in a sample of 314 youth (11-18 years old, 64% female) from a sleep clinic, pain clinic, headache clinic and the community. We examined the factor structure, reliability and validity of the AIQ using self-report questionnaires of sleep disturbance and a semi-structured diagnostic insomnia interview.

Results: Using Exploratory Factor Analysis, we identified 3 subscales consistent with the major diagnostic criteria of insomnia: “Distress or Impairment”, “Sleep Onset”, and “Sleep Maintenance”. The AIQ showed strong reliability through high internal consistency (α=.91), strong convergent validity through positive associations with self-report measures of sleep disturbance, and divergent validity via weak relationships with parent-reported snoring. Results of Receiver Operating Curves (ROC) detected high criterion validity of the AIQ against sleep questionnaires and diagnostic interview and identified a clinical cut-off score to assist in decision making.

Conclusion: We developed the AIQ using strong psychometric procedures to address an important clinical need in busy primary and tertiary care clinical practices. We found that the AIQ has sound psychometric properties with good internal reliability, convergent and discriminant validity, and high criterion validity in a heterogeneous sample of youth.

Support (If Any): Grant K23NS089966 (PI: Law) and a Hearst Fellowship Award (PI: Bromberg).

0753
PSYCHOMETRIC PROPERTIES OF YOUTH SELF-RATING INSOMNIA SCALE (YSIS) IN CHINESE ADOLESCENTS
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Introduction: Although several insomnia scales are available for adults, no insomnia scale has been specifically developed for adolescents. This study assessed the psychometric properties of the Youth Self-Rating Insomnia Scale (YSIS) in a large sample of Chinese adolescents.

Methods: The YSIS consists of 8 items assessing insomnia symptoms and perception of sleep disturbance in the past month (See the Support below). Each item is rated on a 5-point scale. A sample of 11,452 adolescents in China completed the YSIS and a structured questionnaire to assess sleep duration, sleep problems, hypnotic use, and behavioral/emotional problems. A subsample of 242 adolescents completed retest questionnaire 2 weeks later.
**Results:** The YSIS score ranged from 8 to 40 ($M=18.5$, $SD=6.5$). Internal consistency reliability coefficient was .80 and 2-week test-retest reliability coefficient was .82. Both EFA and CFA yielded 2 dominant factors defined as insomnia symptoms and subjective sleep disturbance. The YSIS score was significantly correlated with short sleep duration, depression, attention problems, hypnotic use, sleep disordered breathing problems, and restless legs syndrome. Similar results were obtained between male and female adolescents.

**Conclusion:** YSIS is a simple, reliable and valid scale for assessing an adolescent’s perception of insomnia severity. Further research is warranted to assess its psychometric properties with clinical samples and non-Chinese adolescents.

**Support (If Any):** YSIS: During the past month, A. How would you rate the quality of your sleep overall? Very good, Good, Fair, Poor, Very Poor B. How satisfied were you with your sleep overall? Very satisfied, Satisfied, Fair, Unsatisfied, Very unsatisfied C. Trouble falling asleep? 1=Never, 2=<1 time/week, 3=1-2 times/week, 4=3-5 times/week, 5=6-7 times/week D. Wake up frequently during the night? 1, 2, 3, 4, 5 E. Wake up very early and can’t get back to sleep? 1, 2, 3, 4, 5 F. Do not get enough sleep? 1, 2, 3, 4, 5 G. Feel unrested upon waking? 1, 2, 3, 4, 5 H. Sleep difficulties interfere with your daily activities? 1, 2, 3, 4, 5

**0754**
THE EFFECT OF CONSISTENT EXERCISE ON SLEEP IN ADOLESCENTS WITH SLEEP PROBLEMS

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**Introduction:** The effects of exercise on sleep have been studied in adults, but research on this topic in children is limited. Small sample studies performed in “good sleepers” suggest positive effects of exercise on sleep in children. This study’s aim was to determine if consistent, routine exercise improves sleep latency, sleep efficiency, total sleep time, and/or daytime sleepiness in adolescents with sleep complaints.

**Methods:** This prospective study recruited adolescents (ages 12-18 years) with history of delayed sleep onset, sleep maintenance problems and/or poor sleep quality. Baseline sleep was monitored for 2 weeks with actigraphy and a sleep diary. The subjects were then instructed to exercise (moderate to vigorous intensity) daily between 3-6PM for 4 weeks. Sleep was monitored during these 4 weeks with actigraphy and a sleep diary. A Pediatric Daytime Sleepiness Scale (PDSS) questionnaire was completed at baseline and after intervention (4 weeks of daily exercise) to assess sleepiness.

**Results:** A total of 19 children with an average age of 14.1 years (range 12-17 years) were enrolled in and completed the study. Eleven were males (57.9%). After 4 weeks of routine exercise, there was no significant change in total sleep time, but the PDSS score decreased significantly from 19.42 to 15.58 (p = 0.002), sleep latency decreased from 30.24 minutes to 10.15 minutes (p = 0.001), and sleep efficiency increased significantly from 75.71% to 82.16% (p = 0.001).

**Conclusion:** Consistent exercise seems to improve sleep initiation, increase sleep efficiency and decrease daytime sleepiness in adolescents with sleep disturbance.

**Support (If Any):** Department of Pediatrics, Medical College of Wisconsin

**0755**
SLEEP DISORDER DIAGNOSIS AND SEX DIFFERENCES IN RISK OF DEPRESSIVE SYMPTOMS IN AN ADOLESCENT SLEEP CLINIC PATIENT SAMPLE

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**Introduction:** Depression is highly prevalent among patients with sleep disorders, and there is a strong association between insufficient sleep and suicidal ideation. Treatment of sleep disorders may improve outcomes for depressed patients. This study examined risk factors for depression in patients presenting for sleep disorders at a pediatric sleep clinic.

**Methods:** Data were retrospectively analyzed from patients aged 12-21. All patients were screened for depression using the Patient Health Questionnaire-2 (PHQ-2), consisting of two questions probing mood and anhedonia. Patients who screened positive on PHQ-2 were subsequently screened using PHQ-9, consisting of nine questions that mirror diagnostic criteria for depression. Logistic regression was used to examine the independent effects of age, gender, race, sleep diagnosis (Obstructive Sleep Apnea [OSA], Insomnia, Other), and BMI percentile on the likelihood of a positive PHQ-2 depression screen. Linear regression was performed to examine these relationships within the subset of patients who completed the PHQ-9.

**Results:** Among all patients screened (n=601, mean=15.7y), there were significant effects of sex ($X^2(1)=14.13$, p<.001) and sleep diagnosis ($X^2(1)=11.001$, p<.004) on PHQ-2 depression status. Females (OR=2.145, p<.001), insomnia (OR=2.98, p=.001), and OSA (OR=1.73, p=.023) patients had significantly greater odds of screening positive on PHQ-2. Within the PHQ-9 group (n=81, 64% positive PHQ-9), the effect of sex on PHQ-9 score was moderated by age (b=1.754, p=.008). Females had higher PHQ-9 scores than males (p=.017). There was also a main effect of sleep diagnosis ($F(2,75)=3.252$, p=.044); Insomnia patients reported more depressive symptoms than OSA patients (b=3.746, p=.018). OSA patients did not differ from patients with other sleep disorders (b=-.284, p=.855).

**Conclusion:** Depression is highly prevalent in adolescents with sleep disorders, and adolescent females with insomnia were found to have the highest risk. Amongst depressed patients, older females endorsed greater levels of depression than males and younger females. Regardless of sex, patients with insomnia endorsed more depression symptoms. Identification of these risk factors amongst children presenting with sleep disorders may inform earlier recognition and treatment strategies for children with depression.

**Support (If Any):** F31AA027148-01
**0756**

**FOCAL INTERVIEW OF SLEEP (FIOS) FOR CHILDREN: PRELIMINARY PSYCHOMETRICS**

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**Introduction:** Sleep-related problems are pervasive among youth with psychiatric symptoms, heterogeneous in nature, and vary by frequency, intensity, duration, and impairment. This poses a challenge for measurement of sleep problems in these populations. Although there are well-validated self-reports of sleep functioning in pediatric samples, we presently lack validated clinician-rated interviews of sleep-related problems for youth. Therefore, we developed and validated a multidimensional clinician-administered interview for sleep-related problems that are common in youth with psychiatric symptoms.

**Methods:** Participants were 46 youth (ages 9-15; M = 11.60; SD = 1.63) from sleep trial (Sleeping Tigers) delivered through the Child Anxiety Treatment Study (CATS). An independent evaluator administered the Focal Interview of Sleep (FIOS), assessing the frequency, duration and intensity of seven sleep problems (e.g., trouble going to bed, trouble falling asleep, sleepy, tired, irritable, etc.) at baseline and post-treatment. Three FIOS scores, including Number of Sleep Problems, Impairment and Total Score were derived from these ratings. Youth completed actigraphy, sleep diary, and the Sleep Self-Report; and parents rated youth sleep (i.e., Children’s Sleep Habits Questionnaire), and behavior and emotions (i.e., Child Behavior Checklist 6-18). Parents and youth also completed the Mood and Feelings Questionnaire and Screen for Child Anxiety and Related Emotional Disorders.

**Results:** Interrater reliability was excellent (ICC=.75-1.00) for FIOS Duration, Frequency and Intensity scores by sleep problem type. Internal consistency was mostly excellent (range α = .65 to .94) for sleep problems. FIOS scores demonstrated strong treatment sensitivity. Convergent validity was fair for parent- and child-report of youth sleep, and sleep quality per sleep diary. There was limited support for discriminant validity, as evidenced by non-significant Fisher's R to Z transformation for the difference between FIOS Total and behavioral/emotional problems, anxiety and mood. Baseline FIOS predicting one-year sleep outcomes was non-significant.

**Conclusion:** Findings suggest the FIOS is a psychometrically sound clinician-rated measure of sleep-related problems in youth with psychiatric symptoms. Future research can focus on discriminant and predictive validity, as well as replication in larger, more heterogeneous samples.

**Support (If Any):** National Institute of Mental Health: MH080215

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**0757**

**ASSOCIATION OF SLEEP AND TECHNOLOGIES IN A SAMPLE OF ITALIAN ADOLESCENTS**

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**Introduction:** In the last years more clinical and academic attention has been demonstrated to sleep deprivation in adolescents because of the derived risk of physical and mental problems. One of the main reason that keep adolescents in a persistent sleep deprivation status is the increased use of technologies that seem to influence the regular release of melatonin and to stimulate the wake network functioning. Aim of our study was to assess the relationship between pre-sleep habits and subjective sleep duration and quality during weekdays (WD) and weekend (WE) in a sample of Italian adolescents.

**Methods:** 972 adolescents aged 13-20 filled a self-administered questionnaires that included information on pre-sleep habits (such as browse the internet, watch TV, listen to music, use the smartphone, etc...) and on subjective sleep (total sleep time [TST], bedtime [BT], wake-up time [WU], sleep latency [SL]).

**Results:** Mean age was 15.7 (SD 1.4) yrs, 59% were female. Mean TST during WD was 456.1 (SD 57.8) min., and 551.3 (SD 87.1) min. during WE. Mean BT was 23.3 (SD 4.7) a.m. with no significant difference between WD and WE. WU time was at 06:40 a.m. (SD) during WD and at 09:50 a.m. during WE. Significant correlations between subjectively reported sleep and pre-sleep habits were found (p<.005). In particular those adolescents going to sleep later and with a lower TST during WD were the ones with the higher use of the internet, smartphone and videogames. Moreover, also on the WE, a significant correlation between late BT and increased SL was found with the following pre-sleep habits: browse the internet, listen to music, smartphone use, watch movies.

**Conclusion:** Our results confirm other literature data that show the negative impact of technologies on sleep. In particular in our sample browse the internet, listening to music, smartphone use and videogames use postponed BT and reduced WD sleep duration. These findings underline the negative impact of technologies on sleep in adolescents and open a possible way of improving pre-sleep habits by means of educational and sleep hygiene strategies.

**Support (If Any):** none

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**0758**

**NATURAL HISTORY OF INSOMNIA SYMPTOMS FROM CHILDHOOD THROUGH ADOLESCENCE INTO YOUNG ADULTHOOD: THE PENN STATE CHILD COHORT**

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**Introduction:** Difficulties falling and/or staying asleep (DFA/DSA) are the most common parent-reported symptoms of poor sleep in children, while insomnia is the most prevalent sleep disorder in adults. However, little is known about the natural history of...
childhood and adolescent poor sleep and insomnia in their transition to young adulthood.

Methods: The Penn State Child Cohort is a general population sample of 700 children (8.7±1.7y), of whom 421 were followed-up 8.3 years later during adolescence (17.0±2.3y) and 302 another 6.6 years later during young adulthood (23.6±2.6y). Subjects underwent a 9-h polysomnography in childhood and adolescence and parent- or self-reported standardized surveys at all time points. Poor sleep was defined as moderate-to-severe parent-reported (childhood) or self-reported (adolescence and young adulthood) DFA/DSA, while the presence of insomnia was also ascertained in young adulthood.

Results: Among youth without any history of poor sleep, the incidence rates of poor sleep and insomnia in young adulthood were 18.0% and 6.3%, respectively. The remission rates of poor sleep in young adulthood were similar in children who had remitted in adolescence (56.0%) and those with adolescent-onset poor sleep (50.0%), while significantly lower (29.6%) in adolescents with childhood-onset poor sleep (P<0.05). The incidence rate of insomnia in young adulthood was significantly increased (P<0.05) in youth with a history of poor sleep, regardless of whether it was childhood-onset (18.5%), adolescent-onset (18.8%) or had remitted in the transition to adolescence (16.0%).

Conclusion: This ongoing 15-year longitudinal study with three time points shows that childhood-onset insomnia symptoms that persist into adolescence are highly unlikely to remit in the transition to young adulthood, a low remission rate (25-30%) similar to that found in middle-age adults. Interestingly, worsening into insomnia in young adulthood was also ascertainment in young adulthood.

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Support (If Any):

0759

QUANTIFICATION OF NEUROMUSCULAR EFFORT IN UPPER AIRWAYS OF PEDIATRIC PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Airway obstruction in obstructive sleep apnea (OSA) is caused by a breakdown in the balance between neuromuscular control of the airways and aerodynamic forces acting on the airway walls. Computational fluid dynamics (CFD) simulations of respiratory airflow can determine the aerodynamic forces, and realistic airway wall motion can be determined from cine magnetic resonance imaging (MRI). The relationship between these forces and motion reveals the underlying neuromuscular control of the airway.

Methods: CFD modeling was performed in three patients with OSA (age=12.2±6.3, obstructive index (OI)=42.1±51.5). CFD simulations modelled airflow during breathing in airway anatomies obtained from MRI and with airway wall motion determined from registration of cine MRI. Respiratory flow rates were recorded synchronously with MRI via an MRI compatible pneumotach. CFD simulations calculated the aerodynamic forces (pressure and wall shear-stress) acting on the airway wall throughout the airway during the breath. Combining these forces with the motion of the airway wall (taking the vector dot product) allowed calculation of the work done by aerodynamic forces on the airway wall and of the neuromuscular work done on the air in the lumen. The total of this effort in the oropharynx and larynx was then calculated over the duration of inhalation and exhalation.

Results: The volume of upper airway increased during inhalation and decreased during exhalation, contrary to the air pressure forces. The ratio of aerodynamic to neuromuscular work done in moving the airway wall in the oropharynx and larynx increased with OI, (OI=16.7,23.5,101.4 corresponding work ratio=18,27,53%). Pressure loss in the same region at peak inhalation also increased with OI (1.5,19.9,26.2cmH2O).

Conclusion: In this small cohort of patients, we have demonstrated that neuromuscular control of the airway in relation to the aerodynamic forces acting on the airway is decreased in patients with a high OI. In all cases neuromuscular control of the airway caused more airway motion than aerodynamic forces. Quantification of neuromuscular control in patients with OSA may allow treatment strategies personalized based on the patients’ ability to control their airway caliber.

Support (If Any): NIH (R01 HL136587, R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499)

0760

SLEEP SPINDLE DENSITY IN GENERALLY ANXIOUS CHILDREN AND HEALTHY CONTROLS

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Introduction: Childhood generalized anxiety disorder (GAD) is common, impairing, and linked with development of depression; however potential neurophysiological markers of the disorder have not been identified. Despite frequently reported sleep difficulties in children with GAD, studies using polysomnography (PSG) have largely failed to find abnormalities in sleep architecture. Investigations of ‘micro’ sleep features, such as sleep spindles, have not been conducted but may help to identify children at risk. An increasing number of studies reveal a link between spindle activity and emotional health. The current study compared sleep spindle activity in children with a primary GAD diagnosis to matched typically-developing controls. Association between spindle activity and symptom severity were also examined.

Methods: A total of 58 children (26 with primary GAD, and 32 matched controls) aged 7-11 years (52% female) completed diagnostic assessments and one night of PSG. None of the youth with GAD met criteria for a comorbid depressive disorder and none were taking medication. The Penn State Worry Questionnaire for Children (PSWQ) was used to assess severity of worry and the Screen for Child Anxiety Related Disorders (SCARED) was used as a measure of overall anxiety severity. Sleep spindle activity was detected during N2 and N3 sleep via HypnoLab, software.

Results: Mean spindle density was higher among children with GAD, but differences did not reach statistical significance. Linear regression models showed greater worry, but not overall anxiety, to predict greater spindle density in all children (β=.36, p=.005, R²=.189). Models did not change based the inclusion of diagnostic group.

Conclusion: In contrast to published findings of reduced spindle activity in youth with depression and social anxiety disorder, we failed to find evidence of reduced spindle activity in children with GAD. In fact, spindle activity tended to be higher in the GAD group and was significantly associated with greater worry. GAD is uniquely characterized by persistent worry, which may represent...
a form of cognitive rehearsal (i.e., a process that aids in memory encoding). Thus, worry as a cognitive process might serve to increase nightly spindle activity.

Support (If Any): None

0761
PREVALENCE OF DIAGNOSED PEDIATRIC NARCOLEPSY IN THE UNITED STATES

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Introduction: Prevalence of pediatric narcolepsy has not been well studied. The objective was to estimate the prevalence of diagnosed narcolepsy in pediatric patients (0-17 years) in a large U.S. healthcare claims database. Trends in diagnosed narcolepsy among pediatric patients also were assessed and extrapolated to the U.S. pediatric population.

Methods: Nationwide medical/prescription claims (Symphony Health) were utilized to assess prevalence of diagnosed narcolepsy per 100,000 pediatric patients for each calendar year (2013-2016). Data on age (0-6, 7-11, 12-17 years), sex, insurance type, and narcolepsy type (with/without cataplexy) were collected. Cases were identified as having either ≥2 claims with a narcolepsy diagnosis (with/without cataplexy) ≥6 months apart, or ≥1 narcolepsy claim and ≥1 multiple sleep latency test or maintenance of wakefulness test within 6 months before the narcolepsy claim. Direct standardization was applied to narcolepsy prevalence to control for possible changes in the age-sex distribution of the database.

Results: The majority of pediatric patients with narcolepsy in the database were aged 12-17 years (79.0%), female (51.6%), commercially insured (62.8%), and had diagnosis claims of narcolepsy without cataplexy (56.4%). Standardized pediatric narcolepsy prevalence increased from 8.9 (95% confidence interval [CI] 8.3-9.5) per 100,000 persons in 2013 to 10.0 (95% CI 9.3-10.6) in 2016. When extrapolated to the US pediatric population, estimated prevalence of diagnosed narcolepsy increased from 6,780 persons in 2013 to 7,606 in 2016. Estimated diagnosed prevalence increased by age category from 0.7 per 100,000 for 0-6 years to 6.9 for 7-11 years and 24.0 for 12-17 years. Codes for cataplexy in claims suggest a standardized prevalence of diagnosed narcolepsy with cataplexy of 2.9 per 100,000 in 2013 and 4.4 in 2016.

Conclusion: The prevalence of diagnosed pediatric narcolepsy increased over the study period. Findings likely represent an underestimate, as this database only includes diagnosed and insured patients. Further research is needed to understand the prevalence of narcolepsy among the undiagnosed/uninsured pediatric population and the challenges in identifying cataplexy in pediatric patients, given the high rate of narcolepsy without cataplexy observed in this study.

Support (If Any): None

0762
DIAGNOSIS OF PEDIATRIC NARCOLEPSY: REVIEW OF PSG/MSLT AT A SINGLE INSTITUTION

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Introduction: Excessive daytime sleepiness is a common symptom in children with a wide differential diagnosis. Although narcolepsy may present during pediatric years, there is often a delay in diagnosis. In adults, a polysomnogram (PSG) followed by a multiple sleep latency test (MSLT) is used to diagnose narcolepsy. There are less published data regarding the use of this test in pediatric patients. The purpose of this study is to assess PSG/MSLT variables in the pediatric population presenting with excessive daytime sleepiness and to evaluate additional variables on the PSG which may be associated with narcolepsy.

Methods: This IRB-approved, retrospective chart review evaluated data from all patients who completed a PSG and MSLT from January 2012 to June 2018 at the Nemours/du Pont Hospital for Children. Demographics, sleep study data, and clinical symptoms were reviewed for eligible patients. T-tests not assuming equal variance were used to compare the results between patients with and without narcolepsy.

Results: 183 patients completed a PSG and MSLT during the 6.5-year testing timeframe (mean age 12.6 years, 53% male, 52% Caucasian). Of these, 39 patients (21%) were diagnosed with narcolepsy. There were no demographic differences between patients diagnosed with narcolepsy and those not diagnosed with narcolepsy. On the MSLT, patients with narcolepsy showed a significantly lower mean sleep latency and more sleep-onset REM periods (SOREMs) than patients without narcolepsy (mean sleep latency: 3.21 vs. 11.15 minutes, P < 0.001; SOREMs 2.94 vs. 0.37, P < 0.001). On the PSG, there were no differences in measurements of sleep-disordered breathing between the two groups. However, patients with narcolepsy showed a higher appearance of periodic limb movements (PLMs) and higher PLM index (appearance of PLMs: 53.19% vs. 33.59% P = 0.02; PLM Index: 6.26 vs. 2.50, P = 0.03).

Conclusion: The MSLT is a valid test for diagnosing pediatric narcolepsy. Additionally, the overnight polysomnogram may reveal important clues about a diagnosis of narcolepsy. We found that patients with narcolepsy showed increased periodic limb movement compared to patients without narcolepsy.

Support (If Any): None

0763
PEDIATRIC NARCOLEPSY: REVIEW OF DIAGNOSTIC TESTING AND CLINICAL OUTCOMES IN A PEDIATRIC SLEEP CENTER

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Introduction: Pediatric patients with narcolepsy often present differently than adults leading to delayed diagnosis. There are less published data regarding diagnostic testing and outcomes in children with narcolepsy and limited FDA-approved medications for treatment. The purpose of this study is to describe clinical characteristics, PSG data, and outcomes in a cohort of pediatric patients with narcolepsy.

Methods: This IRB-approved, retrospective chart review evaluated data from all patients diagnosed with narcolepsy and who completed testing from January 2012 to June 2018 at the Nemours/duPont Hospital for Children. Clinical data including
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demographics, PSG variables, clinical symptoms, and medications used for treatment were reviewed using the EMR. Statistical analysis was performed using either t-tests or one-way ANOVA.

Results: 39 patients were diagnosed with narcolepsy during the study timeframe. 14 of these patients also had cataplexy (36%). Patients with cataplexy were older than patients without cataplexy; there were no other significant demographic differences between patients with and without cataplexy. MSLT data did not show any significant differences between these two groups. On PSG, patients with cataplexy had a higher periodic limb movement (PLM) index than patients without cataplexy. Patients without cataplexy showed elevated end-tidal carbon dioxide level compared to patients with cataplexy. Of the 39 patients, 20 were prescribed traditional stimulants, 13 prescribed nontraditional wake-promoting agents (modafinil or armodafinil), 5 were prescribed a combination of both, and one patient was treated with non-medical therapy (scheduled naps). Overall, there was a decrease in patient Epworth Sleepiness Scores after treatment which did not vary based on class of medication. All patients who were eligible to attend college or join the workforce did with no differences noted based on medication class used.

Conclusion: Pediatric patients with narcolepsy showed positive response to treatment in the form of non-traditional wake-promoting agents and traditional stimulants. The overnight PSG showed differences between patients with and without cataplexy (ventilation and PLMs). These data support earlier diagnosis and treatment of children with hypersomnia to improve symptoms and outcomes.

Support (If Any): None

0764
THE DIAGNOSTIC CONUNDRUMPOSED BY ANTIDEPRESSANT MEDICATIONS WHILE CONDUCTING THE PEDIATRIC MSLT
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Introduction: Research examining the influence of antidepressants on multiple sleep latency test (MSLT) parameters in pediatric populations is limited. We examined the impact of rapid eye movement (REM)-suppressant antidepressant medications and other clinical, actigraphy and polysomnography (PSG) characteristics on mean sleep latency (MSL) and sleep-onset REM episodes (SOREMs) in a large pediatric clinical sample.

Methods: This was a retrospective chart review. We identified 164 MSLTs performed in patients aged <18 years. All of the data were manually abstracted. Correlations between clinical, actigraphy and PSG characteristics and MSL as well as SOREMs were examined using univariate and regression analyses.

Results: Mean age of the sample was 11.9 years (SD 4.19); 62% were female, 28 (17%) were on REM-suppressant antidepressants (48% of whom were able to discontinue these prior to MSLT) and mean pediatric daytime sleepiness score was 21.7 (SD 6.1). MSL was 11.27 min (SD=5.77) and mean number of SOREMs was 0.55 (1.04). Twelve patients met criteria for narcolepsy and 40 for idiopathic hypersomnia. In the overall sample, MSL positively correlated with average time in bed on actigraphy, sleep-onset latency on PSG, and negatively correlated with age, use of REM-suppressant antidepressants and number of SOREMs (all p<0.05). The number of SOREMs positively correlated with age, BMI and arousal index and negatively correlated with use of REM-suppressant antidepressants, time in bed and total sleep time on actigraphy as well as self-reported sleep duration (all p<0.05). Similar findings were noted in the narcolepsy and idiopathic hypersomnia groups. In regression analyses accounting for factors significant in univariate analyses and sex, MSL and SOREMs continued to be associated with the use of REM-suppressant antidepressants (p=0.008 and 0.003 respectively). Further analyses examining the impact of tapering these medications in the weeks prior to MSLT did not change these associations.

Conclusion: Clinicians should account for REM-suppressant antidepressant use while interpreting the results of MSLT. Future studies examining the impact, if any, and the precise timing of the discontinuation of these medications to reduce the likelihood of spurious results are required.

Support (If Any): None

0765
DOISING, TITRATION, AND TREATMENT COMPLIANCE TO SODIUM OXYBATE THERAPY IN PEDIATRIC PATIENTS WITH NARCOLEPSY
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Introduction: Dosing, titration, and treatment compliance to sodium oxybate (SXB) were examined in a study of the efficacy/safety of SXB in children/adolescents (7-16 years at screening) with narcolepsy with cataplexy.

Methods: Participants who were SXB-naïve at study entry underwent dose titration (DT, 3-10 weeks) to an optimal stable dose (SD) of SXB; participants who were on-SXB at study entry remained on their current SD. After a 2- (SXB-naïve) or 3-week (on-SXB) SD period, participants entered a 2-week, double-blind period to continue SD SXB or receive placebo, followed by an open-label period of up to 1 year. For SXB-naïve participants, starting dose, titration rate, and maximum recommended dose in the DT period were based on weight-category. Optimal dose of SXB was defined as the dose that achieved both efficacy (improvement in cataplexy frequency/stability) and tolerability, without need for further dose adjustments. Starting dose, time to reach optimal dose, number of dose adjustments in the DT period, optimal dose reached, and percent treatment compliance across all study periods were evaluated.

Results: Of 106 participants enrolled, 74 were SXB-naïve and entered the DT period. The median (range) starting dose in the DT period was 4.5 g (2.0-4.5). Of the 72 SXB-naïve participants who received SXB in the DT period, the median (q1, q3) duration of DT period was 56.0 (42, 70) days, and 67 (91%) reached optimal dose. The most frequent number of dose adjustments during the DT period was 4. The median (range) optimal dose of SXB in the SD period was 7.0 g (3.0-9.0) (n=99). Median treatment compliance rates across study periods ranged from 82.7% and 100%.

Conclusion: Most participants who initiated SXB were able to achieve SXB SD. The rate of treatment compliance to SXB across all study periods was high. These results support dosing and titration recommendations for SXB in children/adolescents with narcolepsy. To achieve SXB SD may take several weeks and may require
several dose adjustments based on clinical symptom improvement and tolerability. 

**Support (If Any):** Jazz Pharmaceuticals

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**0766**  
**EVALUATION OF CATAPLEXY-FREE DAYS IN CHILDREN/ ADOLESCENTS WITH NARCOLEPSY WITH CATAPLEXY TREATED WITH SODIUM OXYBATE**  
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**Introduction:** Cataplexy resolves in some patients with narcolepsy when treated with sodium oxybate (SXB). A post-hoc analysis was conducted to determine the number of cataplexy-free days/week experienced by participants in a placebo-controlled, randomized-withdrawal study evaluating SXB treatment in children/adolescents with narcolepsy with cataplexy.

**Methods:** SXB-naïve participants were titrated to an optimal dose of SXB, then entered a stable dose period (SD) for 2 weeks; participants on SXB entered the SD on their usual dose of SXB for 3 weeks. After a 2-week double-blind, placebo-controlled randomized-withdrawal period (DB), participants entered an open-label safety period (OL) for total duration of 1 year or less. Cataplexy-free days/week were calculated from daily cataplexy diaries completed by participants during each study period. Safety was also assessed.

**Results:** Of 106 participants, 69.8% were SXB naïve and 30.2% were on SXB at enrollment. In SXB-naïve participants, the number (median [Q1, Q3]) of cataplexy-free days/week increased over the titration period: 0.0 [0.0, 2.0] week 1, 1.0 (0.0, 3.0) week 2, 4.0 (1.0, 6.0) last 7 days; n=71. During the last 14 days of the SD, the number of cataplexy-free days/week remained stable and was similar in participants who were SXB naïve or on SXB at study entry: 4.3 (1.0, 5.8), n=66 and 4.8 (0.8, 6.5), n=32, respectively. During the last week of the DB, the number of cataplexy-free days/week decreased to 0.0 (0.0, 2.7) in participants randomized to placebo (n=32) but remained stable at 4.0 (1.0, 6.0) in participants continuing SXB (n=31). The number of cataplexy-free days then remained stable throughout the OL. Common adverse events (>10%) in the safety population (n=104) were enuresis, nausea, vomiting, headache, and decrease in weight.

**Conclusion:** SXB treatment increased the number of cataplexy-free days/week in children/adolescents with narcolepsy with cataplexy. The safety profile of SXB in this study was consistent with previous studies in adult and pediatric narcolepsy.

**Support (If Any):** Jazz Pharmaceuticals

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**0767**  
**LONG-TERM SAFETY OF SODIUM OXYBATE IN PEDIATRIC NARCOLEPSY WITH CATAPLEXY: OPEN-LABEL CONTINUATION POST 1-YEAR OF TREATMENT**  
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**Introduction:** In a placebo-controlled, randomized withdrawal study with subsequent open-label investigation for up to 1 year, sodium oxybate (SXB) demonstrated efficacy and safety in the treatment of pediatric narcolepsy with cataplexy. In a further continuation period for up to 2 years, safety of SXB and effects on growth were assessed.

**Methods:** Participants who completed Part 1 (up to 52 weeks on study) could transition or re-enroll into the open-label continuation (Part 2) for up to an additional 2 years. Part 2 evaluations included body mass index (BMI), weight, height, treatment-emergent adverse events (TEAEs), and vital signs. Age- and sex-based percentiles for height, weight, and BMI at each assessment were determined using standardized growth charts (CDC, 2000).

**Results:** As of 30 April 2018, of the 44 participants in Part 2, 1 completed and 4 discontinued (3 withdrew consent, 1 lost to follow-up). Mean (SD) age at first SXB dose in Part 2 was 13.1 (2.2) years; 29.5% were 7-11 years, 70.5% 12-17 years; 68.2% male; and 65.9% white. In Part 1, mean baseline BMI was elevated relative to age-matched population means. In Part 1, there was slight initial decrease from baseline in median BMI and weight percentile values, which stabilized, and remained within normal range in Part 2 (median change from baseline to Part 2 month 3: BMI percentile -2.8%; weight percentile -2.4%). There was increase in absolute height and slight decrease in height percentile (median change from baseline to Part 2 month 3: height 9.0 cm, height percentile -2.0%). In Part 2, TEAEs were reported in 18/44 (40.9%) participants; most frequent TEAEs were respiratory tract infection (6.8%), constipation (4.5%), diarrhea (4.5%), gamma-glutamyltransferase increased (4.5%), headache (4.5%), weight increased (4.5%). As of 30 April 2018, for Part 2, there were no serious AEs reported and no discontinuations due to TEAEs. Vital signs remained within normal range throughout the study.

**Conclusion:** Growth parameters remained stable overall, and no new safety findings were identified during the ≤2-year open-label continuation period (Part 2).

**Support (If Any):** Jazz Pharmaceuticals

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**0768**  
**ASSESSING READINESS TO DRIVE IN ADOLESCENTS WITH NARCOLEPSY: WHAT ARE PROVIDERS DOING?**  
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**Introduction:** There are no universally accepted guidelines for assessing driving readiness in adolescents with narcolepsy. The purpose of the present study was to survey pediatric sleep medicine providers regarding their current practice patterns for assessing driving readiness in adolescents with narcolepsy, knowledge of their state laws regarding physician reporting of unsafe drivers, and opinions regarding what physician duty ought to be.
Methods: This was an anonymous web-based survey distributed via the Pedsleep listerv, which serves as a hub of communication for pediatric sleep medicine providers.

Results: A total of 52 pediatric sleep providers from 25 different states completed the survey. Eighty-eight percent of providers routinely assess driving readiness in adolescents with narcolepsy. Factors rated as “absolutely essential” by at least 50% of respondents included: history of previous fall-asleep crash or near miss, sleepiness (reported by patient), sleepiness (reported by caregiver), and cataplexy (reported by patient). Providers included maintenance of wakefulness testing: never (34%), if patient reports not mild sleepiness (10%), if patient reports moderate/severe sleepiness (25%), or always regardless of patient symptoms (30%), and the median minimally acceptable result was 30 minutes (25-75th: 20-40 minutes). There was substantial lack of knowledge regarding legal obligations for reporting.

Conclusion: These results demonstrate great variability in practice patterns among pediatric sleep medicine providers for assessing driving readiness in adolescents with narcolepsy. In addition, it shows limited knowledge of the providers about their respective state’s laws. Further studies are required to identify the best approach to assess residual sleepiness in this population.

Support (If Any): None

0769
THE UTILIZATION OF SOCIAL MEDIA TO IDENTIFY SLEEP PROBLEMS ASSOCIATED WITH PRADERWILLI SYNDROME
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Introduction: Prader Willi Syndrome (PWS) is associated with the generally accepted symptoms of hyperphagia, obesity, and developmental delay. Caregivers of children with the rare disease lack treatment options; therefore, they frequently engage on social media to learn about the diagnosis, share symptoms, and seek support. While research on sleep and PWS is limited, social listening found issues related to sleep to be the topic of many conversations in the PWS community. We therefore performed a retrospective analysis of caregivers reporting on social media.

Methods: After approval from the administrators of two private Facebook groups, TREND downloaded anonymous conversations from the Living Well group (n = 2511, includes caregivers of individuals of all ages) and the Love Bugs group (n = 493, includes children aged 0-2 years). During the time period (2012-2018), there were 24,357 comments in Living Well and 146,458 comments in Love Bugs. We performed an automated analysis of caregiver conversations to quantify sleep problems in PWS, counting the number of times a given term or phrase was mentioned. A subsequent quality assurance was performed to assure the relationship between the terms and sleep.

Results: In total, 3,749 sleep-related symptoms were documented. Dominant symptoms were: apnea (133 mentions in Living Well, 1410 mentions in Love Bugs), tiredness (163 mentions in Living Well, 500 mentions in Love Bugs), and drowsiness (112 mentions in Living Well, 503 mentions in Love Bugs). Excessive daytime sleepiness was not commonly mentioned in either group. The Living Well group mentioned narcolepsy (66 times) and cataplexy (110 times) more frequently than in the Love Bugs group (48 times for narcolepsy, 15 times for cataplexy).

Conclusion: Our retrospective analysis identified a range of sleep problems via social media of a large sample size of PWS including apnea, tiredness, narcolepsy, and cataplexy. The results suggest that the use of social media may enhance/advance our understanding of sleep problems in PWS which may be useful in directing drug development targets and management.

Support (If Any): Harmony Biosciences provided funding in support of this work.

0770
PRADER-WILLI SYNDROME: THE IMPACT OF GROWTH HORMONE ON THE SLEEP PHENOTYPES
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Introduction: Children with Prader-Willi Syndrome (PWS) are at an increased risk for sleep problems. Current treatment of PWS includes growth hormone, which may modify the sleep and clinical phenotypes. We retrospectively reviewed polysomnograms (PSGs) of children with PWS on or off growth hormone (GH) to typically developing obese (TDO) children to determine how sleep phenotypes vary.

Methods: After IRB approval, we compared baseline PSGs and clinical data from children with PWS on GH (PWS-G), off GH (PWS-O) and TDO (BMI > 30 kg/m²). Mann-Whitney U test (2-tailed) was used for statistical analysis.

Results: There were 15 PWS-O (mean age 4.95 ±6.33 years, 10 males), 9 PWS-G (mean age 9.08 ±4.12 years, 6 males), and 25 TDO (mean age 12.00 ±3.51 years, 10 males). PWS-O compared to PWS-G had higher BMIs (25.8 ±4.9 versus 24.2 ±2.9), PWS-O demonstrated more severe obstructive sleep apnea (OSA) than PWS-G (mean AHI 13.1 ±13.3 versus 9.4 ±5.5). More of the PWS-O reported insomnia (28.6% versus 16.7%) and Pediatric Daytime Sleepiness Scale (PDSS) >15 (14.3% versus 0%) than PWS-G. TDO were more obese (BMI median 37.75 ±3.9 kg/m²) compared to PWS-G and PWS-O. TDO had milder OSA (mean AHI 7.7 ±7.64). The PWS-G and PWS-O groups had lower oxygen nadirs (mean 84.3% and 82.9%, respectively) compared to TDO (mean 91.6%). None of the subjects had central sleep apnea. TDO had prolonged REM latencies (median 169.5 ±38.0 minutes) and decreased REM amounts (median 16.0 ±3.1%, p = 0.051, 0.067) while those with PWS-O and PWS-G had normal REM latencies (median 77.3 ±38.3 minutes, 86.5 ±31.9 minutes) and amounts (median 21.8 ±3.0%, 21.0 ±2.1%), respectively. TDO group reported greater sleepiness (PDSS > 15 (44%), p = 0.00058, 0.00214) and insomnia (68%, p = 0.012, 0.013) than both PWS groups.

Conclusion: GH treatment may modify the sleep phenotype in PWS. PWS-G demonstrated a lower AHI and less sleepiness than PWS-O. In comparison to TDO children, PWS-G had similar severity of OSA and REM characteristics but less sleepiness and insomnia.

Support (If Any):
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Introduction: The FDA is currently considering pitolisant as break-through therapy (Wakix®, Bioprojet Pharma, Paris, France) for the treatment of narcolepsy with or without cataplexy, for which EMA gave market approval in 2016. Published studies suggest that pitolisant has an excellent safety profile with documented adverse events including headache, irritability, anxiety, and nausea. We hypothesized that pitolisant may be able to improve sleepiness and quality of life in children with PWS and tracked patient experience data with pitolisant.

Methods: Our database includes eleven children (ages 2-16) in the United States who have obtained pitolisant from Europe via personal importation allowed at the FDA’s discretion. The families agreed to document their experience on the TREND Community platform (https://trend.community), some for more than two years.

Results: Pitolisant was well-tolerated by the children, both at initiation of therapy as well as with increasing dosage. Although, in most cases, pitolisant was obtained at considerable personal expense, all families but one chose to continue with the therapy. The children’s response to pitolisant was rapid and was characterized by improved wakefulness, alertness, tone, and language abilities. Dosing for children with PWS (4.5 - 31 mg/day) is, in many cases, higher than the 18 mg tested in European clinical trials of children with narcolepsy. All children with PWS started with the lowest possible dose of 4.5 mg/day and increased the dose gradually, as necessary, to combat excessive daytime sleepiness. Some children did note a transient buzzing in the head and transient irritability with an increase in dose. Over time, the children continue to experience decreased daytime sleepiness, improved night time sleep, as well as improved cognitive behavior as evidenced by increased processing speed and improved mental clarity.

Conclusion: The promising patient-reported experience suggests that, not only might consultation with an experienced neurologist be helpful for individuals with PWS, but pitolisant may represent a novel therapeutic option to relieve substantial PWS disease burden.

Support (If Any): N/A

0773 FAMILIAR FACTORS ASSOCIATED WITH SLEEP PATTERNS AT AGE 1 YEAR IN THE ELFE BIRTH-COHORT

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Introduction: Infant sleep plays a critical role in his/her normal development. Sleep problems, including sleep onset difficulties (SOD) and night waking (NW), in infants and young children ranges from 20% to 30% and were found to be partially persistent over time up to adulthood. In USA and UK, lower incomes and educational level as well as some racial/ethnic groups have been positively associated with children sleep problems. Few studies focused on infants. We here aimed at studying associations between familial characteristics and sleep patterns in 1-year-old infants from the French nationwide ELFE birth-cohort.

Methods: This study included 11,468 infants from the birth-cohort with information on both sleep (duration/24h (TST), SOD and NW/week) at age 1 and familial factors (parental birthplace, duration since migration to France, single parenting, home crowding index, income per consumption unit, maternal education and working schedule, main childcare). Associations were studied using multinomial logistic regressions adjusted for maternal and infant's characteristics including health, sleep habits.

Results: Mean TST was 13hrs36 including 2hrs54 of naps, 25% of the infants had TST less than 13hrs/24h and 9.3% &gt16hrs/24h. About 46% did not present SOD or NW, while 15.8% had often SOD and 22.3% NW&gt1 night over 2. Crowding index was positively associated with short sleep duration (&lt13h/24h) and negatively with longer sleep duration (&gt14hrs/24h) compared to 13-14h/24h as were migration duration &lt10 years and community and nursery assistant childcare at age 1. Low educational levels were positively associated with TST&lt11hrs/24h and intermediate consumption and maternal depression during pregnancy, twin pregnancy, breastfeeding, infant’s term, sex, small for gestational age (SGA), comorbidities and perinatal care (skin-to-skin, light protection, specific developmental program). Associations were analyzed by logistic regressions additionally adjusted for infant’s neurodevelopment and chronic respiratory treatment, sleep habits and daytime childcare at 1 year old.

Conclusion: Parents of infants born extremely preterm or small for gestational age reported less SOD, NW and IS than parents of infant born moderately preterm or normal for gestational age at age 1. Other early factors associated with 1-year-old sleep patterns are similar to those reported in term children.

Support (If Any): N/A

0772 EARLY FACTORS ASSOCIATED WITH PRETERM INFANT SLEEP PATTERNS AT AGE 1 YEAR IN THE EPiPAGE-2 NATIONAL BIRTH-COHORT

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1INSERM U1153, EAReH team, Villejuif, France, 2U1153, CRESS, EPOPé Team, Paris, France, 4INSERM, Paris, France.

Introduction: Preterm birth is associated with increased risks for several pathologies including neurodevelopmental ones. Studies on sleep patterns among preterm versus non-preterm children provide discordant results. We aimed at describing sleep patterns (i.e. sleep onset difficulties (SOD), night-waking (NW), insomnia symptoms (IS)) and identifying early associated factors at age 1 year among infants born preterm ≤34 weeks’ gestation (WG)) from the national birth cohort EPiPAGE-2.

Methods: The study included 3151 infants from the cohort with sleep information at age 1. SOD were coded as never, sometimes and often; NW as never, &lt1/night and &gt1/night and IS as presence of SOD and NW &gt1/night. Early factors studied were education, incomes, family structure, maternal age, parity, tobacco consumption and maternal depression during pregnancy, twin pregnancy, breastfeeding, infant’s term, sex, small for gestational age (SGA), comorbidities and perinatal care (skin-to-skin, light protection, specific developmental program). Associations were analyzed by logistic regressions additionally adjusted for infant’s neurodevelopment and chronic respiratory treatment, sleep habits and daytime childcare at 1 year old.

Results: Overall 12%, 62% and 26% of the infants were born at 22-26 WG, 27-31WG and 32-34 WG, respectively. At age 1, SOD, NW ( &gt1/night) and IS were declared for 56%, 30% and 23% of the infants. In multivariable analyses, infants born at 22-26 WG presented less SOD, NW and IS than those born at 32-34 WG. Being born SGA in a sibship and having a young mother (&lt25 yo) were also associated with reduced risks for SOD, NW and IS while maternal depression during pregnancy and breastfeeding were associated with slight increased risks. No association was observed between perinatal care and sleep patterns at age 1.

Conclusion: The study included 11,468 infants from the birth-cohort with information on both sleep (duration/24h (TST), SOD and NW/week) at age 1 and familial factors (parental birthplace, duration since migration to France, single parenting, home crowding index, income per consumption unit, maternal education and working schedule, main childcare). Associations were studied using multinomial logistic regressions adjusted for maternal and infant's characteristics including health, sleep habits.

Results: Mean TST was 13hrs36 including 2hrs54 of naps, 25% of the infants had TST less than 13hrs/24h and 9.3% &gt16hrs/24h. About 46% did not present SOD or NW, while 15.8% had often SOD and 22.3% NW&gt1 night over 2. Crowding index was positively associated with short sleep duration (&lt13h/24h) and negatively with longer sleep duration (&gt14hrs/24h) compared to 13-14h/24h as were migration duration &lt10 years and community and nursery assistant childcare at age 1. Low educational levels were positively associated with TST&lt11hrs/24h and intermediate consumption and maternal depression during pregnancy, twin pregnancy, breastfeeding, infant’s term, sex, small for gestational age (SGA), comorbidities and perinatal care (skin-to-skin, light protection, specific developmental program). Associations were analyzed by logistic regressions additionally adjusted for infant’s neurodevelopment and chronic respiratory treatment, sleep habits and daytime childcare at 1 year old.

Conclusion: Parents of infants born extremely preterm or small for gestational age reported less SOD, NW and IS than parents of infant born moderately preterm or normal for gestational age at age 1. Other early factors associated with 1-year-old sleep patterns are similar to those reported in term children.

Support (If Any): N/A
levels with TST &ge 16hrs/24h compared to high levels. Community and nursery assistant childcare at age 1 year were positively associated 1-to-2 NW/week. Single parenting and being a full-time working mother were negatively associated with NW whatever the frequencies while being part-time working was positively associated with SOD. Incomes or parental birthplace were not associated with infant sleep patterns.

Conclusion: Several familial factors, reflecting socioeconomic and sociocultural environment, were associated with infants sleep patterns as early as 1 year old in France. Study of associations’ persistence over time would be interesting.

Support (If Any): N/A

0774 NIGHT-SLEEP DURATION TRAJECTORIES AND BEHAVIOR IN PRESCHOOL-AGED CHILDREN FROM THE EDEN COHORT

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Introduction: The association between sleep and behavior has been extensively studied in adolescents and school-aged children, but very little attention has been given to preschoolers. A systematic review of the literature allowed us to identify 10 articles describing the link between sleep duration and behavior in preschool aged children, with only 2 from the same team using a longitudinal design.

Methods: Within the French birth-cohort study EDEN, repeated measures of children’s night-sleep duration were collected at age 2, 3 and 5-6 through parental questionnaires, and were used to model night-sleep duration trajectories. Behavior was assessed with the “Strengths and Difficulties Questionnaire” which provides 5 sub-scales measuring a child’s conduct problems, emotional symptoms, peer relation problems, antisocial behavior and hyperactivity/attention problems. The behavioral subscales were dichotomized at the higher 25th percentile. Multivariable logistic regressions, adjusted for parents’ socio-economic factors, parental characteristics, children’s characteristics and sleep habits, allowed us to study in 1021 children (53.9% boys) the association between night-sleep duration trajectories from 2 to 5-6 and behavior at age 5-6.

Results: Five distinct night-sleep duration trajectory groups were identified: short-(SS, &lt10hrs, 5.0%), medium-low- (MLS, &lt11hrs, 48.4%), medium-high- (MHS, &gt11hrs30, 37.0%), long- (LS, &ge1hrs30, 4.3%) and modifier sleepers (MS, i.e LS then MLS, 5.3%). After controlling for potential cofounders and baseline behavior at age 2, children belonging to the SS and MLS compared to MHS trajectories had, at age 5-6, increased risk of presenting hyperactivity/ inattention problems. This was observed only in boys (OR 2.8, 95%CI [1.2-6.8], and OR 2.2 [1.3-3.6], respectively; p trajectories-gender interaction =0.02).

Conclusion: Results suggest that the persistence of night-sleep duration &lt11hrs/night in preschool years is positively associated with more hyperactivity/inattention behavior, especially among boys.

Support (If Any): N/A

0775 FAMILY MATTERS: PARENTAL MONITORING, CHRONOTYPE, AND DAILY RHYTHMICITY

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Introduction: Consistent timing of daily activities (daily rhythmicity) and an earlier chronotype, are beneficial for physical and mental well-being in adolescents. Family relationships (e.g., couples, mothers and infants) are linked to individual daily rhythmicity and chronotype. However, less is known about adolescent chronotype and daily rhythmicity in the context of the parent-adolescent dyad. We examined how parental monitoring, an important dimension of the parent-adolescent relationship, influences sleep preferences, and how sleep preferences influence daily rhythmicity.

Methods: Thirty-one parents (mean age = 43.81) and their young adolescents (mean age = 12.26) completed an assessment of parental awareness of adolescents’ waking plans and activities. Chronotype was assessed with midsleep on free days using the Munich Chronotype Questionnaire. Daily rhythmicity was assessed using the Social Rhythm Metric. We used multi-level modeling to test two Actor-Partner Interdependence Models. The first model estimated the effects of parental monitoring on one’s own chronotype and on other’s chronotype. The second model estimated the effects of chronotype on one’s own rhythmicity and on other’s rhythmicity.

Results: Adolescents who perceived more parental monitoring had a later chronotype (b = .474, SE=.187, p = .046). Parent-reported monitoring was not associated with either parent’s chronotype or their adolescent’s chronotype (all p’s > .05). Adolescents’ own earlier chronotype was associated with their own greater rhythmicity (b=-.601, SE=-.229, p < .001). Parents’ own chronotype was not associated with either parent’s rhythmicity or their adolescent’s rhythmicity (all p’s > .05).

Conclusion: More parental monitoring (adolescent reported) is associated with an evening chronotype in adolescents. This suggests that young adolescents who are more delayed also have parents who are monitoring their daytime activities. Adolescents with an earlier chronotype had more consistent daily rhythms. The parent-adolescent dyad may be a novel target for addressing sleep preferences among adolescents.

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0776 A BEHAVIORAL INTERVENTION TO ENHANCE SLEEP IN SCHOOL-AGED CHILDREN: MODERATION BY CHILD ROUTINES

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Introduction: Although mounting evidence suggests that a good night’s sleep has beneficial effects on children’s executive, behavioral, and emotional functioning, many US school-aged children do not achieve recommendations for sleep duration. We previously demonstrated that a brief behavioral intervention can improve children’s objectively estimated sleep time relative to controls; however, not all children achieved clinically meaningful changes in
sleep, underscoring the need to identify factors that may promote success. We therefore examined whether household routines, which may enhance family functioning and adherence to treatment recommendations, moderated the effectiveness of the behavioral sleep intervention.

Methods: Sixty-six short-sleeping (≤ 9.5 hours/day) children ages 8 to 11 years old (M_{age}=9.75±1.02 years, 45 female, 30 Black/African American) randomized to intervention (enhance time in bed by 1-1.5 hours/night) or control with parent-reported Child Routines Inventory (CRI) at baseline were included. The CRI is a 36-item scale providing a total score and four subscales: daily living, household responsibilities, discipline routines, and homework routines. Sleep period was assessed for one week each at baseline and 2 months post-randomization using wrist-worn actigraphy (Actiwatch 2, Respironics); standard scoring procedures were employed. Moderation analysis was performed using the PROCESS macro for SPSS.

Results: Overall mean baseline sleep period was 514 ± 39 minutes/night with no differences between groups. Controlling for baseline sleep period, the intervention group had a longer sleep period at 2 months than control (b=45.93, p<.01). Treatment response was moderated by total routines score (b=1.43, p=.04). Specifically, children receiving the intervention whose families reported higher levels of routines at baseline had greater increases in sleep (b=65.34, p<.01) than those reporting fewer routines (b=26.52, p=.04). Post-hoc analyses revealed that the household responsibilities subscale score had a marginal moderating effect on treatment response (b=2.80, p=.07).

Conclusion: Established household routines may better equip families to improve their children’s sleep within the context of a behavioral intervention. Future work should consider the importance of including a focus on family routines to enhance treatment outcomes.

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0777

BEHAVIORAL SLEEP INTERVENTION: THE ROLES OF MATERNAL SOCIODEMOGRAPHIC, EMOTIONAL, AND INFORMATIONAL RESOURCES

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Introduction: Behavioral sleep interventions (BSI) are often implemented by parents to promote independent infant sleep and reduce night wakings. In regard to efficacy, research often focuses on the type of BSI employed (e.g., unmodified extinction or modified extinction) but less work is done to understand the role(s) of sociodemographic, emotional, and informational resources. The present study investigates several maternal resources to identify mothers who may need more support when implementing BSI.

Methods: Mothers (n=38) at 6 months post-partum completed the State-Trait Anxiety Inventory (STAI) and the Sleep Practices Questionnaire (SPQ). SPQ items were used to determine the degree to which mothers perceived their infant’s sleep-related behaviours as problematic (1: not at all to 5: definitely). Items included: 1) “How much of a problem for you is it to put your baby to sleep at bedtime?”, 2) “Overall, how much of a problem is it for you to put your baby to sleep at bedtime?”, 3) “How much of a problem for you is it to help your baby learn to sleep through the night?” and 4) “How much of a problem for your baby is it to learn to sleep through the night?”. Pearson correlations were used to assess the associations between maternal anxiety and perceptions of infant sleep-related behaviours.

Results: Mothers with higher levels of anxiety reported that their infant’s nocturnal awakenings were more problematic (r=0.43; p<0.01). They also reported that it was more problematic for them to put their infant to sleep at bedtime (r=0.41; p<0.05), for them...
to help their infant learn how to sleep through the night (r=0.40; p<0.05), and for their infant to learn how to sleep through the night (r=0.45; p<0.01).

Conclusion: Findings add to the existing perinatal sleep literature by considering mothers' perceptions of their infants' sleep-related behaviours in addition to their anxiety. Present results suggest that maternal anxiety is related to the degree to which mothers perceive their infant's sleep behaviours as problematic. Maternal perceptions should therefore be considered by clinicians when working with new mothers.

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0779
PARENTAL DEPRESSIVE SYMPTOMS AND INFANT SLEEP ARRANGEMENTS: THE CONTRIBUTING ROLE OF PARENTAL EXPECTATIONS

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Introduction: Infant sleep arrangements have been shown to be associated with maternal depressive symptoms. However, parental expectations about infant sleep location are rarely taken into consideration. Moreover, there is little research that includes fathers in pediatric sleep studies. The aims of this study were 1) to compare parental attitudes regarding sleep arrangements (solitary vs co-sleeping), and 2) to explore the association between current sleep location, expectations, and depressive symptoms, in both mothers and fathers.

Methods: Sixty participants (30 couples), took part in this study when their infant was 6 months old. General attitudes about solitary sleeping and co-sleeping, current sleep location (solitary vs co-sleeping), and concordance between parental expectations and current infant sleep arrangement (Does your baby currently sleep where you expected him to sleep?), were assessed using the Sleep Practice Questionnaire (SPQ). Parental depressive symptoms were measured using the self-administered Center for Epidemiologic Studies Depression Scale (CES-D). Parental attitudes about infant sleep arrangement were compared using paired t-tests. A linear regression analysis was used to assess the predictive value of sleep location (solitary vs co-sleep) and concordance between expected and current sleeping arrangement on depressive symptoms.

Results: In general, fathers were more supportive than mothers of solitary sleeping arrangements (p<0.001), and mothers were more supportive than fathers of co-sleeping arrangements (p<0.05), regardless of the infant's current sleep location. When both mothers and fathers were pooled together, current sleep location was not associated with depressive symptoms (p>0.05). However, when current sleep location was different than expected, higher levels of depressive symptoms were observed (p<0.01).

Conclusion: Mothers and fathers have different attitudes regarding solitary sleeping and co-sleeping arrangements. While the current sleeping location per se did not contribute to the presence of depressive symptoms, a mismatch between expectations and current sleeping arrangement was associated with more depressive symptoms. Researchers and clinicians should consider the expectations of both parents regarding their infant’s sleep arrangement.

Support (If Any): SSHRC, FRQS

0780
LONGITUDINAL AND MULTIMODAL SLEEP ASSESSMENT IN CHILDREN OF MOTHERS WITH DEPRESSION DURING PREGNANCY: PRENATAL ANTIDEPRESSANT EXPOSURE ASSOCIATED WITH DECREASED SLEEP DURATION AT 18-MONTHS AND EARLIER SLEEP SCHEDULES AT 18- AND 36-MONTHS

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Introduction: Few studies have investigated sleep effects of prenatal antidepressant use and those that exist lack control groups and include other substance exposure. In neonates, increased REM sleep and decreased total sleep time have been linked with exposure but longitudinal effects are unknown. Gaining a more accurate understanding of neurodevelopmental effects of prenatal antidepressant exposure on children and how these effects compare with the effects of untreated maternal depression will aid pregnant, depressed women in making informed treatment decisions.

Methods: Participants were 30 children and their mothers who participated in the Fetal and Infant Response to SRI Treatment (FIRST) study, a longitudinal investigation of the effects of antidepressants used during pregnancy. The present study examined child sleep parameters at 18 and 36 months utilizing a multimodal sleep assessment including sleep recordings, wrist and crib actigraphy, as well as sleep diary and questionnaires. Mothers-child pairs were categorized as: 1) No depression or ADs during pregnancy (NoEXP); 2) Depression, no ADs (DEP); 3) Depression with ADs (AD).

Results: Accounting for concurrent maternal depression severity, 18-month-olds with prenatal antidepressant exposure woke up 90 minutes earlier on average than same-age children without AD exposure (p = .07) and experienced an average nightly sleep duration that was 2 hours less than same-age children without AD exposure (p < .05). Also accounting for concurrent maternal depression severity, at 36 months, AD-exposed children went to bed on average 75 minutes before same-age unexposed children (p < .05).

Conclusion: Children of mothers using antidepressants during pregnancy go to bed earlier, wake up earlier, and are in bed fewer hours per night than children without prenatal antidepressant exposure. Further investigation of the circadian and sleep effects of prenatal antidepressant exposure is merited as well as other neurodevelopmental effects that might be related.

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0781
PATTERNS OF FETAL HEART RATE RESPONSE TO MATERNAL SLEEP-DISORDERED BREATHING EVENTS

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Introduction: Despite increasing recognition that maternal obstructive sleep apnea (OSA) increases risk for pregnancy complications, the fetus is less frequently targeted for study. Some
evidence suggests that fetal heart rate (FHR) decelerations, the primary indicators of fetal distress, are elicited by OSA events. More generally, expression and maturation of FHR and patterns of variation reflect development of the fetal nervous system and are predictive of child developmental outcomes. Thus, we sought to identify patterns of FHR response to OSA events in pregnant women.

Methods: Obese pregnant women (BMI>30) underwent third trimester overnight polysomnography with simultaneous collection of fetal electrocardiography (n=69). FHR during and immediately following maternal apneas/hypopneas was examined using multi-level functional principal components analysis to identify FHR response patterns.

Results: We identified a total of 522 apneas/hypopneas with valid fetal heart rate data for analysis. At the event level, two principal components captured 98% of variability. At the participant level, 97% of variability was captured by 2 principal components, with participant level heterogeneity explaining 9% of total variability. Across participants, 64% of variability was explained by FHR patterns of either elevating or dropping first with eventual recovery to the baseline state, while 33% of the variance was explained by the heterogeneity of how much each fetus recovered its HR to the original level. At the event level, a nearly constant baseline FHR shift contributed 92% of variance. Another 6% of variability was explained by the level of change of FHR in the middle of each event.

Conclusion: This study is the first to characterize FHR response to maternal apneas/hypopneas during sleep. Although only a small part of FHR heterogeneity was contributed at the participant level, a subgroup of fetuses showed a pattern of gradual FHR change in the middle and recovery to the initial state at the end of apnea/hypopnea events. We are performing further analyses to identify maternal-fetal characteristics that place some fetuses at greater risk for alternative patterns of FHR responsiveness and to determine whether these patterns are associated with fetal well-being.

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0782
CIRCADIAN RHYTHM SLEEP DISORDERS AND THEIR PREDICTORS AMONG CHILDREN WITH AUTISM - A PROSPECTIVE CASE CONTROL STUDY.
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Introduction: While sleep disturbances have been widely reported among children with Autism spectrum disorders (ASD), there are fewer reports addressing and objectively assessing circadian sleep wake rhythm abnormalities in this population. This study was conducted with the objective of characterizing various circadian sleep wake rhythm disorders (CRSD) and predictors thereof among children with ASD.

Methods: Children aged 3-12 years, with ASD (group 1) and age matched controls (group 2) were enrolled. Following informed consent from parent(s), each participant underwent administration of the Vinland Social Maturity Scale, Developmental Profile 3, and Childhood Autism rating scale-2. Sleep evaluation tools included Brief Infant sleep Questionnaire (BISQ), Child sleep habit’s questionnaire and Pediatric Sleep questionnaire. Actigraphy was conducted for at least for 10 consecutive days for all participants. Diagnosis of CRSDs was based on ICSD - 3. Subjects with Sleep onset delay ≥ 2 hours; average night time sleep duration < 5 hours; average duration of day time naps ≥ 2 hours or mean total (24 hour) sleep duration < 8 hours were classified as CRSD-unspecified.

Results: We recruited 32 children in each group with similar mean age[7.15±3 vs 8.09±3.1, p = .023] and gender[27(84%) vs 23(72%) males, p=0.22], CRSDs prevalence was significantly higher in group 1 [20/32(62.5%)]; than in group 2 [2/32 (6.25%)](p<.001). In group 1, 5 children had CRSD - delayed sleep phase type, 11 had CRSD - irregular sleep wake rhythm type and 4 had CRSD-unspecified. On Multiple logistic regression analysis, autism severity (β= 0.52, p=0.008), day-time-nap irregularity (β = 0.75, p=0.03) and severe sleep problems on BISQ (β = 0.86, p=0.008) significantly predicted presence of a CRSD in the ASD group.

Conclusion: CRSDs are extremely common among children with autism. High autism severity, irregularity of daytime sleep and history of severe sleep disturbances during infancy can independently predict presence of a CRSD among them.

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internalizing symptoms in hospitalized children with ASD. Children with greater communication impairment may be more vulnerable to sleep maintenance problems. There is substantial variability in the types of sleep disturbance experienced by children with ASD, suggesting that further attention is needed to assess variation in etiology and treatment approaches.

Support (If Any): The Simon’s Foundation and the Nancy Lurie Marks Family Foundation

0784 DESPERATE FOR SLEEP: EXPLORING PARENTAL PERCEPTIONS OF MELATONIN USE AMONG ADOLESCENTS WITH NEURODEVELOPMENTAL DISABILITIES

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Introduction: Sleep disturbances are common in adolescents with neurodevelopmental disorders (NDDs) with an estimated occurrence of 50-80%. Attention-deficit/hyperactivity disorder and autism spectrum disorder are the two most prevalent NDDs. Sleep disturbances in adolescents with NDDs can intensify repetitive and stereotypic behavior, inattention, and hyperactivity, as well as impede learning and cognition. Exogenous melatonin has shown promise in increasing total sleep time and improving sleep latency in adolescents with NDDs. The purpose of this study was to describe parents’ perceptions and experiences with melatonin use in their child with an NDD.

Methods: A descriptive qualitative approach was utilized. A convenience sample of parents of adolescents diagnosed with NDDs were recruited from a Midwest academic medical center. Telephone interviews were conducted with 26 parent participants. Semi-structured interview guides directed discussion. Interviews were recorded, transcribed verbatim, and analyzed using conventional content analysis.

Results: Five themes emerged: (1) Sleep Disturbance & Sleep-related Impairment, (2) Life before Melatonin: Abundance of Sleep Interventions, (3) Melatonin Initiation, (4) Life after Melatonin, and (5) Safety & Naturalness. Before initiating melatonin, all parents (n=26) stated their child had experienced difficulties falling asleep. Parents described impacts on child functioning, such as tiredness (n=14), irritability (n=11), and difficulty concentrating (n=5). Impacts on family functioning, such as parental sleep disruption (n=12) and increased stress (n=10), were noted. The majority (n=19) attempted behavioral interventions prior to initiating melatonin; interventions included sleep hygiene (n=18), electronics restrictions (n=11), and aromatherapy (n=7). At the recommendation of their healthcare provider, 62% (n=16) reported first initiating melatonin. All participants (n=26) described improvement in their child’s sleep latency with melatonin. The majority of parents (n=24) believed melatonin was safe to use in their child, and all (n=26) believed melatonin was natural, without major health or safety issues.

Conclusion: According to parents of adolescents with NDDs, melatonin is a safe and effective intervention for managing their child’s sleep disturbances. Future studies would benefit from the development and standardization of age-appropriate pediatric sleep-related intervention protocols, including the use and long-term safety of exogenous melatonin.

Support (If Any):

0785 NATURALISTIC SLEEP PATTERNS ACROSS 12 WEEKS REFLECT ADHD SYMPTOMATOLOGY IN CHILDREN

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Introduction: In children, attention-deficit/hyperactivity disorder (ADHD) has been associated with poor sleep, yet few studies have objectively measured sleep patterns in this population. Our goal was to test the hypothesis that reduced sleep regularity indexes ADHD symptoms in children.

Methods: The sleep-wake patterns of thirteen middle-school students (8F; 12.6±0.7 years; varying in ADHD severity) were monitored for twelve weeks using wrist-worn actigraphy and daily diaries. ADHD symptoms were assessed at the beginning of the recording period using Conners-3 rating scales completed by teachers and parents. Sleep variables of interest (duration, timing, regularity) were calculated from actigraphy. Regularity was assessed through the Sleep Regularity Index, a 24-hour autoregressive prediction of sleep-wake scores. Multiple regression analyses assessed associations between sleep outcomes and ADHD symptoms, controlling for gender and age.

Results: Our sample captured a broad range of ADHD severity (hyperactivity T-scores: [teacher range=43-90; median=60±14.0]; [parent range=39-85; median=57.0±12.9]). More irregular sleep was associated with higher teacher-rated hyperactivity (b=-0.0025;r²=.2.54;p=.032;η²=.42). Unlike teacher ratings, no associations were found with parental report (b=-0.0011;r=-0.88;p=4.02;η²=.14). Regardless of reporter, no significant associations (all p’s>.05) were present between symptoms and other sleep variables of interest: duration (i.e., total sleep time) and timing (i.e., bedtime, sleep midpoint).

Conclusion: These data indicate sleep regularity as a potential novel index of ADHD severity. More irregular sleep across the 12-week interval was associated with more hyperactive and impulsive behaviors in youth, as rated by their classroom teachers. This effect was specific to sleep regularity, with variables pertaining to sleep length or timing not associated with symptoms. The effect’s specificity to teacher report may reflect the unique on-task behaviors present in the classroom, underscoring the importance of considering multiple reporters when assessing youth. Finally, whether heightened hyperactivity is driving more erratic sleep, or whether poor sleep is leading to hyperactive behavior cannot be determined from these cross-sectional analyses. Ongoing data collection with longitudinal measurements of behavior and brain function may better untangle the directionality of these relationships.

Support (If Any): Rhode Island Foundation Grant & K01MH1109854 (JMS); Brown University Undergraduate Teaching and Research Award (GdQC)

0786 ADHD SYMPTOMS MODERATE THE NEURAL VULNERABILITY OF INHIBITION TO SLEEP LOSS IN CHILDREN

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REFLECT ADHD SYMPTOMATOLOGY IN CHILDREN

VULNERABILITY OF INHIBITION TO SLEEP LOSS IN CHILDREN

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Conclusion: These data indicate sleep regularity as a potential novel index of ADHD severity. More irregular sleep across the 12-week interval was associated with more hyperactive and impulsive behaviors in youth, as rated by their classroom teachers. This effect was specific to sleep regularity, with variables pertaining to sleep length or timing not associated with symptoms. The effect’s specificity to teacher report may reflect the unique on-task behaviors present in the classroom, underscoring the importance of considering multiple reporters when assessing youth. Finally, whether heightened hyperactivity is driving more erratic sleep, or whether poor sleep is leading to hyperactive behavior cannot be determined from these cross-sectional analyses. Ongoing data collection with longitudinal measurements of behavior and brain function may better untangle the directionality of these relationships.

Support (If Any): Rhode Island Foundation Grant & K01MH1109854 (JMS); Brown University Undergraduate Teaching and Research Award (GdQC)
Introduction: Sleep disruption is a proposed mechanism underlying disinhibition in attention-deficit/hyperactivity-disorder (ADHD); however, whether ADHD symptoms bestow increased vulnerability to sleep loss is unknown. Thus, we combined a behavioral go/no-go paradigm with functional neuroimaging in a dimensional sample of child ADHD to test whether those with more ADHD symptoms will be less resilient to the consequences of short sleep.

Methods: 13 children (7F; aged 11.7±1.3 years) were characterized for ADHD symptomatology (inattention and hyperactivity/impulsivity) using Conners-3 scales, before sleeping at home for a week (9.5h time-in-bed [TIB]). Each then slept in the laboratory for two consecutive EEG-monitored nights: baseline (9.5h TIB) followed by restriction to 4h TIB (20h extended wake). fMRI-monitored visual go/no-go task assessing the neural systems underlying behavioral inhibition occurred each morning. Mixed-effects modelling assessed whether ADHD symptoms moderate the impact of sleep loss on behavioral and neural indices of inhibition; all models covaried age and gender.

Results: Our sample captured a range of parent-rated ADHD symptoms (inattention T-scores: 38-72; mean: 51.15±10.38; hyperactivity/impulsivity: 41-89; mean: 54.7±14.2). Extended wakefulness was associated with faster (213.5 ms) response times (RT) on go/no-go trials after commission errors (F(1,10.06)=10.46; p<.009). This effect was moderated by inattention (b=3.65; t=2.89; p=.016); that is, error-dependent RT changes were present only for children with few symptoms. Consistent with an increased failure to integrate error into behavior, symptoms (here, hyperactivity/impulsivity) were also associated with greater decreases in fMRI activation after sleep loss: activity associated with making commission errors in the right insula and activity associated with successful inhibition in the dorsal anterior cingulate cortex (voxel-wise p<.005; k=20mm³).

Conclusion: These data indicate that a short acute dose of partial sleep loss by extending wakefulness 5.5 hours can disrupt inhibition in children. ADHD symptoms were associated with differential sleep restriction changes in both behavioral and neural indices of inhibition. While preliminary, these results support the hypothesis that ADHD symptoms may bestow increased vulnerability to sleep loss in youth, thus underscoring the importance of supporting healthy sleep in children with this disorder.

Support (If Any): K01MH109854 (JMS)

0787

SLEEP PROBLEMS AND THE ASSOCIATION WITH EARLY CONDUCT PROBLEMS

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Introduction: Conduct problems (CP) refer to a variety of antisocial behaviors, including aggression, rule breaking, deceitfulness, destruction of others’ property, as well as comorbid defiance, and are considered early if present before age 10. Early CP, in comparison to adolescent-onset CP, is associated with worse physical and mental health outcomes over time. Researchers have shown that children with CP reported more sleep problems than children without CP, and increases in aggressive and rule-breaking behavior were reported in children with shorter sleep durations. However, longitudinal predictive effects of poor sleep on later externalized behaviors among children with early CP are still lacking.

Methods: Participants (N = 434) were children with early CP from an ongoing longitudinal study. Child-rated sleep problems were assessed when children were approximately 10 years old (range 8-12 years) using the Youth Self-Report of the ASEBA. Externalized behaviors were assessed one year later, using the Child Behavior Checklist (CBCL; parent and child-rated). T scores were used in analyses, such that higher scores indicate higher levels of problems. The longitudinal effect of child-rated sleep problems on externalized behaviors (parent and child-rated) was estimated in hierarchical regressions. Age, sex and internalized symptoms were controlled, given their known associations with sleep and externalized behaviors.

Results: Child-rated sleep problems significantly positively predicted parent-rated externalized behaviors one year later, after accounting for the effects of the other covariates (p < 0.05). Child-rated sleep problems did not predict child-rated externalized behaviors one year later (p > 0.05). The interaction between sleep problems and sex was not significant (p > 0.05).

Conclusion: Higher levels of sleep problems were associated with higher levels of externalized behaviors one year later, only when externalized behaviors were reported by parents. These results suggest that children with early CP might be less aware than their parents of their problematic behaviors, following sleep difficulties. These results highlight the importance of interventions aimed at improving sleep among children with early CP.

Support (If Any): Canadian Institutes of Health Research (NRF 82694), Social Sciences and Humanities Research Council (435-2012-0803)
Questionnaire (CSHQ) before and after the intervention. Explosive outbursts were scored from 1 (less severe) to 10 (more severe).

Results: The average actigraphy data over 2 weeks for the 7 children was not atypical, including sleep latency (26.9 ± 4.0 min.), total sleep time (493.1 ± 19.5 min.) and sleep efficiency (90.8% ± 1.1%). Three out of the 7 participants experienced explosive outbursts during the actigraphy recording period, for a total of 8 events (mean severity score: 6.3 ± 0.9). There were no differences in actigraphy variables extracted from the nights preceding and those immediately following the explosive outbursts. During the pre-intervention period, mothers and fathers responded in similar ways to the CSHQ (total score 49.4 ± 2.9 vs 46.4 ± 1.7, respectively), but mothers reported more parasomnias (11.1±1.2 vs 9.6±1.3; p<0.01). All of the children exceeded the CSHQ clinical cut-off of 41. Post-intervention analyses are currently being analyzed.

Conclusion: Children with TS display signs of sleep disorders according to CSHQ scores but not actigraphy. Explosive outbursts do not seem to be preceded nor followed by particular sleep patterns.

Support (If Any): Institut universitaire en santé mentale de Montréal

0789

WHY SO SLANGRY? (SLEEPY AND ANGRY) NIGHTLY SLEEP DURATION AND EFFICIENCY PREDICT INDIVIDUAL TEENS’ NEXT-DAY REPORTS OF MOOD

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Introduction: A majority of American adolescents sleep less than the recommended 8-10 hours per night. Studies indicate that adolescents who are sleep deficient report more emotional and behavioral problems, including greater stress, anger, and anxiety. The purpose of this study was to evaluate daily associations between actigraphic nighttime sleep duration and sleep maintenance efficiency (calculated between sleep onset and sleep offset) and next-day mood (anger, loneliness, happiness) among urban adolescents.

Methods: Participants were enrolled in the Fragile Families & Child Wellbeing Study, a longitudinal birth cohort of children from 20 U.S. cities. When the children were approximately 15 years old, a sub-sample (N=577) concurrently wore a wrist actigraphic sleep monitor (Actiwatch Spectrum, Philips Respironics) and completed daily diaries that included questions about mood (5-point Likert scales) for one week, from which nighttime sleep measures and next-day self-reported mood were determined. Multilevel models tested the within-person temporal association of nightly sleep duration and sleep maintenance efficiency with next-day feelings of happiness, anger, and loneliness. The models also tested the between-person association of sleep variables and mood. Analyses adjusted for sociodemographic and family characteristics, and weekend/school year.

Results: Within individuals, on nights when sleep duration was shorter than that individual’s average, next-day anger ratings were higher (p<.01), but no statistically significant association was shown for sleep maintenance efficiency and next-day anger. On nights when an individual had higher sleep maintenance efficiency than their average, next-day happiness ratings were higher (p<.01). Within-person sleep duration and sleep maintenance efficiency were not related to next-day loneliness. At the between-person level, those who slept shorter than the sample average reported higher ratings of anger (p<.01) and loneliness (p<.01) but sleep maintenance efficiency was unrelated to anger, happiness, and loneliness.

Conclusion: Our results illustrate that within-person improvements to nightly sleep may help increase next-day feelings of happiness and decrease feelings of anger in adolescents. This suggests that promoting healthy sleep habits may improve next-day and overall mood.

Support (If Any): R01HD073352

0790

PARENTAL PRESENCE AT TODDLER SLEEP ONSET WITHIN UNDER-RESOURCED FAMILIES

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Introduction: Parental presence at sleep onset is linked to poor sleep outcomes in childhood. Limited research has examined how parental presence at toddler sleep onset relates to sleep among under-resourced families; a population at increased risk of poor sleep. This study examined the associations between parental presence, bedtime variability, and toddler sleep onset. We hypothesized that parental presence would be associated with more bedtime variability and subsequently later sleep onset for toddlers.

Methods: This study uses baseline data from low-income mother-toddler dyads (age 12-32 months) who participated in an obesity prevention study. Mothers provided demographic information and completed the Brief Infant Sleep Questionnaire (BISQ). Toddlers wore Actical accelerometers for up to 7 days. Sleep was from accelerometer data using the Sadeh sleep algorithm. Bedtime variability was the within-person standard deviation (SD) of accelerometer derived sleep onset across all days. A mediation model was conducted in the SPSS macro PROCESS to examine relationships between parental presence, bedtime variability and parent-reported sleep onset.

Results: Sample included 160 low-income mother-toddler dyads; 70% African American, 72% not married, 63% unemployed, 70% living at or below poverty. Approximately 50% of parents were present at toddler sleep onset. The average variability (SD) of bedtime was 85 minutes (range = 4-213 minutes). Toddlers fell asleep around 9 pm on average. Parental presences was associated with more bedtime variability (β = 936.95, SE = 433.89, p = .03), and bedtime variability was associated with later sleep onset (β = 0.31, SE = .10, p = .001). There was a significant indirect effect of bedtime variability on the relation between parental presence and later parent-reported sleep onset (β = -291.69, 95% CI = -735.34, 11.08 p = .024).

Conclusion: Toddlers’ reliance on parents to fall asleep was associated with more variable bedtimes, and was subsequently associated with later sleep onset. Future research should investigate strategies
to help toddlers self soothe and fall asleep independently to ultimately improve toddler sleep in under-resourced families.

Support (If Any): Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), R01HD056099

0791

TEACHER PERCEPTION OF CHILD FATIGUE AND BEHAVIORAL HEALTH OUTCOMES AMONG BLACK FIRST GRADERS IN HIGH-POVERTY SCHOOLS
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Introduction: Child fatigue has been associated with behavioral outcomes, including aggression, hyperactivity, and conduct problems, which may affect academic performance. We explored whether fatigue was associated with external behavioral health outcomes in a predominantly Black (Afro-Caribbean and African-American) student population (90%). Ratings of parent and teacher agreement of child fatigue was evaluated. This analysis was part of a larger research program, which included a cluster randomized controlled trial in ten public elementary schools in historically disinvested neighborhoods.

Methods: A total of 804 first-graders (7± 0.6 years old) participated in the study focused on child self-regulation, mental health achievement, parenting and parent involvement. Externalizing behaviors (i.e., conduct problems, aggression, and hyperactivity) were reported by teachers using the Behavior System for Children (BASC-2). A composite score of teacher-perceived child fatigue was created based on ratings of child fatigue, morning alertness, and falling asleep in class. Parent perception of child fatigue was assessed using the Children's Sleep Habits Questionnaire. Regression analysis was conducted to determine the association between teacher’s reports of child fatigue and externalizing behavior problems. Cohen's kappa coefficient assessed parent and teacher agreement of child fatigue based on categorical classification of presence of child fatigue.

Results: Children who were perceived as fatigued (i.e., tiredness and falling asleep in class) by their teacher were more likely to have a high BASC externalizing composite score (T=60 cut off) (β = -0.24, p<.001). Cohen's kappa of 0.004 (p<0.05) showed a slight discordance in perception of child fatigue comparing reports from teachers and parents, although results were not significant.

Conclusion: Teacher perception of child fatigue was significantly associated with teacher BASC T-score of child externalizing behavior outcomes. Future studies should explore longitudinal relationships between fatigue and mental health.

Support (If Any): R305FO050245 and the National Institutes of Health (R01HL077331, K07AG052685, T32HL129953).

0792

PARENT AND PROVIDER PERCEPTIONS ABOUT SLEEP IN CHILDREN LIVING WITH ECONOMIC ADVERSITY
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B. Clinical Sleep Science and Practice

Introduction: Infants and toddlers need 11-14 hours of sleep daily. Children with racial/ethnic minority backgrounds and children who experience economic adversity often suffer from sleep disparities. Environmental, family, and community factors may affect their sleep and influence the need for contextually relevant sleep interventions. The purpose of this community-engaged qualitative study, guided by the Social Ecological Model, was to describe (1) parent perceptions of their own and their children's sleep patterns/practices; and (2) community pediatric healthcare providers' (PCHPs) and childcare providers’ (CCPs’) perceptions about sleep and approaches to sleep in young families living with economic adversity.

Methods: A community advisory committee guided the study. We used purposive sampling of families from a pediatric primary care center and snowball sampling to recruit providers. Semi-structured interviews were conducted with 25 parents of children (6-36 months), and 16 PCHPs/CCPs. We coded interviews simultaneously with data collection. Inductive coding and thematic analysis resulted in themes, which were compared within and across groups of participants.

Results: The sample included 13% white, 43.5% Black, 13% multi-ethnic and 44% Latina parents, of whom 94% were mothers, M age = 28.8 ± (±5.6) years. PCHPs included 6 nurses and 4 physicians. CCPs included 2 in-home and 4 center-based providers. Themes included the critical importance of sleep, despite many misconceptions about sleep; influence of family stresses and parental work schedules on sleep/bedtimes; household noise and safety worries interfering with sleep; ubiquity of electronic screens in bedrooms and family co-sleeping; perception that PCHPs and CCPs are sources of sleep information; and widespread need for more information about sleep. Participants suggested childcare centers as good locations for sleep promotion programs. CCPs wanted to learn about and add sleep to their curricula.

Conclusion: Sleep is a topic of importance for young families. There are unique challenges to developing a sleep promotion program tailored for low-income multi-ethnic communities. These findings inform our ongoing research on the development and feasibility of a community-based behavioral sleep intervention to improve sleep and prevent negative sleep-related outcomes among low-income young families.

Support (If Any): R21NR016190

0793

A COMPARISON OF CHILDREN’S SLEEP CHARACTERISTICS FROM A COMMUNITY SAMPLE AND FROM CHILD PROTECTION SERVICES FOR CHILD NEGLECT.
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Introduction: Child neglect is associated with many factors that are likely to adversely affect children's sleep quality. However, almost no studies compared sleep of children who have been exposed to this type of maltreatment to those who haven’t. The aim of this study was to compare sleep of children growing up in a neglect context to sleep of children coming from a similar socio-economic background but not exposed to parental neglect.

Methods: Items derived from the Child’s sleep habits questionnaire (CSHQ) were assessed in two cohorts of mothers of children aged 2 to 79 months, attending either an intervention group for child neglect (n=52) or activities offered by community services (n=92). A repeated measures ANCOVA was computed to assess the differences in the children’s sleep reported by both group of mothers.
Introduction: Youth from low socioeconomic status families are at elevated risk of sleep problems (El Sheikh et al., 2013). Although the sleep environment (e.g., bedding, temperature, electronics, light) contributes to sleep problems across all youth, it may be of particular concern for youth residing in low-income households and/or neighborhoods due to difficulty accessing resources, noise, and potential safety concerns. This study examined the association between sleep environment and sleep patterns in a sample of low-income Latinx youth.

Methods: Participants included 44 low-income, Latinx middle school students (43% female, Mean age = 11.7). In Fall and Spring, participants completed the Child Report of Sleep Patterns (Meltzer et al., 2014) and a questionnaire assessing past week ambient sleep disruptions, nights slept at home, and nights slept in a bed (Bagley et al., 2015; Rubens et al., in press).

Results: Participants reported an average of 2.10 (SD = 1.64) past-week ambient sleep disruptions; the most common were room temperature (46%), noise outside (36%), and someone snoring (36%). Most participants slept in a bed (89%) and at home (93%) seven nights out of the previous week. Sleep problems were repressed on sleeping in a bed, sleeping at home, and ambient sleep disruptions. Exposure to more past-week ambient sleep disruptions was associated with higher levels of insomnia symptoms, daytime sleepiness, bedtime fears/worries, and symptoms of restless legs syndrome (p < .05) in the Fall. The number of nights sleeping on a bed and symptoms of restless legs syndrome were regressed on sleeping in a bed, sleeping at home, and days of school missed in Fall (Beta = .25, p < .002), showing that the sleep variables were varying differently according to groups. Single comparison follow-up analysis using independent t-tests specified that the mothers of children in the neglect group report higher TST than the mothers in the community group (10h48±1h37 vs 10h02±1h32 respectively; t(142)=−2.82, p=.005). On the other hand, mothers from the neglect group also indicate more EDS than the mothers in the community group (1.57±.82 vs 1.25 ±.53; t(77.13) = −2.52, p=.014). No other difference was found.

Conclusion: Knowing that, in a child neglect population, parents tend to report higher level of daytime sleepiness even though they also report longer sleep duration in their child, future research should attempt to objectively evaluate children’s sleep quality in this population.

Support (If Any): None

ASSOCIATIONS BETWEEN SLEEP ENVIRONMENT AND SLEEP PATTERNS IN LOW-INCOME LATINX YOUTH

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0794

Introduction: Poor sleep is linked to devastating health and academic outcomes. However, many college students do not prioritize sleep. The relationship between sleep health literacy and sleep quality in emerging adults needs study. We assessed sleep health literacy and sleep quality over the course of a semester in students enrolled in a sleep focused course.

Methods: This study used a descriptive paired design to explore the relationship between sleep perceptions and sleep quality as a proxy for sleep health literacy and sleep hygiene practices, respectively. Full-time undergraduate students at the University of Texas at Austin currently enrolled the Freshman Signature course Sleep: Are We Getting Enough? were invited to participate. The Sleep Beliefs Scale (SBS) and the Pittsburgh Sleep Quality Index (PSQI) were administered in the first and fourteenth weeks of the semester using RedCap surveys.

Results: 161 of the 201 enrolled students completed both surveys. Participants were primarily female (54.3%), Asian (48.8%), first semester freshmen (88.9%), and living on campus (55.6%) with one roommate (58.6%). Students represented a wide range of majors (e.g. business, sciences, liberal arts, and health sciences). Baseline means for PSQI global (7.87) and SBS (13.50) scores reflect moderate sleep disturbance and low sleep literacy. Time 2 follow up scores showed statistically significantly improved sleep literacy scores (t=2.822; p=0.005) and maintenance of sleep quality (PSQI decrease 0.48 points from T1 to T2) over the course of the semester.

Conclusion: Emerging adults, roughly from the ages of 18 to 22, are vulnerable to sleep disturbances. Students demonstrated an improvement in sleep health literacy, as would be expected. However, they also reported a small improvement in the global sleep quality. This finding was encouraging in the face of the expected significant decrease in sleep quality that is commonly observed in the first year of college. This study supports the hypothesis that active education about importance of sleep for personal health as well as academic success can improve sleep health literacy and possibly prevent the expected drop in sleep quality in freshman college students.

Support (If Any):

DOES IN-SITU HIGH FIDELITY SIMULATION AND EDUCATION IMPROVE THE COMFORT LEVELS OF SLEEP TECHNOLOGISTS RESPONDING TO MEDICAL EMERGENCIES IN A PEDIATRIC SLEEP CENTER

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0796

Conclusion: Assessing disruptions in the sleep environment can inform more comprehensive sleep interventions in youth. This is particularly relevant to youth at risk of elevated disruptions to their sleep environment, such as low-income youth and those living in disadvantaged neighborhoods.

Support (If Any): none
Introduction: This sleep lab is located within a free standing pediatric hospital serving patients from infancy to 18 years of age. It is currently accredited through the American Academy of Sleep Medicine (AASM). In 2016, the AASM changed the emergency drill criteria to include annual drills performed on the unit. Few studies have been conducted to identify the best method to prepare sleep technologists (ST) to respond in emergent situations. Although these events are rare, the risk remains high. A program was developed utilizing the Medical Emergency Team (MET) and Simulation specialist. The criteria was aimed at enhancing the ST ability to recognize deteriorating patients and increase comfort levels when responding to emergent situations.

Methods: The participants were required to recognize signs of deterioration and respond appropriately to these events. Participants responded to an in-situ mock code scenario utilizing high fidelity simulation mannequins. These were conducted in the sleep lab and required participants to use available emergency equipment. Each session began with a pre-survey and introduction to the team and mannequin. Each ended with debriefing, education, post-survey, and evaluations. Wilcoxon signed-ranks tests were used to test for pre to post differences in survey items. The Holm-Bonferroni procedure was used to correct for multiple testing.

Results: A total of 14 staff members participated (1-Registered Nurse, 4-Respiratory Therapist, and 9 Sleep Technologist). The response rate for pre and post surveys was 100%. On average, respondents felt significantly more comfortable with their skills needed to perform basic life support and the ability to identify their role when a code team arrived. Additionally, education increased the comfort level of respondents when identifying signs and symptoms of sepsis and troubleshooting equipment.

Conclusion: A unit specific, in-situ mock code simulation may increase the ST ability to recognize deteriorating patient and increase their comfort levels when responding to potential high risk situations.

Support (If Any):
without the DLMO covariate. Interestingly, although no clusters exhibited higher Win-related activation during the Misaligned scan in unadjusted analyses, two large clusters emerged after accounting for DLMO: a cluster encompassing posterior cingulate, cuneus, and calcarine sulcus \((k=983, r=8.12, p=0.001)\) and a cluster encompassing the anterior cingulate \((k=1039, r=5.28, p<0.001)\).

**Conclusion:** These findings provide the first experimental evidence that circadian misalignment causes altered neural response to monetary reward in healthy adolescents. Our results also suggest that circadian features, including phase and alignment, may influence different stages of reward processing. Misalignment-induced changes in reward processing may lead to enhanced sensation-seeking activities, including substance use.

**Support (If Any):** Funding from NIH: K01DA032557 (Hasler).

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**0799**

**ACCEPTABILITY OF WEEKEND MORNING BRIGHT LIGHT AND EARLIER SCHOOL-NIGHT BEDTIMES AMONG ADOLESCENTS**

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**Introduction:** Morning bright light (BL) and sleep scheduling are used to advance circadian rhythms. Systematic studies examining barriers to using these strategies among adolescents are lacking. We examined the acceptability of these interventions in adolescents attending high school.

**Methods:** Fifteen healthy participants (16.5±0.8 years; N=8 female) from the intervention group of an ongoing study of adolescents reporting short school-night sleep (<7 hours) and late bedtimes (school-night midnight and non-school night 2midnight) are included in this analysis. Over two weeks, participants advanced school-night bedtime from their own baseline: 1h earlier during the first week and 2h earlier during the second; wake times remained stable. Individualized evening time management goals were set to encourage early bedtimes. During the intervening weekend, participants received BL from two light boxes in the laboratory (~6000 lux; three 50-minute exposures with 10-minute breaks between), during which they had access to a computer. On Sunday morning BL started 2h after their baseline mid-sleep time and 1h earlier than that on Sunday. Participants provided open-ended responses on a questionnaire probing acceptability of the intervention. Four participants completed a 3-week extension where they maintained their sleep schedules and used morning BL at least once per weekend. A semi-structured interview probing acceptability followed. Data were analyzed through NVivo software using a grounded theory approach.

**Results:** Barriers to engaging in the intervention were primarily related to maintaining scheduled bedtimes, and included: 1) perceived need to use technology; 2) need to socialize; and 3) difficulty completing nighttime activities. Participants also noted having an adjustment period to using the light. Factors improving acceptability included: 1) the ability to engage in activities on a computer during BL treatment; 2) external influences (e.g., incentives; being instructed by an adult); and 3) goal-setting. Themes, however, have not yet reached saturation. Data collection is ongoing.

**Conclusion:** Barriers to treatment must be addressed to improve outcomes. Potential avenues include motivational interviewing and psychoeducation in conjunction with evening goal-setting. Flexibility of what adolescents are able to do while receiving BL can improve treatment acceptability.

**Support (If Any):** R01HL105395 (S.J.C)

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**0800**

**SLEEP LONGER, BE ACTIVE, AND EAT HEALTHILY: 24-HOUR CIRCADIAN-RELATED BEHAVIORS ARE PROTECTIVE OF CHILDREN’S WEIGHT STATUS**

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**Introduction:** Obesity is pandemic, spans across all ages, and disproportionally affects Latinos and African Americans. Understanding sleep, physical activity and dietary behaviors that may predict childhood obesity can help identify behavioral intervention targets.

**Methods:** Data were from a cohort study of 320 Mexican American 8-10-year-old children collected at baseline, follow-up 1 (FU1) and follow-up 2 (FU2). Mothers reported on household income and acculturation status (baseline). Child height and weight were collected; BMI z-scores were calculated (FU1, FU2). At baseline and FU1, accelerometer-estimated sleep duration (minutes) and moderate- to vigorous-intensity physical activity (MVPA; minutes) were collected across three days (baseline, FU1); two 24-hour dietary recalls were performed within one month of sleep/activity assessment. The Healthy Eating Index (HEI) score and food group servings (per 1000 kcals) were computed. Factor analysis, using food group servings, revealed that servings of total vegetables, total protein, seafood and plant protein, and reduced refined grains loaded onto a construct assessing diet quality (factor loadings=0.32-0.79). Structural equation modeling was used to test behavioral predictors (sleep, MVPA, and diet) at baseline and FU1 on weight status at FU1 and FU2, respectively. Diet quality and HEI score were examined separately, resulting in four models.

**Results:** Baseline measures of longer sleep duration (β=0.26, P<0.001), higher MVPA (β=0.14, P=0.02), higher household income (β=0.12, P=0.05), but not diet quality, significantly predicted decreased BMI z-score at FU1 (Model fit indices: CFI=0.98, RMSEA=0.03, SRMR=0.04). FU1 measures of longer sleep duration (β=0.23, P<0.001), higher MVPA (β=0.18, P=0.01), and better diet quality significantly predicted decreased BMI z-score at FU2 (CFI=0.91, RMSEA=0.04, SRMR=0.04). Models explained 10% (FU1) to 12% (FU2) of the variance for children’s BMI z-score. HEI total score was not significant in separate models.

**Conclusion:** Longer sleep and more MVPA were protective of children’s weight status across time, and diet quality was protective at FU2. These findings suggest that 24-hour circadian-related behaviors—sleep, physical activity, and diet quality—are important for maintaining a healthy weight, particularly among Mexican American children.

**Support (If Any):** K01HL129087, R01 HL084404

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**0801**

**CHANGES IN SLEEP HABITS AS A FUNCTION OF AGE IN LATE ADOLESCENCE**

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**Introduction:** Understanding sleep, physical activity and dietary behaviors that may predict childhood obesity can help identify behavioral intervention targets.

**Methods:** Data were from a cohort study of 320 Mexican American 8-10-year-old children collected at baseline, follow-up 1 (FU1) and follow-up 2 (FU2). Mothers reported on household income and acculturation status (baseline). Child height and weight were collected; BMI z-scores were calculated (FU1, FU2). At baseline and FU1, accelerometer-estimated sleep duration (minutes) and moderate- to vigorous-intensity physical activity (MVPA; minutes) were collected across three days (baseline, FU1); two 24-hour dietary recalls were performed within one month of sleep/activity assessment. The Healthy Eating Index (HEI) score and food group servings (per 1000 kcals) were computed. Factor analysis, using food group servings, revealed that servings of total vegetables, total protein, seafood and plant protein, and reduced refined grains loaded onto a construct assessing diet quality (factor loadings=0.32-0.79). Structural equation modeling was used to test behavioral predictors (sleep, MVPA, and diet) at baseline and FU1 on weight status at FU1 and FU2, respectively. Diet quality and HEI score were examined separately, resulting in four models.

**Results:** Baseline measures of longer sleep duration (β=0.26, P<0.001), higher MVPA (β=0.14, P=0.02), higher household income (β=0.12, P=0.05), but not diet quality, significantly predicted decreased BMI z-score at FU1 (Model fit indices: CFI=0.98, RMSEA=0.03, SRMR=0.04). FU1 measures of longer sleep duration (β=0.23, P<0.001), higher MVPA (β=0.18, P=0.01), and better diet quality significantly predicted decreased BMI z-score at FU2 (CFI=0.91, RMSEA=0.04, SRMR=0.04). Models explained 10% (FU1) to 12% (FU2) of the variance for children’s BMI z-score. HEI total score was not significant in separate models.

**Conclusion:** Longer sleep and more MVPA were protective of children’s weight status across time, and diet quality was protective at FU2. These findings suggest that 24-hour circadian-related behaviors—sleep, physical activity, and diet quality—are important for maintaining a healthy weight, particularly among Mexican American children.

**Support (If Any):** K01HL129087, R01 HL084404
Introduction: As they grow older, adolescents tend to go to bed later, but still wake-up early to go to school during weekdays. It has also been found that boys and girls have different sleep habits. However, few studies have looked at the changes in these sleep habits in both genders across adolescence. This was the aim of the present study.

Methods: 654 adolescents (269 boys; 385 girls; 14-17 y) completed questionnaires on sleep habits. First, repeated measures ANOVAs were performed on the sleep midpoint during school nights and during weekends in order to compare the sleep patterns of boys and girls across age (14 to 17 years old). Secondary analysis were then performed on bedtimes and wake-up times during weekends using repeated measures ANOVAs to compare only the 16 and 17 years old boys and girls.

Results: A significant Gender X Age interaction was found (F [3, 4, 567] = 2.714, p < .05) for the sleep midpoint during weekends. Single comparison follow-up analysis using independent t-tests showed that 16y, the boys’ sleep midpoint on weekends was significantly later than the girls’ (5h23±1h24 vs 4h55±1h10, respectively; t (206) = 2.622, p = .01). This finding led us to investigate the sleep schedules of older teenagers. There was no difference in bedtimes during weekends between 16 and 17 year old boys and girls. However, there was a significant Gender X Age [F (1, 12, 087) = 4.466, p < .05] interaction for the wake-up times on weekends. Results show that 16 and 17 years old girls continued to gradually delay their wake-up times as they grow older. On the other hand, at 17, boys show a significant advance in their wake-up times.

Conclusion: Our results suggest that sleep habits are changing differently in boys and girls across adolescence. Further studies should look at possible explanations for these gender differences. For example, it could be hypothesized that older boys are more likely to have a job than older girls, which could explain why they wake-up earlier on weekends. Our results underline the importance of studying weekend sleep habits in late teens, as it may have a significant impact on their overall sleep.

Support (If Any): N/A

0802 CYBER VICTIMIZATION AND DEPRESSIVE SYMPTOMS: A MEDIATION MODEL INVOLVING SLEEP QUALITY
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Introduction: Cyber victimization on the internet and social media platforms is a unique form of peer victimization and an emerging mental health concern among adolescents who are digital natives. Although studies have explored the relationship between cyber victimization and depression, few have explored how sleep quality influences this association. The current study extends previous findings on cyber victimization and depressive symptoms by examining the mediating effect of sleep quality among adolescents.

Methods: A community sample of adolescents (n = 801; 57% female; mean age = 13.99, SD = .81) recruited via address-based sampling completed measures of Pittsburgh Sleep Quality Index; cyber aggression scale; and Center for Epidemiologic Studies Depression Scale Revised via on-line survey. Hayes’ (2013) approach was used to examine whether the relationship between cyber victimization and depression would be mediated through poor sleep quality among adolescents.

Results: Cyber victimization was positively associated with having depressive symptoms when controlling for adolescents’ poor sleep quality, sex, and age (c2 = .03, n (758) = 3.80, p < .01, CI [.01, .04]). The mediation analysis indicated a significant indirect effect of poor sleep quality in the relationship between cyber victimization and depression among adolescents (ab = .02, bootstrapped SE = .004, bootstrapped CI [.02, .03]). Specifically, adolescents’ cyber victimization led to poor sleep quality (a = .10, SE = .02, p < .001), which also led to increased depression (b = .26, SE = .02, p < .001). The indirect effect of cyber victimization on depression was estimated through poor sleep quality (a*b = .10(.26) = .02).

Conclusion: Adolescents who were cyber victimized were more likely to suffer from poor sleep quality, which in turn led to a higher level of depression. Understanding these inter-correlational associations supports the need to provide effective risk prevention and interventions targeting cyber victimized youths who exhibit signs and symptoms of depression and to incorporate sleep hygiene education.

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was significantly associated with increased risk of DS. Sleep duration \(>=11\) h on weekends was also associated with increased risk of DS (OR=1.63, 95%CI: 1.21-2.20). Sleep duration on weekends showed a U-shaped relationship with DS, with the nadir at 9.5h. Furthermore, the risk of DS began to increase if the difference in sleep between weekends and weekdays was \(>=4\) h.

**Conclusion:** Our findings suggest that short sleep duration (\(<=6\) h) on weekdays and weekends (\(<6\) h), long sleep duration (\(>=11\) h) on weekends, and the difference in sleep duration \(>=4\) h between weekends and weekdays are all associated with increased risk of subsequent depressive symptoms in adolescents.

**Support (If Any):** None

**0804 SLEEP DISTURBANCE IN YOUTH AT HIGH AND LOW RISK FOR DEPRESSION**

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**Introduction:** Parental depression is a robust risk factor for youth psychopathology. The pathways through which familial depression confers risk for offspring remain unclear. Sleep disturbance is a transdiagnostic risk factor for psychopathology. No previous study has examined whether youth at high and low risk for depression exhibit distinct sleep patterns. Thus, the current study examined differences between high- and low-risk youth on several dimensions of sleep health: duration, quality, timing, and variability.

**Methods:** We examined 83 adolescents (ages 9-14; 50% female), including 46 at high-risk (based on parental depression) and 47 at low-risk (without parent psychopathology). At baseline, youth and their parents completed questionnaires of sleep disturbance and internalizing symptoms. For 9 days, youth completed EMA reports of bed and wake times, which were used to calculate sleep duration, sleep timing (midpoint) and sleep variability. We evaluated whether there were differences between high- and low-risk youth in sleep disturbance (parent and child reports), and daily-derived sleep indices, covarying pubertal status, age, and youth internalizing symptoms (reported by parent and child).

**Results:** High-risk youth only had significantly more sleep disturbance, based on self (\(\beta=2.59, p=.01\)) and parent report (\(\beta=2.05, p=.04\)). There were no differences between high- and low-risk youth in self-reported daily sleep patterns, including sleep duration (B=16, p=.52), timing (B=.01 p=.64), or variability (B=.05, p=.70).

**Conclusion:** Findings indicate that youth with parental depression are more likely to have sleep disturbance, which is a major risk factor for psychopathology and suicide. However, these findings are specific to disturbance, and may not be present in other sleep domains. This underscores the need for assessing multiple sleep health domains in high-risk youth. Further, our findings highlight that sleep disturbance may represent a potential transdiagnostic risk factor that emerges among high-risk youth, which has implications for prevention and intervention.

**Support (If Any):** T32 HL082610 (PI: Bylsse); R01MH104325 (PI: Bylsma)

**0805 ADOLESCENT CIGARETTE SMOKING INTERACTS WITH ANXIETY SENSITIVITY IN RELATION TO SLEEP ONSET LATENCY**

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**Introduction:** Studies suggest adolescent cigarette smoking is associated with sleep difficulties (Pasch, Latimer, Cance, Moe, & Lytle, 2012), yet little work has examined smoking and sleep onset latency (SOL). Adult research suggests smoking prospectively relates to SOL (Cohrs et al., 2014). A meta-analysis found mixed evidence for adolescents (Bartel, Gradisar, & Williamson, 2015). Inconsistent findings may be due to anxiety sensitivity (AS), which has been linked to smoking (e.g., Leventhal & Zvolensky, 2014) and sleep disturbances (e.g., Gregory & Eley, 2005). The current study examined AS and the relation between smoking and SOL among adolescents.

**Methods:** We hypothesized AS would interact with smoking such that as levels of AS increased, smoking level would be more strongly, positively related to extended SOL. Ninety-four adolescents (n = 50 males) ages 12-17 (mean = 15.72; SD = 1.38) were included. The Childhood Anxiety Sensitivity Index (CASI; Silverman, Fleisig, Rabian, & Peterson, 1991) was used to measure AS. The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) was used to index SOL. Daily smoking was measured using a continuous question from the Smoking History Questionnaire (SHQ).

**Results:** Separate hierarchical multiple regression analyses were conducted revealing a significant omnibus regression model, \(F(5,88) = 9.60, p < .001,\) explaining 18.24% of variance in SOL. Age and gender did not account for significant variance in SOL scores in step 1. In step 2, CASI, \(\beta = .06, p < .001,\) \(r^2 = 0.09,\) and cigarettes per day, \(\beta = .03, p = .052, r^2 = 0.01,\) were significantly related to prolonged SOL. At step 3, there was a significant interaction between cigarettes smoked and CASI scores, \(\beta = 0.01, p < .001,\) \(r^2 = 0.09.\) Post hoc probing analyses suggested cigarettes smoked was associated with prolonged SOL, but only for adolescents who were at high or mean levels of AS.

**Conclusion:** The link between smoking, AS, and SOL suggests a complicated process requiring consideration in smoking prevention and treatment, as sleep disturbances may exacerbate symptoms.

**Support (If Any):**
HIV+, indoor combustible fuel use, secondhand smoke exposure, and daytime respiratory symptoms (breathlessness, chest tightness, phlegm, wheezing) were associated with reports of poor sleep, poor energy, nighttime wheezing and nighttime cough.

**Results:** Among 167 HIV+ and 99 HIV- adolescents, median age was 14 years and 49% were male. Although we detected no significant associations between HIV status and sleep symptoms, among HIV+ participants, CD4<200 was associated with nighttime cough (OR 3.42 (1.09-10.7)) and poor sleep (OR 5.6 (1.48-21.2)). In the overall cohort, associations (p<0.05) included: greater hours/week of indoor kerosene use with poor sleep (OR 1.05 (1.01-1.08)); secondhand smoke exposure with nighttime cough (OR 2.11 (1.13-3.93)) and poor energy (OR 2.00 (1.09-3.62)). Daytime respiratory symptoms were associated with sleep-related respiratory symptoms.

**Conclusion:** Among HIV+ adolescents, CD4<200 is associated with poor sleep and nighttime cough. Overall, exposure to secondhand smoke and kerosene combustion products is associated with poor sleep, poor energy, and nighttime cough. Daytime respiratory symptoms may represent clinical findings that could inform detection of poor sleep quality among adolescents in resource-constrained settings. Additional investigation using validated sleep questionnaires is needed to better understand the impact of indoor air pollution, HIV and other exposures on the sleep of adolescents in this setting.

**Support (If Any):** K23HL129888

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**0808 COMPARISON OF ACTIGRAPHY TO POLYSOMNOGRAPHY IN THE MEASUREMENT OF NOCTURNAL SLEEP IN CHILDREN WITH CRANIOPHARYNGIOMA**

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**Introduction:** Craniopharyngioma is a rare brain tumor located in the suprasellar region that often extends to the hypothalamus. Given this location, children who undergo resection are at greater risk for excessive daytime sleepiness (EDS) that interferes with psychosocial function, academic performance and quality of life. Polysomnography (PSG) and Multiple Sleep Latency Tests (MSLT) are gold standards for diagnosing sleep disorders. When monitoring response to treatment, however, they are time-intensive, costly, and do not offer an in vivo measure of typical sleep. We assessed the sensitivity, specificity, and accuracy of actigraphy in measuring nocturnal sleep in comparison to PSG.

**Methods:** Fifty children with craniopharyngioma (3 to 20 years) were assessed with overnight PSG and concurrent actigraphy after surgical resection and prior to proton therapy. PSG and actigraphy data were synchronized utilizing an epoch-by-epoch comparison method. Sensitivity, specificity, and accuracy were calculated using measures of true wake, true sleep, false wake, and false sleep, calculated based on the percentage of agreement between PSG versus actigraphy. In addition, paired samples t-tests evaluated differences in sleep outcome variables between the two measures.

**Results:** Actigraphy was 93% sensitive and 87% accurate in measuring sleep versus wakefulness in comparison to PSG, while specificity was poor (55%). Actigraphy was a reliable measure of sleep efficiency, however, significant differences were found for total sleep time (TST; p=.002) and wake after sleep onset (WASO; p<.001). Actigraphy underestimated TST by 15.1 minutes and overestimated WASO by 14.7 minutes.

**Support (If Any):** N/A
B. Clinical Sleep Science and Practice

Conclusion: Strengths of the current study include being first to assess whether actigraphy is a reliable measure of nocturnal sleep in comparison to PSG within pediatric craniopharyngioma. Actigraphy demonstrated strong sensitivity and accuracy and was a reliable measure of sleep efficiency. While differences exist for actigraphy-measured TST and WASO in comparison to PSG, this work provides a foundation for exploring actigraphy in measuring treatment response to wakefulness-promoting medication in pediatric craniopharyngioma.

Support (If Any): This study was supported by ALSAC.

0809
FEASIBILITY AND ACCEPTABILITY OF LIGHT THERAPY TO INCREASE ENERGY IN ADOLESCENTS AND YOUNG ADULTS NEWLY DIAGNOSED WITH CANCER
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Introduction: Fatigue is one of the most consistent, distressing symptoms reported by adolescent/young adult (AYA) oncology patients. Bright white light (BWL) has been shown to combat symptoms reported by adolescent/young adult (AYA) oncology patients. We therefore designed a study to estimate the feasibility and acceptability of BWL to decrease fatigue in AYA oncology patients. We were therefore designed a study to estimate the feasibility and acceptability of BWL to decrease fatigue in AYA oncology patients with newly diagnosed solid tumors.

Methods: Participants were randomized to receive dim red light (DRL, n = 24) or BWL (n = 27) via LiteBook® (retrofitted with adherence monitors) for 30 minutes upon awakening daily for eight weeks. Feasibility was defined as at least 65% of participants consenting and at least 50% utilizing the light on at least 50% of days. Of the 70 patients approached, 55 consented and randomized. Four participants never used the light book and were deemed passive refusals; final n = 51 (mean age = 15.96 ± 2.41, range = 12-22 years; 49% female). To determine acceptability, treatment-emergent extreme headache or eye strain were evaluated. Side effects were assessed weekly via modified Systematic Assessment for Treatment Emergent Effects (SAFTEE). Participants also completed mood, quality of life, and fatigue measures.

Results: 72.96% of those approached consented and participated. 67% used the light for at least 15 minutes on at least 50% of the days. Mean adherence was 57% of days on study (CI 47.57-62.1%). At each stopping point, BWL demonstrated no significantly greater number of extreme treatment-emergent effects than DRL.

Conclusion: This is the first study to evaluate feasibility and acceptability of light therapy to reduce fatigue in AYA oncology patients, and we found that this therapy is feasible and acceptable. Measures of fatigue, quality of life, and mood will be evaluated as secondary analyses to provide preliminary support for an effectiveness trial. Given the severity of fatigue experienced by AYA oncology patients and the lack of evidence-based interventions to ameliorate this symptom, our approach promises new research opportunities for symptom management.

Support (If Any): ALSAC

0810
SLEEP AND FERRITIN IN ADOLESCENT FEMALES WITH AND WITHOUT ASTHMA
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Introduction: Although children with asthma are known to have sleep disturbances, few studies have compared sleep quality between adolescents with and without asthma using both validated objective and subjective measures. Further, recent studies have suggested a relationship between low serum ferritin and restless sleep in youth, as well as a potential relationship between low serum ferritin and asthma. The aim of this study was to examine sleep quality and serum ferritin in adolescent females with and without asthma.

Methods: Study participants were adolescent females (ages 12-17 years) with and without asthma. Objective sleep quality was measured with one-week of actigraphy (sleep efficiency [SE]); subjective sleep quality was measured with the pediatric PROMIS Sleep Disturbance (SD) and Sleep Related Impairment (SRI) item banks, and the Pediatric Sleep Questionnaire (PSQ). Finally, serum ferritin was collected at the end of the study week. Due to the small sample size, effect sizes (Cohen’s d) are presented rather than p-values (small effect 0.2, medium effect 0.5, large effect 0.8).

Results: Fourteen adolescents with asthma (mean age 14.3y, mean BMI 20.0, 71% White, 36% Hispanic) and 17 adolescents without asthma (mean age 13.8y, mean BMI 22.7, 71% White, 24% Hispanic) participated. There were no significant differences between groups for age or BMI. Compared to adolescents without asthma, adolescents with asthma had slightly lower actigraphic SE (89.4% vs. 90.8%, d=0.38), more symptoms of sleep disordered breathing (PSQ, 0.12 vs. 0.07, d=0.55), poorer subjective sleep quality (PROMIS SD, 56.1 vs. 54.4, d=0.47), and greater daytime sleepiness (PROMIS SRI, 51.6 vs. 46.1, d=0.89). Finally, adolescents with asthma had lower ferritin compared to adolescents without asthma (20.2 vs. 31.4, d=0.73). Although not significant, lower ferritin was modestly associated with poorer objective SE in adolescents with asthma (r=0.30), but not in adolescents without asthma (r=0.08).

Conclusion: Preliminary findings from this study highlight differences in both objective and subjective sleep quality between adolescent females with and without asthma. Additional research is needed with larger samples to further examine the relationship between asthma, sleep, and ferritin in adolescents.

Support (If Any): NIH R01HL119441

0811
POLYSOMNOGRAPHIC CHARACTERISTICS OF ALTERNATING LEG MUSCLE ACTIVATION IN CHILDREN
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Introduction: Currently available studies have not evaluated the prevalence and the polysomnographic characteristics of Alternating Leg Muscle Activation (ALMA) in the pediatric population.

Methods: Polysomnographic scoring and description of ALMA sequences on consecutive pediatric overnight diagnostic polysomnography (PSG) of 122 children (male =71, female = 51), median age 6.5y (10mo-12y). All patients were referred for evaluation for obstructive sleep apnea.

Results: Thirteen percent of subjects,11 males, five females, median age 9 (2-12y), had ALMAs with a median number of three ALMA
sequences per night (range: 1-84). We observed that 14.7% of all ALMAs occurred during waking, 85.3% occurred during sleep. Of those ALMA episodes occurring during sleep, 43% occurred during stage 1, 42% during N2, 0.8% during N3, and 14.2% during REM. One-third of ALMA sequences were not related to arousals, one third occurred before, and one third occurred after arousals. The median duration of ALMA sequences was 6.5 sec (1.2-101 sec), and median frequency was 1.9 Hz (0.5-3 Hz). The analysis of 2558 single electromyographic bursts distributed over 156 ALMA sequences showed a median duration of 380 msec (40-2725 msec), median amplitude of 70 microvolts (7-1236 microvolts), median interburst interval duration of 480 msec (50-4240 msec), and the median burst to burst alternation frequency was 2.1 Hz (0.23-20 Hz). Significant cardiac frequency fluctuations were observed in 47.3% of the sequences that occurred in stable sleep, not related to arousals or respiratory events that could otherwise explain the autonomic variation. Visible feet and leg movements were present in 11.5% of the sequences. Seven individuals also had alternating sequences with a mean frequency range of 3.1 to 5.4 Hz. The final polysomnographic diagnosis was OSA in 13 of the 16 patients, but only 8.3% of ALMA series occurred closely to apneas or hypopneas.

**Conclusion:** ALMA is a relatively common pattern in pediatric PSGs and has a possible association with autonomic fluctuation. Fast alternating sequences (3.1-5.7 Hz) frequently coexisted with typical ALMA (0.5-3.0 Hz); these fast sequences possibly represent a particularity of ALMA expression in children's sleep.

**Support (If Any):** None

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**0812**

**THE RESTLESS SLEEPER: ASSOCIATIONS BETWEEN CLINICAL SYMPTOMS, FERRITIN LEVEL, AND LIMB MOVEMENTS**

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**Introduction:** Iron status is an important aspect of the evaluation of children with restless leg syndrome, periodic limb movement disorder, or clinically restless sleep. While there is clear data in adults to support this relationship, the data in children is less well established. We evaluated possible associations between iron status, clinically symptoms of restless sleep, and polysomnographic-derived limb movements during sleep in a large pediatric sample.

**Methods:** This is a retrospective analysis of a single institution sleep program looking at all patients who underwent overnight polysomnogram, had ferritin test within 24 hours of doing the sleep study, and had completed parent-report sleep questionnaire over the course of 1 year. Those with sleep apnea (Central Apnea Index >5/hr or Obstructive Apnea Hypopnea Index >2/hr) were excluded. In addition, children who were taking medications that could potentially affect outcomes of interest were excluded (hypnotics, psychotropic medications, supplemental iron).

**Results:** There were a total of 46 patients who qualified for inclusion. Mean age was 6.7 years (range 0-15 years). Ferritin levels were not significantly different between children with or without six possible parent-endorsed descriptors of restless sleep. Children described as having “repeated kicks of legs” during sleep had a significantly higher single limb movement index (10.1 +/- 5.4 vs 6.7 +/- 3.0, p=0.02) and total limb movement index (15.1 +/- 7.3 vs 10.3 +/- 5.7, p=0.04); otherwise there were no significant associations between symptoms and limb movement indices.

**Conclusion:** In this carefully screened sample of children, we found no significant association between ferritin level and any parent-reported symptom of restless sleep or limb movement index. We found that children with parent-reported “repeated kicks of legs” during sleep had increased single limb movement and total limb movement indices.

**Support (If Any):** None

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**0813**

**INCREASED SLEEP FRAGMENTATION AND EMOTIONAL-Behavioral PROBLEMS IN TODDLERS PRESENTING SLEEP TERRORS**

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**Introduction:** Sleep terrors are nocturnal episodes characterized by screams, cries, and confusion lasting a few seconds to a few minutes. This parasomnia is especially prevalent in toddlers and has been associated with separation anxiety. While sleepiness and reduced sleep quality have been reported in adults with sleep terrors, it is unclear whether this holds true in children. The objectives of this study were to investigate whether sleep terrors were associated with sleep latency, duration and fragmentation, and emotional-behavioral problems.

**Methods:** Participants were children from the Maternal Adversity Vulnerability and Neurodevelopment longitudinal cohort (N=509). Maternal reports were used to assess the presence or absence of sleep terrors and sleep habits (sleep latency, total nocturnal sleep duration, consecutive hours of sleep) when children were 12, 18, 24, and 36 months old. Internalizing and externalizing problems were assessed at 48 months with the Children Behavioral Checklist (maternal report).

**Results:** Sleep terrors were reported in 21% of 12 months old children, 16% of 18 months old, 20% of 24 months old, and 19% of 36 months old. Results from a generalized estimating equation model showed that, while controlling for total nocturnal sleep duration, the presence of sleep terrors in children was associated with longer sleep latency (p<0.05), and less consecutive hours of nocturnal sleep (p<0.05). Sleep terrors were also associated with increased internalizing and externalizing problems (p<0.05).

**Conclusion:** The frequency of sleep terrors in our sample was similar to what is reported in the literature. Toddlers presenting sleep terrors had a more fragmented sleep, i.e. longer latency and less nocturnal sleep consolidation. It is not yet clear whether sleep terrors lead to increased sleep fragmentation, or whether they are triggered by fragmented sleep. Present results also suggest that sleep terror might represent an early sign of emotional-behavioral problems in toddlers.

**Support (If Any):** CHIR, Ludmer Centre for Neuroinformatics and Mental Health

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**0814**

**SLEEP PROBLEMS IN INDIAN CHILDREN AT HIGH RISK FOR BEHAVIORAL AND NUTRITIONAL PROBLEMS**

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Punjab, India, 3Dayanand Medical College, Ludhiana, India, 4Washington University, St.Louis, MO, USA, 5Government Medical College Patiala, Punjab, India.

**Introduction:** Sleep disorders in children and adolescents are associated with significant adverse daytime consequences on mood and behavior. The aim of this study is to assess the psychological issues prevalent in children with a single parent. A secondary aim is to evaluate the prevalence of sleep problems in this high risk group.

**Methods:** 180 children with a single parent were identified in Block Khamanon in District Fatehgarh sahib, Punjab in the age range of 5-16 years through purposive sampling. The study is cross sectional in nature and makes use of mixed design technique aimed to identify the psychological issues in terms of cognitive, emotional, behavioral and social issues in children. Before the baseline data collection, informed consent was taken from the parents regarding their and their children's participation. Different scales to assess psychological issues related to intelligence, emotional, behavioral and social aspects were used. Strengths and difficulties questionnaire in which the Punjabi version of the test was used for parents of children aged 5-10 years and the Hindi version will be translated into Punjabi was used for children above 10 years. Peabody reading test, child behavior checklist and adjustment questionnaire were used. The enrolled participants were assessed for their nutritional status by using dietary survey and anthropometric measurements. Hemoglobin estimation was done for checking anemia among children. Presence of sleep problems was assessed by questionnaire.

**Results:** Preliminary data on 129 children is presented here. Median age of children was 11years and 52% were male. Prevalence of psychosocial problems necessitating counseling was identified in 26 children (20%). Anemia was diagnosed in 71 children (55%). Frequent snoring was report by 5 children (4%) and talking during sleep was reported by 2 children (1.5%).

**Conclusion:** Data presented above demonstrate the high prevalence of psychological issues and anemia in children of single parents. Future studies assessing RLS and PLMD in anemic children in this cohort are planned.

**Support (If Any):** Sai Eye Care Society

**0816**

**EFFECTIVENESS OF AN MHEALTH INTERVENTION FOR INFANT SLEEP DISTURBANCES**

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**Introduction:** Bedtime problems and night wakings are highly prevalent in older infancy. This study assessed the effectiveness of an online intervention (Customized Sleep Profile; CSP) utilized in the real world delivered via a freely available mobile application.

**Methods:** Caregivers (83.9% mothers) of 404 infants (age range 6 to 11.9m, M = 8.32m, 51.2% male) used the CSP (free and publicly available via smartphone application, Johnsonins® Bedtime® Baby Sleep App), completing the Brief Infant Sleep Questionnaire (BISQ) at baseline and again 4 to 28 days later. We analyzed changes in sleep patterns over time, based on whether sleep was initially identified as a problem (PS group) or not (NPS).

**Results:** Between- (PS vs. NPS) and within-group differences from baseline to follow-up (controlling for child age and time to follow-up) using mixed-fatorial ANOVA with repeated measures procedures showed significant improvements across groups in total overnight sleep (p < .05). BISQ score significantly improved for both groups, with greater change demonstrated in the PS group (p < .01). At follow-up, only PS showed earlier bedtimes (p < .01) and decreased number and duration of night wakings (p < .05). The PS group caught up with the GS group for total sleep time at follow-up (p <.001). After intervention, McNemar tests showed that bedtime and overnight feeding decreased, bedtime was easier, routine regularity increased, more infants fell asleep independently, more caregivers were confident about managing sleep and babies were perceived to sleep better (p <.001) within the PS group.

**Conclusion:** A real world, publicly-available, mHealth intervention was associated with improved sleep outcomes for older infants (ages 6 to 12 months). Recommendations resulted in changes in caregivers’ behavior and improvements in parent-reported sleep outcomes in infants identified as problem sleepers.

**Support (If Any):** Johnson & Johnson Consumer Inc., Skillman, NJ, USA.

**0817**

**PREDICTORS OF HYPERSOMNIA AND NARCOLEPSY IN PEDIATRIC CRANIOPHARYNGIOMA**

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**Results:** Caregivers who use internet more than two hours a day showed significantly delayed bedtime and wake time. Wake time of children was significantly later among children whose caregivers use internet more. Use of internet of children was twice as longer (0.2 vs 0.4 hours on weekdays and 0.4 vs 0.8 hours on holidays) among children whose caregivers use internet more than two hours.

**Conclusion:** Use of internet of caregivers impaired sleep habit of both caregivers and children, and also significantly affected the use of internet of children. Careful attention on caregiver’s behavior over internet may be necessary to prevent internet overuse of children in later life.

**Support (If Any):** This research was supported by Health Labor Sciences Research Grant, Japan.
A clinical sleep disturbance in children is a well-recognized condition, often characterized by hypersomnia, including both narcolepsy and hypersomnia due to medical conditions. This study is the first to describe the sleep disturbances among children with newly diagnosed craniopharyngioma and the associated patient, disease, and treatment variables.

Methods: 110 children diagnosed with craniopharyngioma were enrolled in an institutional phase II trial of either limited surgical resection followed by proton therapy (PT) or observation after total resection. Prior to PT, patients ≥4 years completed a baseline polysomnography (PSG) and those ≥26 years completed a multiple sleep latency test (MSLT). Logistic regression models were conducted to explore the relationship between patient characteristics and a diagnosis of hypersomnia due to medical condition or narcolepsy.

Results: Of the 98 patients who completed a baseline PSG, none met criteria for obstructive sleep apnea (OSA). Of those who completed the PSG and MSLT, 45% were diagnosed with hypersomnia due to medical condition, and 35% with narcolepsy, indicating 80% of the sample experienced pathological sleepiness. Overweight/obesity predicted the presence of hypersomnia due to medical condition (p=0.012) and narcolepsy (p=0.009) compared to patients who were not overweight/obese. Lastly, compared to patients with grade I preoperative hypothalamic involvement (HI), grade 2 HI indicated higher odds of narcolepsy diagnosis (odds ratio = 6.3, p=0.008).

Conclusion: This study is the first to describe the prevalence and associated predictors of sleep disturbance after surgical resection and prior to PT in pediatric patients with newly diagnosed craniopharyngioma. Findings indicated a high prevalence of central disorders of hypsomnolence in pediatric craniopharyngioma. Greater HI was predictive of narcolepsy diagnosis, and higher BMI z-score was predictive of both hypersomnia due to medical condition and narcolepsy. This study highlights the importance of assessing sleep/wake disturbance prior to the initiation of PT, as well as the promotion of wakefulness interventions with repeated sleep assessment.

Support (If Any): This study was supported by ALSAC.

ACTIGRAPHY SLEEP ASSESSMENT IN EARLY INFANCY: ASSOCIATIONS WITH SOCIOECONOMIC FACTORS OVER AGES ONE TO SIX MONTHS

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Introduction: Maturation of sleep/wake patterns across early childhood is linked with brain and physical development. An improved understanding of factors associated with sleep/wake development during early infancy may help elucidate the origins of chronic diseases and provide insight into normative sleep patterns. Actigraphy is a popular objective sleep assessment method due to its ease of data collection in natural home environments, but has not been widely used in infants. The aim of this analysis was to characterize sleep/wake patterns using actigraphy and evaluate the association of demographic/socioeconomic factors with changes in 24-hour and nocturnal sleep duration between one and six months of age.

Methods: As part of the ongoing Rise & SHINE (Sleep Health in Infancy & Early Childhood) study, a Massachusetts-based birth cohort that examines sleep patterns and growth in early life, full-term healthy singletons were actigraphy on their ankle for 3-7 days at approximately one month and six months of age. At each visit, the parents completed concurrent sleep diaries and a subset of questions from the Brief Infant Sleep Questionnaire. Outcomes were changes in nocturnal sleep (7pm-8am) between six and one month of age.

Results: The sample includes the first 181 infants (20 Black, 30 Asian, 77 White, 52 Hispanic, 2 multi-racial/others). Of these 44(24%) were offspring of mothers with less than Bachelor degree education and 69(38%) were from households with low income. Nocturnal sleep duration increased from 444.6±95% (CI: 433.8, 455.3) to 512.0(95%CI: 501.5, 522.5) minutes between ages one and six months (p<0.001). Increase in nocturnal sleep duration was 67.3 minutes less in infants with low maternal education (16.5±97.6 vs. 83.8±89.4, P<0.001), and 45.3 minutes less in infants with low household income (39.4±100.0 vs. 84.7±89.0, P=0.002).

Conclusion: Actigraphy estimated an average increase of 67.4 minutes of nocturnal sleep from one to six months of age. However, sleep duration, potentially reflecting decreased nocturnal sleep consolidation, increased less over six months in infants from low socioeconomic households, suggesting that early environmental factors may impact sleep neurodevelopment.

Support (If Any): NIDDK fund (R01 DK107972)

IMPACT OF CHANGING MIDDLE AND HIGH SCHOOL START TIMES ON SLEEP, EXTRACURRICULAR ACTIVITIES, HOMEWORK, AND ACADEMIC ENGAGEMENT

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Introduction: Although it is recommended that middle and high schools start at/after 8:30 a.m., most districts in the United States have not delayed start times. In Fall 2017, the Cherry Creek School District delayed school start times (Middle School [MS]: 8:00 to 8:50 a.m.; High School [HS]: 7:10 to 8:20 a.m.). This study examined changes to student sleep, extracurricular activities, homework, and academic engagement.

Methods: Students in grades 6-11 completed online surveys during school hours in Spring 2017 (pre-change n=15,700) and Spring 2018 (post-change n=18,607). Questions included weekday and weekend bedtime [BT], wake time [WT], and total sleep time [TST], extracurricular activity participation, sleepiness during homework, and academic engagement. Parents (n=3,441) provided consent for
a sample of students whose surveys were allowed to be linked year-to-year, as well as with demographic information.

**Results:** On weekdays, MS students reported slightly later BT (8m), later WT (39m), and longer TST (31m); HS students reported slightly later BT (13m), significantly later WT (61m), and longer TST (48m). When controlling for free/reduced lunch (FRL) status and race, results were similar for HS students; however, sleep duration increased more for MS students who received FRL (19m vs. 10m, p=0.05). Post-change, weekend oversleep was reduced by 38m for MS and 59m for HS students, and significantly more students obtained sufficient sleep (MS [≥9h]: 38% vs. 44%; HS [≥8h]: 27% vs 58%). Overall MS participation in sports decreased by 8%, while participation in HS sports, MS/HS activities, or HS employment decreased by <3%. Fewer students reported feeling too sleepy to do their homework for both MS (46% vs. 35%) and HS (71% vs. 56%). Scores on a measure of academic engagement were significantly higher after the start time change for both MS and HS students (p<0.001).

**Conclusion:** This large study with linked data demonstrates that MS and HS students benefit from later start times with increased sleep duration, less sleepiness while doing homework, minimal changes to extracurricular participation, and improved academic engagement.

**Support (If Any):** Robert Wood Johnson Foundation

### 0820

**RESTLESS SLEEP DISORDER IN CHILDREN: A CLINICAL, POLYSOMNOGRAPHIC AND VIDEO ASSESSMENT**

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**Introduction:** Children with restless sleep disorder (RSD) a recently identified condition to describe subjects who do not fit the criteria for any other sleep disorder but with restless sleep and daytime symptoms are studied to quantify clinically, polysomnographically and with video recordings their sleep-related movement disorder, in order to better differentiate it from other sleep disorders of childhood.

**Methods:** 15 school-aged children with RSD, 15 sex- and age-matched children with restless leg syndrome (RLS) and 15 controls were included. Data obtained included nocturnal and diurnal parental concerns, iron and ferritin levels, polysomnography (PSG) data and video PSG characterization and quantification of the movements during sleep

**Results:** Fifteen children with RLS (12 males; three females), with a mean age of 11.9 years (SD 3.52), 15 with RSD (11 males, four females) with a mean age of 9.5 years (SD 3.18), and 15 age and sex matched controls were included. RSD subjects presented with frequent nocturnal large body movements, restless sleep and daytime sleepiness or behavioral problems. RSD subjects had low ferretin levels (mean 20, SD 8.87). Total sleep time in RSD was (mean minutes, SD) 400.7, 67.92; RLS: 394.7, 70.14; controls 464, 61. Video movement quantification showed that RSD subjects moved an average times per hour of 7.34 movements, SD 1.3, RLS 3.8, SD 1.96, controls 2.25, SD 0.625. Data showed that ≥5 movements per hour can reliably differentiate RSD from RLS (accuracy 90%, specificity 83.3%, ROC area 0.917) or controls.

**Conclusion:** Our study confirms that RSD is a distinct clinical condition, different from other sleep movement disorders in children. A quantitative definition of this movement disorder is useful and reliable. Children with RSD move during sleep at an average exceeding 5 large body movements per hour, have decreased sleep efficiency, low ferritin levels and daytime sleepiness. Restless sleep in children may affect daytime function. Future larger studies are needed to depict the epidemiology of this disorder and evaluate the natural progression of restless sleepers.

**Support (If Any):** None

### 0821

**SUCCESSFUL SLEEP EXTENSION AND PHASE ADVANCE IN ADOLESCENTS IN RESPONSE TO A PILOT SLEEP/CIRCADIAN MANIPULATION**

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**Introduction:** Developmental changes in sleep and circadian rhythms conflict with early school start times during adolescence, leaving many teens with insufficient sleep and circadian misalignment. Short sleep and circadian misalignment increase risk for substance use problems, which may be mediated by changes in brain reward and impulse control systems. In this pilot study, we examined the effects of a two-week sleep/circadian manipulation in adolescents on sleep timing/duration, circadian phase, and measures of reward and impulse control.

**Methods:** We studied 10 healthy 13-15 year-olds (6 females) categorized as having late/short sleep based on published norms. During baseline and manipulation phases, participants monitored sleep via diaries and actigraphy for ~14 days, followed by a 2- and 1-night laboratory visit (pre/post-manipulation). During laboratory visits, circadian phase was assessed via dim light melatonin onset (DLMO). Both visits included self-report measures and computer-based tasks assessing reward function (Behavioral Inhibition/Behavioral Activation Scales; Balloon Analogue Risk Task) and impulsivity (UPPS-P Impulsive Behavior Scale; Two-Choice Impulsivity Paradigm). During the 14-day manipulation, participants were asked to wear blue-blocker glasses for 2 hours before bed, go to bed 1.5 hours earlier, maintain a consistent rise time, and wear Re-Timer light goggles for 30 minutes each morning. Pre-Post manipulation changes were tested via paired t-tests.

**Results:** Following the 14-day manipulation, all sleep timing measures and DLMO significantly advanced (mean change 0.35-1.65 hours; p-values ranged from <0.001 to 0.040) and total sleep time increased by 0.95 and 0.57 hours for diary (p=0.015) and actigraphy (p=0.012), respectively. No significant change was observed in any sleep continuity measures. Among the four reward and impulsivity measures, only the Two-Choice Impulsivity Paradigm showed a significant change (p=0.046); participants selected fewer sooner-smaller choices post-manipulation, indicating improved impulse control.

**Conclusion:** We found preliminary evidence that a sleep/circadian manipulation can extend sleep, advance circadian timing, and reduce behavioral impulsivity in adolescents. Replication in a larger, controlled sample would suggest pathways by which sleep timing, sleep duration, and circadian alignment ultimately impact substance use.

**Support (If Any):** Grant from University of Pittsburgh Brain Institute (McClung)
ASSOCIATION BETWEEN HIGH RISK OF OBSTRUCTIVE SLEEP APNEA AND INTRACRANIAL CAROTID ARTERIAL CALCIFICATION IN ACUTE ISCHEMIC STROKE

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Introduction: Obstructive sleep apnea (OSA) is an independent risk factor for stroke. Further, intracranial artery calcification (ICAC) is a marker for subclinical atherosclerosis and future cardiovascular events. We investigated the association between ICAC and OSA in patients with acute ischemic stroke.

Methods: 1,163 patients were retrospectively analyzed. They were admitted to the hospital with an acute ischemic stroke, between June 2015 and November 2017. Among them, 858 patients had a high risk of OSA. Of these patients, we included those with a cerebral infarction in the unilateral middle cerebral artery (MCA) territory, which was classified as large artery atherosclerosis according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification. Patients were excluded if they did not have a unilateral MCA territory infarction, or had a cardioembolic stroke, or another etiology of stroke according to the TOAST classification.

Two raters measured the semi-automatic quantitative Agatston score and calcium volume of intracranial internal carotid arteries on each image. The risk for OSA was assessed using the Berlin Questionnaire and patients were classified into either a low risk or high risk group. We compared the burden of arterial calcification between risk groups.

Results: Ultimately, 73 patients were enrolled in the study. The high risk for OSA group, comprising 35 (47.9%) patients, was significantly older, and had a higher rate of hypertension and diabetes mellitus than the low risk for OSA group. A multivariate analysis, controlling for demographics, sleep habit parameters, and traditional cardiovascular risk factors, revealed that high risk for OSA was associated with higher burden of ICAC, defined by the Agatston score on both the symptomatic (OR: 1.008, 95% CI: 1.001 to 1.016) and asymptomatic side (OR: 1.010, 95% CI: 1.002 to 1.017) of the internal carotid artery, and total calcium of both internal carotid arteries (OR: 1.006, 95% CI: 1.002 to 1.011). The disease characteristic was self-reported. Physical and mental health was derived from the SF-12. Univariate logistic regressions assessed the relationship between insomnia likelihood, demographic, clinical, and disease-specific variables. Significant covariates were carried forward into a multivariate model.

Conclusion: Sleep improves over time for most YA cancer survivors but poor mental health is associated with insomnia regardless of where they are in the cancer trajectory.

Support (If Any): Dr. Garland has a New Investigator Award from the Beatrice Hunter Cancer Research Institute (BHCRI). Funding also provided by the Newfoundland and Labrador Support Unit for People and Patient-Oriented Research and Trials (NLSUPPORT).
direct influence on other lifestyle factors) and additional MR techniques have been developed to evaluate this. We aimed to establish the extent to which the observed causal effect of chronotype might be explained by other lifestyle factors associated with breast cancer (body mass index (BMI), alcoholic drinks per week (DPW) and age at first birth (AFB)) using bidirectional and multivariable MR.

**Methods:** We investigated whether chronotype and other lifestyle factors (BMI, DPW and AFB) are causally related by performing bidirectional MR in a two-sample framework, using genome-wide association study (GWAS) summary statistics for chronotype (UKBiobank, n=449,734), BMI (GIANT, n=339,205), DPW (GSCAN, n=226,223) and AFB (SSGAC, n=251,151). We next estimated the effect of chronotype on breast cancer controlling for BMI, DPW and AFB, using GWAS summary statistics for breast cancer from BCAC (n=228,951) in a multivariable MR approach.

**Results:** Bidirectional MR analysis revealed evidence for a causal effect of increased BMI on morning chronotype (beta=0.09 category increase per SD (95% CI=0.01,0.17; p=0.025)) and of increased DPW on evening chronotype (beta=0.37 category increase per SD (95% CI=0.10,0.64; p=0.006)). In multivariable MR, there was robust evidence for an independent, causal effect of chronotype on breast cancer after controlling for BMI, DPW and AFB, although the magnitude of the causal effect was 13% lower.

**Conclusion:** The protective effect of morning chronotype on breast cancer observed in univariable MR analysis can in part be explained by other lifestyle factors, including adiposity and alcohol. However, evidence of an independent effect of chronotype on breast cancer support hypotheses around a direct effect of circadian timing on mammmary oncogenesis which requires further investigation.

**Support (If Any):**

**0825**

**THE EFFECT OF ANDROGEN DEPRIVATION THERAPY ON INSOMNIA SYMPTOMS, FATIGUE, MOOD, AND HOT FLASHES IN MEN WITH NON-METASTATIC PROSTATE CANCER**

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**Introduction:** Androgen deprivation therapy (ADT) as a treatment for prostate cancer has been associated with sleep problems, mood disturbance, hot flashes, and fatigue, but it is not entirely clear how these factors are associated with each other. The objective of the current study was to examine the impact of ADT on sleep and other symptoms in the first four months of treatment and assess associations among these variables.

**Methods:** Men diagnosed with non-metastatic prostate cancer who had not yet begun ADT were eligible. Participants completed the following measures at baseline and four-month follow-up: the Insomnia Severity Index (ISI), the Hot Flash Daily Interference Scale (HFRDIS), the Hospital Anxiety and Depression Scale (HADS) and the Multidimensional Fatigue Symptom Inventory - Short Form (MFSI-SF). Repeated measures t-tests were performed to assess change in symptoms from pre-treatment to four months and correlations were used to describe the relationship between change among variables.

**Results:** The current study consisted of 24 participants, with a mean age of 70 years. At the four-month timepoint, the men reported significant increases in symptoms of insomnia (p=0.01, d=0.63), impairment due to hot flashes (p<0.01, d=1.48), and fatigue (p<0.01, d=1.36), but not anxiety or depressive symptoms. Prior to treatment, only 8% of men reported moderate symptoms of insomnia compared to 21% reporting clinically significant symptoms of insomnia (moderate or severe) at 4-month follow-up. Increases in fatigue, but not insomnia, was significantly associated with increased symptoms of depression (r=-.43, p=.04) and anxiety (r=-.50, p=.02), and impairment due to hot flashes (r=.62, p=.002)

**Conclusion:** Side effects from ADT present early in treatment. Large effects sizes were observed for insomnia symptoms, hot flashes, and fatigue. Change in fatigue was more strongly associated with mood and hot flashes than insomnia. Data collection is still underway to examine symptom profiles at 8-months and 12-months.

**Support (If Any):** Dr. Garland is supported by a New Investigator Award and seed funding from the Beatrice Hunter Cancer Research Institute (BHCR1).

**0826**

**A COMPARISON OF PRE-TREATMENT SLEEP AND SYMPTOM PROFILES IN AGE-MATCHED BREAST AND PROSTATE CANCER PATIENTS**

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**Introduction:** Breast and prostate cancer patients report sleep disturbance and other problematic symptoms even before beginning cancer treatment. The current analysis examined whether pre-treatment prostate and breast cancer patients differ on sleep quality, insomnia symptom severity, fatigue, and anxiety and depression symptoms.

**Methods:** Patients newly diagnosed with non-metastatic breast and prostate cancer were recruited from the Dr. H. Bliss Murphy Cancer Centre in St. John’s, Newfoundland. Participants completed the Consensus Sleep Diary for one week, the Pittsburgh Sleep Quality Index (PSQI), the Insomnia Severity Index (ISI), the Multidimensional Fatigue Symptom Inventory - Short Form (MFSI-SF) and the Hospital Anxiety and Depression Scale (HADS). A MANOVA was conducted to examine sex differences on the sleep diary variables, PSQI, ISI, MFSI-SF, and HADS.

**Results:** Participants were 28 males and 28 females (N = 56) with a mean age of 68. Using the recommended cut-off of 5 on the PSQI, 82% of females and 64% of males had poor sleep quality. Twice as many females (21% vs. 11%) could be classified as having moderate to severe insomnia on the ISI (a score of 15+). Females were more likely than males to experience clinically significant anxiety (17% vs. 7%) and depression symptoms (11% vs. 4%). Females reported longer sleep latency (35.68 minutes vs. 16.68 minutes; F(1, 42) = 9.860, p = .003), less total sleep time (6.61 hours vs. 7.76 hours; F(1, 42) = 7.893, p = .008), and worse sleep efficiency (78% vs. 86%; F(1, 42) = 5.683, p = .022), compared to males. Males and females did not differ significantly on global scores of the PSQI, ISI, or MFSI-SF.

**Conclusion:** Results of the current study suggest that breast cancer patients are entering treatment with poorer sleep and mood compared to prostate cancer patients. These pre-treatment differences may make women more vulnerable to poorer functioning during and after completing cancer treatment.
0827
PREVALENT AND FACTORS ASSOCIATED WITH PRE-TREATMENT INSOMNIA SYMPTOMS IN WOMEN WITH EARLY STAGE BREAST CANCER
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Introduction: Up to 70% of post-treatment breast cancer (BCa) survivors report having insomnia symptoms, but less is known about the prevalence of insomnia in women with BCa prior to treatment initiation. The present study aims to identify the prevalence and factors associated with pre-treatment insomnia symptoms in women with early stage BCa.

Methods: This study is part of a larger ongoing prospective observational cohort study of women with non-metastatic breast cancer. Participants completed the Insomnia Severity Index (ISI), the Hot Flash Daily Interference Scale (HFRDIS), the Hospital Anxiety and Depression Scale (HADS) and the Multidimensional Fatigue Symptom Inventory-Short Form (MFSI-SF). Insomnia symptoms were defined as a score on the ISI of greater than 7. Using participant's pre-treatment data, a hierarchical regression model was used to examine associations between clinical variables and insomnia severity, anxiety, and fatigue, after statistically adjusting for age.

Results: Among 86 women with breast cancer, 36% reported symptoms of insomnia before beginning cancer treatment. After adjusting for age, the model was significant F(4, 78)=4.88, p<.001, accounting for 20% of the unique variance in insomnia severity. Zero-order correlations indicated significant bivariate associations between insomnia severity and symptoms of anxiety (r=.34), depression (r=-.29), fatigue (r=.43), and not perceived impairment due to hot flashes (r=-.16). After partitioning out variability from other independent variables, only fatigue remained significantly associated with insomnia severity, accounting for 5.3% unique variance.

Conclusion: Although symptoms of depression and anxiety are associated with insomnia severity, fatigue appears to be the most important factor associated with pre-treatment insomnia symptoms. Given the bi-directional relationship of insomnia and fatigue, interventions targeting one is likely to benefit the other.

Support (If Any): Dr. Garland is supported by a New Investigator Award and seed funding from the Beatrice Hunter Cancer Research Institute (BHCR1).

0828
PRE-TREATMENT INSOMNIA SYMPTOMS AND PERCEIVED COGNITIVE IMPAIRMENT IN NEWLY DIAGNOSED WOMEN WITH EARLY STAGE BREAST CANCER
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Introduction: Among 86 women with breast cancer, 36% reported symptoms of insomnia before beginning cancer treatment. After adjusting for age, the model was significant F(4, 78)=4.88, p<.001, accounting for 20% of the unique variance in insomnia severity. Zero-order correlations indicated significant bivariate associations between insomnia severity and symptoms of anxiety (r=.34), depression (r=-.34), sleep quality (r=-.39), fatigue (r=.56) and depressed (r=.38), anxious mood (r=.37). After partitioning out variability from other independent variables, only fatigue remained significantly associated with PCI, accounting for 15.3% unique variance. A follow up hierarchical regression revealed that mental and general fatigue were the dimensions of fatigue significantly associated with PCI.

Conclusion: Even before undergoing cancer treatment, sleep, mood, and fatigue are associated with PCI in pre-treatment women with BCa. Fatigue, particularly general fatigue (e.g. I am worn out) and mental fatigue (e.g. I make more mistakes than usual), have the strongest relationships with PCI.

Support (If Any): Dr. Garland is supported by a New Investigator Award and seed funding from the Beatrice Hunter Cancer Research Institute (BHCR1).

0829
EXPLORING INSOMNIA AS A FACTOR CONTRIBUTING TO COGNITIVE DIFFICULTIES IN NEWLY DIAGNOSED MEN WITH PROSTATE CANCER
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Introduction: Insomnia may impact cognitive performance. Men with prostate cancer (PCa) report difficulties with cognition, insomnia, and mood during cancer treatment. Less is known about how these symptoms interact prior to cancer treatment. This study evaluated associations between symptoms of insomnia and cognition performance, and whether this was influenced by symptoms of depression and anxiety.
**Methods:** Men with newly diagnosed non-metastatic PCa were recruited prior to receiving cancer treatment. Participants completed the Insomnia Symptom Index (ISI), the Functional Assessment of Cancer Therapy Cognitive Scale (FACT-COG), and the Hospital Anxiety and Depression Scale (HADS). Separate hierarchical regressions evaluated the associations between symptoms of insomnia and perceived cognitive impairment (PCI), perceived cognitive abilities (PCA), and impact of cognitive performance on quality of life (QOL), after accounting for symptoms of anxiety and depressed mood. Zero-order correlations assessed bivariate associations and part correlations assessed incremental variance accounted for.

**Results:** 31 men (M=70; range 58-77 yrs) participated. Symptoms of insomnia were associated with PCI (Zero-order r =-.37, p=.04), but did not account for significant variance (part r=-.15) in PCI after adjusting for symptoms of anxiety and depression, which explained 18.7% variance in PCI, F(2, 30) = 3.22, p=.05. Similarly, symptoms of insomnia were associated with PCA (Zero-order r =-.38, p=.03), but did not account for any variance (part r=.00) in PCA after adjusting for symptoms of anxiety and depression, which explained 41% variance in PCA, F(2, 30) = 9.57, p<.01. Lastly, symptoms of insomnia were associated with QOL (Zero-order r =-.55, p<.01), but accounted for a non-significant 3.6% variance (part r=−.19) in QOL after adjusting for symptoms of anxiety and depression, which explained 43% variance in QOL, F(2, 30) = 10.74, p<.01.

**Conclusion:** Although insomnia symptom severity was associated with various domains of cognition in men with PCa, it did not account for any variance beyond what was accounted for by symptoms of anxiety and depression.

**Support (If Any):** Dr. Garland is supported by a New Investigator Award and seed funding from the Beatrice Hunter Cancer Research Institute (BHCRI).

### 0830

**EFFECTS OF INTIMACY AND ADULT ATTACHMENT ON SLEEP IN COLORECTAL CANCER PATIENTS: PRELIMINARY REPORT**

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**Introduction:** Sleep disturbance is a prominent concern for cancer patients. Sleep is optimized when the individual feels emotionally safe, which is reflected in close relationships and intimacy. Cancer diagnosis threatens the close relationship between patients and their partner, which activates one’s attachment internal working model and can be manifested in poor sleep. This study examined the degree to which intimacy and adult attachment is associated with sleep efficiency and sleep quality among adult colorectal cancer patients across 14 days.

**Methods:** Colorectal cancer patients (n=24; 56 years old; 37% female) completed daily intimacy and sleep logs individually across 14 consecutive days. Three items regarding feeling cared for, validated, and understood by one’s partner were used to measure intimacy. Sleep efficiency was assessed with the Consensus Sleep Diary, and a single item was used to measure sleep quality. Patients self-reported adult attachment orientations (MAQ: security, avoidance, and anxiety) around the time of diagnosis. Age, gender, and cancer stage were covariates.

**Results:** Patients reported fair sleep efficiency (M=91%) and sleep quality (M=3.64). Multilevel modeling was employed to separately predict patients’ sleep efficiency (SE) and sleep quality (SQ) by intimacy with their partner that day and attachment orientation. Better SE was predicted by greater intimacy with the partner during that day, which was the case for older patients and greater attachment avoidance (Bs<.002, ps<.013). Overall, attachment avoidance was associated with poorer SQ (B=-1.524, p<.036). However, better SQ was predicted by greater intimacy with the partner during that day, which was the case for greater attachment avoidance (B=.425, p<.010), although not so for greater attachment anxiety (B=-.288, p<.044). Attachment security was not associated with any sleep outcome.

**Conclusion:** Findings provide preliminary evidence that highlight the significance of intimacy and adult attachment orientation in sleep for cancer patients. Results suggest that sleep interventions be tailored to improve intimacy while considering individual differences in relational characteristics. Findings warrant further investigation of interpersonal factors and possible underlying biopsychosocial mechanisms that contribute to sleep disturbance for this vulnerable population.

**Support (If Any):** R01NR016838
Introduction: Cardiovascular (CV) disease is the leading cause of death and there is a well-established relationship with obstructive sleep apnea (OSA). Accurate CV risk prediction using epidemiological data is fundamental to advance precision medicine. Machine learning methods can improve CV risk prediction, especially when OSA-related risk factors are incorporated. We evaluated the performance of different supervised machine learning methods to predict incident CV disease based on conventional risk factors and OSA severity metrics.

Methods: We used data from 3,674 individuals without baseline CV disease from the Sleep Heart Health Study (SHHS) and evaluated the following predictors at baseline: age, sex, race, ethnicity, diabetes, hypertension, HDL, total cholesterol, triglycerides, lipid-lowering medication, alcohol, smoking, apnea-hypopnea index (AHI) and Epworth Sleepiness Scale (ESS). To verify the ability of different machine learning methods to predict incident CV disease (median observation period 11.4 years), we compared naïve Bayes (NB), logistic regression (LR), elastic-net regularized general linear model (enGLM), multi-layer perceptron neural network, decision tree, random forest, extreme gradient boosting, K-nearest neighbors, and support vector machine (SVM). Data was split into training (N=2,939) and testing (N=735). Training data was used to optimize hyper-parameters and evaluate model performance using 5-fold cross-validation. Training and testing performances were measured by the area under the receiver operating characteristics curve (AUC).

Results: The average cross-validation training AUC varied between 0.498 (for SVM) and 0.767 (for enGLM). All methods, except SVM, had a significant improvement in disease prediction compared to the null model (Benjamini-Hochberg adjusted p<0.021). The models with the highest performance in the test data were LR (AUC [95% CI]=0.752 [0.712-0.793]), enGLM (0.749 [0.708-0.791]) and NB (0.719 [0.673-0.766]). Age was the most important predictor across all evaluated models.

Conclusion: We have demonstrated the applicability of supervised machine learning to predict CV disease in the SHHS using conventional risk factors, AHI and ESS. These findings can be used as benchmark results for comparing future CV analysis over different methods and with other available features.
Methods: 50 patients with a confirmed diagnosis of IBD were recruited. Exclusion criteria included a known history of a sleep disorder or a Charlson Comorbidity Index greater than or equal to 3. Subjects were grouped as either Caucasian or a minority. Patients were asked to complete the PROMIS-8a Short Form, Epworth Sleepiness Scale (ESS), and the Women’s Health Initiative Insomnia Symptom Rating Scale. Each patient was provided with an actigraph and a sleep diary and instructed to use them for seven days. Actigraphy data was interpreted by blinded investigators using ActiLife actigraphy reading software.

Results: 44 of 50 patients returned a completed actigraphy device and diary with at least 3 days of data. 26 patients were recruited in the Caucasian group and 18 patients were recruited in the minority group (16 AA and 2 Hispanic). Baseline characteristics revealed an elevated median CRP (10 vs. 1.8, p=0.006) and Harvey Bradshaw Index (0.5 vs 0, p=0.008) in minority patients. Consistent with previously reported data, there was a trend towards an increased ESS (median 7.0 vs. 4.5) and PROMIS-8a score (median 50.1 vs. 46.7) in minority patients. Upon analysis of actigraphy data, the median sleep efficiency recorded was 81.3 percent for Caucasians and 73.57 percent for minority patients (p=0.05). Wake after sleep onset times showed a trend towards elevation in minority patients (117.01 minutes in minorities vs. 77.3 in Caucasians, p=0.09).

Conclusion: This study provides objective evidence for reduced sleep quality in minority patients with IBD using actigraphy. Further studies to confirm these findings and explore the etiology behind this disparity of sleep quality among races is indicated.

Support (If Any): None.

0835

DO LOW VS. NORMAL BMI SUBJECTS DIFFER WITH RESPECT TO SLEEP DISORDERS SYMPTOMS?

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Introduction: It is commonly accepted that high BMI values are associated with a wide range of sleep complaints and/or signs and symptoms of various sleep disorders. In contrast, little is known about the relationship between low BMI values and sleep disturbance. Accordingly, the present study represents an initial inquiry into whether low BMI values are associated with sleep disturbance.

Methods: An archival analysis was conducted on an existing database of 4,206 individuals who completed a screening survey (www.sleeplessphilly.com). Low BMI (BMI of <18.5 kg/m²) subjects were identified and matched 1:1 by race, age, and gender to normal BMI controls (BMI of 18.5-24.9 kg/m²). The two groups were compared using unadjusted serial t-tests for differences in sleep continuity disturbances (i.e., SL, N1/AR, WASO, TST) problem endorsements (e.g., “my SL is a problem for me”) and on sleep disorder symptom endorsements (e.g., “I snore”).

Results: Overall, the Low-BMI group (N= 58, Female= 65.5%, Age= 39.2 years) did not significantly differ from the Normal-BMI group (N= 58, Female= 63.8%, Age= 40.0 years) for sleep continuity disturbances, problem endorsements, or sleep disorder symptoms. A trend was evident for problem endorsement viz. SL, with more Low-BMI subjects reporting problems with falling asleep than normal BMI subjects (84.9% vs. 69.2%, p = 0.056). For sleep disorder symptoms, there were trends for fewer Low-BMI subjects endorsing snoring (37.9% vs. 50.0%, p = 0.190) and more Low-BMI subjects endorsing restless leg symptoms (35.3% vs. 19.0%, p = 0.139).

Conclusion: The data suggest that there may be some differences for viz. problem endorsements and sleep disorders symptoms, between individuals who have Low and normal BMI. Of interest: 1) fewer Low-BMI subjects reported snoring, and this may be taken as evidence of the validity of the present analysis; and 2) more of the Low-BMI subjects reported RLS, and this may be suggestive of iron deficiency, glucose dysregulation, or uremia. More refined queries are likely required to substantiate the observed trends (e.g., questions that better assess RLS/PLMs and/or NES or SRED).

Support (If Any): Perlis NIH R01AG041783; K24AG055602; R01AT003332

0836

THE ASSOCIATION BETWEEN DISCRIMINATION AND SLEEP IS EXACERBATED IN INDIVIDUALS WITH COMORBID CHRONIC HEALTH CONDITIONS


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Introduction: The consequences of recurrent and stressful daily experiences for sleep health appear to be particularly intensified in individuals with pre-existing health conditions. Although experiences of discrimination have been associated with sleep outcomes, the exacerbating role of chronic comorbid health conditions, and the impact of perceptions of discrimination, remains unclear. The present study investigated the associations between daily discrimination and subjective and objective sleep outcomes while examining the moderating roles of comorbid health conditions and perceived daily life interference and hardship.

Methods: The current study utilized archival data from the Midlife in the United States (MIDUS) Study II. Participants were 174 adults (51% female, M age = 57 yrs., SD = 11.5 yrs.) who completed 7 days of actigraphy, sleep diary measures, the PSQI, and a measure quantifying individuals’ number of chronic health conditions. Age and gender were covariates. Models examined the moderating effects of number of comorbidities, daily life interferences, and hardship on the association between discrimination and sleep outcomes.

Results: Daily experiences of discrimination predicted a variety of poor objective and subjective sleep outcomes. These associations were exacerbated for persons with higher numbers of comorbid conditions. Higher chronic disease comorbidity (95% CI=5.40, 68.75) exacerbated the association between daily discrimination and TSTactigraphy. This moderation was further strengthened by perceived hardship (95% CI= -3.75, -4.40) and interference (95% CI= 3.65, -3.0) in persons with higher numbers of comorbid conditions, qualified by perceived hardship (95% CI= 0.04, 0.94) and interference (95% CI= -0.01, 0.05), predicted diary sleep quality above discrimination alone. The interaction between comorbid conditions and hardship also predicted global quality PSQI scores (95% CI=91, -12) beyond discrimination.

Conclusion: Daily experiences of discrimination are associated with shorter objectively-measured sleep duration and worse subjectively-assessed sleep quality. These associations were stronger for individuals with multiple chronic comorbid health conditions.
The exacerbating effects of health conditions were further perpetuated by perceptions of interference and hardships, suggesting the presence of individual differences in emotion regulation strategies. Future research should explore how, and by which mechanisms, differential responding toward discrimination by persons with comorbid health conditions impacts sleep outcomes.

Support (If Any):
Introduction: Associations between sleep duration and obesity have been mixed, and have predominantly focused on body mass index (BMI) rather than measures of abdominal obesity such as waist-hip ratio (WHR). Furthermore, it is unclear whether and to what extent body composition affects sleep duration. We aimed to clarify these relationships using a large prospective study design.

Methods: We analyzed data from UK Biobank participants at baseline (n=58,877) and up to two follow-up assessments (n=20,139, n=4,073). We estimated the association of habitual, self-reported sleep duration (hours/day) with cross-sectional and prospective changes in BMI and WHR, adjusting for confounders and sleep traits. We then investigated whether baseline BMI or WHR associated with change from normal (7-8 hours) to short (<7 hours) or long (>8 hours) sleep duration at follow-up.

Results: Short and long sleep duration were associated with higher BMI and WHR at baseline, but short sleep was not associated with WHR after adjusting for BMI. Significant increases in BMI and WHR at baseline, but short sleep was not associated with changes in weight outcomes. In reverse association, we observed that amongst individuals with normal sleep duration, a one-standard deviation (SD) higher BMI at baseline was associated with becoming either a short (OR=1.08, CI 1.02-1.14) or a long (OR=1.14, 1.06-1.22) sleeper at follow-up, and a one-SD higher WHR was associated with becoming a long sleeper at follow-up (OR=1.16, 1.06-1.28).

Conclusion: Sleep duration of four hours per night, reported by a small proportion of the population, was a risk factor for increases in BMI, but not for abdominal adiposity. Reverse causality potentially impacts associations of sleep duration with obesity, and weight loss should be investigated as a strategy to improve sleep health.

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0840
LONGITUDINAL ASSOCIATION OF OBJECTIVE SLEEP DURATION, TIMING, AND REGULARITY WITH WEIGHT CHANGE IN HC/SS/SS EUN I ALLY STUDY
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Introduction: We examined the prospective association between objective sleep and weight change in a representative sample of Hispanic/Latinos in the US. We expected shorter sleep, later sleep timing, and more irregular sleep to be associated with higher weight change across ~6 years follow-up.

Methods: Baseline and follow-up weight was available in 1,859 Hispanic Community Health Study/Study of Latinos Sueno participants (after outlier exclusion; mean weighted age: 42.1 years, 45% male), and baseline one-week wrist actigraphy was used to quantify sleep duration, timing, and regularity (Sleep Regularity Index [SRI]; range: 0-100 from least to more regular). We used complex survey regression methods to examine prospective associations of quartiles of each sleep metric with weight change (continuously) and weight gain (>5kg), adjusting for age, sex, ethnic background, site, marital status, depressive symptoms, income, education, the other sleep dimensions, and time between assessments.

Results: Average weight change across follow-up was +0.11 kg. We did not observe significant statistical associations of sleep duration, timing, or regularity with continuous weight change or categorical weight gain, but estimates suggested associations in the hypothesized directions. We also did not observe evidence for effect modification of the association between sleep and weight change by baseline overweight status (body mass index [BMI] <25 vs. >= 25). Amongst participants with no weight change or weight gain throughout follow-up (N=873), more regular sleep was associated with less weight gain after multi-variable adjustment (Q1 vs. Q4= -0.85 kg, 95% confidence interval 1.740.03; p=0.04).

Conclusion: Overall, we did not observe significant associations between baseline objective estimates of sleep and 6-year prospective weight change. Possible explanations include that we were limited to a single assessment of sleep behavior, small effect size, and/or limited statistical power. Future studies with repeated exposure and outcome measures are needed to evaluate the role of changes in sleep behaviors over time to overweight, obesity and weight gain.

Support (If Any): NIH HL098927

0841
IMPACT OF SLEEP DURATION ON DIET AND ACTIVITY BEHAVIORS WITHIN AN 18-MONTH BEHAVIORAL WEIGHT LOSS INTERVENTION
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Introduction: Evidence suggests a reciprocal relationship between obesity-related health behaviors and sleep. The objective of this analysis was to examine whether changes in sleep duration affected energy intake (EI) and levels of moderate-vigorous PA (MVPA) within a behavioral weight loss intervention.

Methods: A total of 91 adults with overweight/obesity (age 18-55 years, BMI 27-42 kg/m²) enrolled in an 18-month behavioral weight loss intervention targeting decreases in EI and increases in MVPA. EI (3-day diet diaries), MVPA (SenseWear Armband), and sleep duration (SenseWear Armband) were assessed at baseline and 18 months. Age-specific sleep recommendations (≥7 hrs/night) were used to categorize participants into 4 sleep duration groups: 1) stable adequate sleep (≥7 hrs/night at baseline and 18 months); 2) stable inadequate sleep (<7 hrs/night at baseline and 18 months); 3) increased sleep (<7 hrs/night at baseline and ≥7 hrs/night at 18 months) and 4) decreased sleep (≥7 hrs/night at baseline and <7 hrs/night at 18 months). Linear regression analyses examined if changes in sleep duration predicted changes in EI, MVPA, and weight loss.

Results: EI decreased by 247±37 kcal/d (p<0.001), MVPA increased by 9±38 min/d (p=0.02) and weight decreased by 8.2±9 kg
(p<0.001) across the intervention. While there was no overall change in sleep duration (+2±72 min/night; p=0.61) across the intervention, 33% of participants demonstrated stable adequate sleep, 41% demonstrated stable inadequate sleep, 12% increased sleep, and 14% decreased sleep. Although the overall effect of change in sleep on change in EI was not significant (p=0.08), those who improved sleep demonstrated a significant decrease in EI compared to those with stable adequate sleep (+51 kcal/d vs -43 kcal/d; p=0.02). Changes in sleep duration were not associated with change in MVPA or weight.

**Conclusion:** Majority of adults were not meeting sleep recommendations throughout the 18-month intervention. Improvements in sleep duration may enhance adherence to dietary energy restriction during weight loss. Future research is needed to determine whether interventions targeting improvements in sleep duration could improve dietary adherence within a behavioral weight loss program.

**Support (If Any):** NA

**0842**

**Impact of Age-Related Social and Environmental Determinants in Sleep-Cardiometabolic Health Relationships**

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**Introduction:** Research suggests that sleep impairment is associated with cardiometabolic disease risk and that physical activity may be an important means to improve both conditions. Few studies have investigated the influence of age-related, social and environmental determinants that might impact sleep-cardiometabolic health relationships. The objective of this study was to examine the degree to which sociodemographic, health behavior, environmental, stress, and type of cardiometabolic disease risks are associated with sleep disorders in a diverse sample of insured adults throughout Hawaii who engaged in moderate to strenuous exercise.

**Methods:** Adult patient data from the Kaiser Permanente database (2016-2018) were used (N=39,999; 53.2% female). Self-reported physical activity was categorized by duration (0-150+ minutes) and frequency (0-7 day/week). ICD-10 codes for sleep disorders and cardiometabolic disease were used. Determinants included geolocation, sex, race/ethnicity, education and income level, caregiver stress, work stress, nutrition/exercise counseling, and substance use. Kruskal-Wallis test and logistic regression analyses were performed.

**Results:** Statistically significant differences in sleep disorder (20.52%) and cardiometabolic disease by type (CVD(20.91%), hypertensive(50.59%), metabolic(54.96%), nutritional(65.95%)) were found between different age ranges (χ²(7)=1206.12;p<0.0001); (χ²(7)=6447.89;p<0.0001), (χ²(7)=5158.46;p<0.0001), (χ²(7)=11573.96;p<0.0001),(χ²(7)=5830.14;p<0.0001),sexes(χ²(1)=139.76, p<0.0001); (χ²(1)=154.87;p<0.0001), (χ²(1)=110.29;p<0.0001), (χ²(1)=136.99;p<0.0001), (χ²(1)=80.63;p<0.0001), and races (χ²(6)=195.38;p<0.0001); (χ²(6)=362.17;p<0.0001), (χ²(6)=847.99, p<0.0001), (χ²(6)=788.71;p<0.0001), (χ²(6)=426.30;p<0.0001). In multinomial models that independently included CVD, hypertensive, metabolic, or nutritional disease, age, female, Asian, Native Hawaiian/Pacific Islander, Unknown race, exercise frequency, urban living, caregiver stress, alcohol use, and tobacco use all added significantly to the prediction of a sleep disorder (p<0.0001). Work stress added significantly (p<0.0316) in the metabolic disease model only. Whereas Hispanic race (p<0.01) and income level (p<0.01 to p<0.03) added significantly in all models except the CVD model. 

**Conclusion:** Several important age-related, social and environmental factors are associated with comorbid cardiometabolic disease and sleep disorders in a diverse patient sample who engaged in moderate to strenuous exercise. Further exploration of the role of mediating determinants in sleep-cardiometabolic health relationships is needed to design targeted interventions that include modifiable health and lifestyle factors based upon unique, at-risk profiles.

**Support (If Any):**

**0843**

**Association of Exercise, Anxiety, Socio-Environmental Determinants, and Sleep with Heart-Related Health Issues**

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**Introduction:** Research indicates that socio-environmental factors may increase the risk of anxiety, which can alter sleep efficiency. Short sleep duration has been linked to an increased risk of cardiovascular disease. Moderate daily exercise is often recommended to address physical and mental health issues, yet individuals with serious psychological distress are less likely to be physically active. The objective of this study was to explore associations between presence of anxiety, exercise, socio-environmental determinants, and sleep duration with heart-related health issues.

**Methods:** Data from the 2016 Behavioral Risk Factor Surveillance System (BRFSS) survey were used (N=486,303). Self-reported sleep duration was categorized as short(6 hours), normal(7-8 hours), and long(9 hours). Kendall’s tau-b correlations were performed.

**Results:** Participants with anxiety(n=5061; 58.2% female) reported similarity in normal(23.6%) and short sleep(20.8%) duration compared to participants without anxiety(32.3%; 14.2%). Although no statistically significant correlation between presence of anxiety and having exercised in the past month was found, positive correlations between presence of sleep duration and anxiety(τ=-0.134,p<0.0001) and heart disease(τ=-0.005,p<0.0001) emerged, which both were statistically significant. A negative correlation between exercise and diagnosis of heart disease was found, which was statistically significant(τ=0.10,p<0.0001). Negative correlations were found between individuals with anxiety and normal sleep duration and sex(τ=-0.126,p<0.0001), marital status(τ=-0.084,p<0.0001), exercise(τ=-0.053,p<0.0001), employment status(τ=-0.028,p<0.021), and having health care(τ=-0.087,p<0.0001). Positive correlations were found between individuals with anxiety and normal sleep duration and age(τ=0.164,p<0.0001), inability to see a physician due to cost(τ=-0.2,p<0.0001), poor physical health (τ=-0.193,p<0.0001), and number of children(τ=-0.109,p<0.0001). Whereas positive correlations were found between individuals with anxiety who exercise and age(τ=0.184,p<0.0001), inability to see physician due to cost(τ=0.138,p<0.0001), poor physical health(τ=0.104,p<0.0001), employment status(τ=0.052,p<0.0001), and number children(τ=0.108,p<0.0001), negative correlations were found between individuals with anxiety who exercise and marital
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status($\tau=0.041, p<0.001$), education level($\tau=-0.07, p<0.0001$), heart disease($\tau=-0.056, p<0.0001$), having health care ($\tau=-0.045, p<0.001$), and number of adults in household($\tau=-0.034, p<0.054$).

**Conclusion:** Positive associations between sleep duration, anxiety, and diagnosis of heart-related health were found. There is a need to further examine the potential involvement of socio-environmental determinants in altering sleep and the role of exercise in protecting mental and physical health.

**Support (If Any):** .

0844

SLEEP-DISORDERED BREATHING IN CYSTIC FIBROSIS

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**Introduction:** Cystic fibrosis (CF) is a lethal, genetic disease that affects approximately 30,000 Americans. Patients frequently report snoring, mouth breathing, and insomnia. Yet, the extent to which sleep-disordered breathing (SDB) may underlie these complaints remains unknown.

**Methods:** Single-center retrospective review of polysomnography results from referred patients with CF (cases), including 29 children and 23 adults, and referred non-CF patients (controls) individually-matched (1:2) for age, gender, race, and body mass index (BMI).

**Results:** Mean ages were 8±5.1(sd) and 36±12.8 years, among the children and adults respectively. Mean BMI %tile was 61±29% among children. Mean BMI in adults was 25±5 kg/m². Approximately 60% of cases and controls proved to have SDB (Chi-square test, p=0.82). However, pediatric cases, in comparison to controls, had 3.5 times greater odds of having moderate-severe SDB (as defined by apnea-hypopnea index (AHI) > 5; conditional logistic regression, p=0.04).

Adult cases vs. controls had a similar (3.3) though non-significantly greater odds of having moderate-severe SDB (AHI ≥ 15; p=0.1). The oxygen saturation nadir was 88%, on average, for cases and 90% for controls (Wilcoxon rank sum test, p=0.002). Cumulative duration of hypoxemia (oxygen saturation <90% or <88% for children or adults, respectively), was worse among the cases vs. controls (5.81 vs. 0.39 minutes, p=0.005). Cases also had a 7 times greater odds, as compared to controls, of experiencing hypoxemia for a cumulative overnight total of ≥5 minutes (p=0.02). Among subjects with CF, the forced expiratory volume in 1 second (FEV1) %predicted, a marker of lung disease severity, was significantly associated with the nocturnal oxygen saturation nadir (Pearson correlation, r=0.56, p=0.0001) but not AHI (r=-0.17, p=0.27). However, both AHI and FEV1 %predicted showed independent associations with the nocturnal oxygen saturation nadir (Linear regression, FEV1: $\beta=0.07$, SE=0.02, p=0.0002; AHI: $\beta=-0.24$, SE=0.08, p=0.0047).

**Conclusion:** Severity of SDB may be worse among referred patients with CF as compared to matched patients without CF. Moreover, severity of SDB may predict nocturnal hypoxemia, a known risk factor for pulmonary hypertension and mortality, independent of lung disease severity.

**Support (If Any):** NIH Training Grant (T32NS007222)

0845

FLOW MEDIATED DILATION AND PHYSICAL ACTIVITY INTENSITY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA AND CHRONIC OBSTRUCTIVE PULMONARY DISEASE OVERLAP SYNDROME

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**Introduction:** Patients who have both obstructive sleep apnea (OSA) and chronic obstructive pulmonary disease (COPD) (Overlap Syndrome, OS) have increased coronary artery disease (CAD) risk. Endothelial dysfunction precedes clinical disease of coronary atherosclerosis and myocardial infarction and can be measured by brachial artery flow-mediated dilatation (FMD). A physically active lifestyle could prevent the development of CAD. Cross-sectional data on the relationship between physical activity (PA) and endothelial dysfunction in OS are lacking. We investigated prospectively the association of leisure-time PA with endothelial dysfunction measured by FMD in patients with OS.

**Methods:** Patients with OS (FEV1/FVC<70 and CPAP therapy) were prospectively enrolled from sleep clinics at the Salem VAMC into an exercise study. FMD was measured with ultrasonography. An FMD cutoff below 10.7% was used to estimate CAD risk as per Schechter et al. PA was quantified during a 7-day period using ActiGraph wGT3X-BT wrist worn accelerometer. The percentage of time spent in sedentary, light and moderate intensity activities was quantified over a 7 day period using ActiLife software version 6 (ActiGraph, Pensacola, FL, USA). Data are expressed as mean (SD). The association between intensities of leisure-time PA and FMD was tested using Spearman rank correlation coefficient (rho). The strength of correlation coefficients was considered strong if rho ≥ 0.7.

**Results:** The mean age was 64±7 years in 9 male patients enrolled to date. Mean BMI was 31±3 kg/m². One patient had mild COPD, 6 had moderate COPD and 3 had severe COPD. FMD was less than 10.7% in 80% of patients. There was no correlation between FMD and BMI, severity of COPD or CPAP compliance. There was a strong correlation (rho=0.84, p=0.004) between percentage of time spent in moderate intensity PA and FMD.

**Conclusion:** These research findings suggest that directly-measured physical activity is potentially related to reduced CAD risk, mediated via FMD. Further studies would be needed to confirm these findings.

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0846

OPIOID USE AND SLEEP ARCHITECTURE IN FIBROMYALGIA

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**Introduction:** Patients with Fibromyalgia (FM) are frequently prescribed opioids to treat chronic pain and sleep disturbances. However, opioid use is associated with self-reported/actigraphic sleep disruption, and research suggests opioid effects may depend on age, dosage, or pain intensity. Whether opioid use/dosage affect physiological sleep (polysomnography, PSG-assessed) in FM is unclear. The present study assessed associations between opioid
Introduction: Adults living with HIV have greater sleep difficulties and are more likely to smoke cigarettes. Not known is if these associations are present in younger adults, such as college students, and if current smoking exacerbates the sleep difficulties experienced by college students with HIV.

Methods: Data were evaluated from the 2011-2014 waves of the National College Health Assessment, an annual survey conducted by the American College Health Association. Health conditions (including HIV positive status) were self-reported. Participants were also asked whether “sleep difficulties” were “traumatic or difficult for you to handle” over the past 12 months. Number of cigarettes per month was self-reported (classified as smoker or non-smoker). N=112,807, including N=281 HIV positive, provided data. Logistic regression models were adjusted for age, sex, and survey year.

Results: HIV positive students were more likely to be smokers (OR=1.74, 95%CI[1.08,2.81], p=0.023) and were more likely to experience sleep difficulties (OR=2.20, 95%CI[1.69,2.85], p<0.0005). An HIV-by-smoking interaction was found (p=0.0005). When models were stratified by smoking, the relationship between HIV status and sleep difficulties was seen among non-smokers (OR=2.11), and this relationship was stronger among smokers (OR=2.62).

Conclusion: Among college students, HIV positive status is associated with increased sleep difficulties. These problems are worse among smokers. Not only are sleep interventions warranted in this vulnerable group, but smoking cessation efforts could potentially be enhanced by sleep interventions in this group.

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0849 SLEEP DISTURBANCE IN WOMEN WITH AND WITHOUT HIV: THE ROLE OF PSYCHOSOCIAL FACTORS

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Introduction: Patients with fibromyalgia (FM) suffer from chronic widespread pain which limits their physical activity, and is associated with disturbed sleep. However, the relationship between physical activity, pain level, and nighttime sleep is unclear. This study examined whether objectively measured activity levels (via actigraphy) and pain intensity are associated with actigraphically measured sleep.

Methods: Adults with FM (n=160, Mage=52, SD=12, 93% female) completed 14 days of actigraphy. Activity levels (i.e., magnitude of wrist motion captured per 30 second epoch) were recorded, and average afternoon/evening activity for intervals 12:00-15:00, 15:00-18:00, and 18:00-21:00 was computed, removing days in which participants slept during these periods. Multiple linear regressions examined whether afternoon/evening activity, pain, or their interaction, predicted actigraphically measured sleep onset latency (SOL), wake after sleep onset (WASO), total sleep time (TST), total wake time (TWT), early morning snooze time, and sleep efficiency (SE), controlling for age, body mass index, and usage of sleep or pain medication.

Results: Greater evening activity from 18:00-21:00 was independently associated with lower SE (B=-.01, p=.02) and higher TWT (B=.06, p=.03). Greater pain intensity was independently associated with lower SE (B=-.06, p=.03). Activity from 12:00-15:00 and 15:00-18:00 was not significantly associated with sleep outcomes.

Conclusion: Results suggest that in FM, increased evening physical activity, regardless of pain level, may exacerbate objective sleep disturbance. It is likely that higher evening activity increases pre-bedtime arousal, and leads to more fragmented sleep. Reducing evening activity levels may help promote better sleep quality in FM.

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Introduction: Sleep disturbance is recognized to be highly prevalent in people living with HIV (affecting ~29-97%). Women over the age of 40 years are particularly affected. It is not known however, if HIV infection independently contributes to sleep disturbance, or if the observed sleep disturbance is mostly due to psychosocial factors that can co-occur in people living with HIV. Therefore, we examined subjective and objective sleep parameters in women participating in the Women’s Interagency HIV Study (WIHS) Chicago site. The WIHS study recruits women with and without HIV using similar methods, thereby minimizing psychosocial differences between them.

Methods: Ninety women (46 HIV+ virally suppressed with antiretroviral therapy, 15 HIV+ viremic, and 29 HIV- women, average age 51 years) completed a sleep quality questionnaire (PSQI), a week of wrist actigraphy, and an overnight urine collection. Variables extracted from the wrist actigraphy included the weekly average total sleep time (TST) and sleep efficiency (SE). The overall night-time secretion of creatinine-adjusted levels of 6-sulphatoxymelatonin (melatonin metabolite, MLT) was extracted from the urine sample.

Results: Many demographic and psychosocial factors known to influence sleep were not significantly different between the three groups (e.g. age, race/ethnicity, BMI, education, income, employment, stable housing, alcohol and substance use, depressive and PTSD symptoms; p>0.05). PSQI was elevated in all 3 groups but did not differ between groups (PSQI 6.4 HIV+ viremic, 6.7 HIV+ aviremic, 7.7 HIV-; p>0.05). Wrist actigraphy revealed similar sleep duration and sleep efficiency in all 3 groups with no group difference (TST: 6.7 h HIV+ viremic, 6.6 h HIV+ aviremic, 6.2 h HIV-; SE: 83.5% HIV+ viremic, 85.2% HIV+ aviremic, 84.7% HIV-; p>0.05). Melatonin metabolite concentration also did not differ between the groups (MLT: 21.6 HIV+ viremic, 25.0 HIV+ aviremic, 26.1 HIV-; p>0.05).

Conclusion: While sleep disturbance is widely recognized in people living with HIV, HIV infection in and of itself does not appear to be systematically associated with greater sleep disturbance. Concomitant psychosocial factors likely play a greater role in contributing to sleep disturbance in HIV.

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0850 THE ROLE OF SLEEPING PILLS IN THE DEVELOPMENT OF SHINGLES IN VETERANS.
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Introduction: There is continuing evidence that the chronic use of sleeping pills may be a risk factor for infection. One infection of concern in the aging veteran population is Herpes Zoster (HZ). Veterans are commonly prescribed sedative-hypnotics (sleeping pills) for chronic conditions such as insomnia, generalized anxiety disorders, mood disorders, alcohol withdrawal, seizures, panic attacks.

Methods: We studied the relationship between commonly prescribed sedative-hypnotics (benzodiazepines and Z-drugs) and incident HZ among veterans who received care at the James A. Haley Veteran’s Hospital. A total of 22,000 veterans were randomly selected from each quarterly year from 2007-2011 from the CPRS/VISTA patient record system. All outpatient diagnoses, procedures and pharmacy data between 2006-2015 were then drawn for this cohort. To eliminate confounding by calendar date, patients without HZ were frequency matched on a visit date that was close to a HZ diagnosis date in the patients with HZ. Hypnotic use was examined in the 365 days prior to the HZ diagnosis date or a matching control date. Patients who had an acute hypnotic use (e.g. for a medical procedure) prior to the 90 days of HZ diagnosis date were excluded from that analysis. Logistic regression was used to calculate odds ratios (OR).

Results: Of 3522 patients on sedative-hypnotics, 200 (5.7%) developed HZ; out of the 18422 patients with no prescription for hypnotics, 741 (4.0%) developed HZ (OR = 1.437, 95%CI = 1.224, 1.687). The association remained significant (OR= 1.22, 95%CI =1.024,1.453) after adjusting for age, sex, BMI, Charlson comorbidity index, race, Hispanic ethnicity, marital status, combat status, opioid use.

Conclusion: Chronic use of sleeping pills is associated with later development of HZ. This supports a premise that long-term use of sleeping pills lowers immune status.

Support (If Any): This material is the result of work supported with resources and the use of facilities at the James A. Haley Veterans’ Hospital.

0851 SOCIAL JETLAG AND THE INCREASED RISK OF ANEMIA: DATA FROM THE KOREA NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY VII
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Introduction: The discrepancy between social and biological time, described as ‘social jetlag’, can be estimated by the difference in mid-sleep time during the weekend and during weekdays. Social jetlag is known to increase risk of metabolic complications, heart disease and other problems. Anemia is associated with sleep related conditions such as night sleep duration and sleep quality. In this study, we aimed to evaluate the association between social jet lag and anemia.

Methods: We analyzed adult participants (age ≥19) of the seventh Korean national health and nutrition examination survey (KNHANES VII, 2016). Shift workers were excluded from the analysis. The association between social jetlag and a low hemoglobin level, defined as hemoglobin <12 g/dL was analyzed using multivariable logistic regression.

Results: A total of 5146 participants were included in the analysis. Mean age of the study population was 51.8 (SD 16.7), and 2983 (58%) were women. Anemia was found in 411 (9%) of the subjects. After adjusting for age, sex, job status, body mass index, hypertension, diabetes, hyperlipidemia, smoking, and alcohol consumption, social jetlag of more than 1 hour had an increased risk of low hemoglobin level with an odds ratio (OR) of 1.47 (95% confidence interval (CI),1.01-2.06; p = 0.03). The association was stronger in women (OR 1.53, 95% CI1.06-2.17, p = 0.02) but not significant in men.

Conclusion: These results suggest that social jetlag is associated with a higher risk of anemia. This study warrants further
investigations on the effect of social jetlag and anemia-related health conditions.

Support (If Any): None

0852
CHARACTERIZING SLEEP DISORDERS IN VETERANS WHO ARE DIAGNOSTICALLY ELIGIBLE FOR CARDIAC REHABILITATION
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Introduction: The prevalence of sleep disorders is high in individuals with cardiovascular disease. It may be further heightened in individuals who have recently experienced a cardiac event, undergone a cardiac procedure, or have a chronic cardiac condition (i.e., individuals eligible for cardiac rehabilitation [CR]). Factors related to the cardiac event or disease-process (e.g., hospitalization, physiology, medications) as well as psychosocial factors (e.g., mood) may precipitate or exacerbate sleep disorders in this group. The objective of this analysis was to estimate the prevalence of sleep disorders in Veterans eligible for CR.

Methods: Analysis was conducted with Veterans Affairs (VA) Electronic Health Records data. The total sample included Veterans who utilized VA VISN 4 services from FY2011-FY2017. The sample of interest was Veterans who were diagnostically eligible for CR, indicated by receipt of International Classification of Diseases (ICD) or Current Procedural Terminology codes corresponding with CR diagnostic enrollment criteria. Sleep disorders were identified using ICD codes. Data on prescription medications for insomnia was also collected.

Results: Of 482,164 Veterans who utilized VA VISN 4 services from FY2011-FY2017, 68,485 were diagnostically eligible for CR. Of Veterans eligible for CR, 27.4% had at least one sleep disorder, and 5.2% had more than one. Breathing-Related Sleep Disorders were the most commonly diagnosed sleep disorders (20.2%), followed by Insomnia Disorders (9.6%), Sleep-Related Movement Disorders (1.5%), and Parasomnias (1.4%). Approximately 20.4% of Veterans eligible for CR were prescribed an insomnia medication.

Conclusion: The prevalence of sleep disorders, indicated by a diagnosis or prescription medication, was high in this sample of Veterans eligible for CR. These findings provide preliminary support for the need to routinely assess and monitor sleep in this population. The assessment of sleep and implementation of interventions that promote sleep health could enrich existing CR goals and enhance Veterans’ revitalization and long-term well-being.

Support (If Any): VA Pittsburgh Healthcare System, VISN 4 Mental Illness Research, Education and Clinical Center Pilot Funds; Department of Veterans Affairs Office of Academic Affiliations, Advanced Fellowship Program in Mental Illness Research and Treatment.

0853
NAPPING AND ASSOCIATED CHRONIC DISEASES. SURVEY OF 43,060 ADULTS OF THE NUTRINET SANTÉ COHORT.
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Introduction: The objectives of this study were to assess the associations among various physical and mental chronic conditions and napping. In addition to sleeping at night, increasing evidence shows that napping may also have real power to relieve physical fatigue and restore alertness. Napping is therefore highly recommended by public health authorities, especially to avoid/compensate for sleep debt and prevent sleep-related road/work accidents and comorbid diseases. To our knowledge, a specific interview on napping and sleep has never been administered to a prospective dataset of subjects to clarify how concise napping characteristics (i.e., the duration and the frequency on weekends and on weekdays) may be associated with chronic diseases.

Methods: A cross-sectional epidemiological survey was proposed within the NutriNet-Santé population-based e-cohort launched in France in 2009. Participants were 43,060 French volunteers aged 18 and over with Internet access. A self-report questionnaire assessing sleep characteristics was administered in 2014. The main outcome (dependent) variable was weekday or weekend napping (yes/no). The main exposure (independent) variables were overweight/obesity, hypertension, diabetes, anxiety and depressive disorders, incident major cardiovascular diseases (myocardial infarction, stroke, unstable angina), and incident cancer (breast and prostate). The associations of interest were investigated with multivariable logistic regression analysis. We found that napping was more common among males (46.1%) than among females 36.9% (p<0.0001).

Results: The tests for interaction by sex were not statistically significant, so all models were fit in the full sample. The adjusted associations between chronic diseases and napping showed that Individuals who were overweight or obese or had hypertension, diabetes (type 1 and 2), or depression or anxiety disorders had a significantly increased likelihood of napping compared with individuals without these disorders. The adjusted ORs ranged from 1.14 to 1.28. No significant associations were found between major CVD or breast or prostate cancer and napping.

Conclusion: Future longitudinal analyses are needed to elucidate causality.

Support (If Any):
Introduction: Sleep disturbance and mental health symptoms are common in patients with spinal cord injury or disease (SCI/D). Unfortunately, data are limited regarding the relationship between insomnia and mental health symptoms in SCI/D. The current study aimed to examine the extent to which sleep disorder diagnosis predicts deployability and subsequent health issues.

Support (If Any): Support for this study came from the Military Operational Medicine Research Program of the United States Army Medical Research and Materiel Command Q5a task area.

8055 INSOMNIA SEVERITY PREDICTS DEPRESSION, ANXIETY, AND PTSD IN VETERANS WITH SPINAL CORD INJURY OR DISEASE

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Introduction: Sleep disturbance and mental health symptoms are common in patients with spinal cord injury or disease (SCI/D). Unfortunately, data are limited regarding the relationship between insomnia and mental health symptoms in patients with SCI/D. Our objective was to examine the impact of insomnia symptoms on mental health symptoms in patients with SCI/D.

Methods: 57 Veterans (38.53 ± 10.69 years; 91% male) with SCI/D completed baseline assessments for a positive airway pressure adherence intervention study. Nested regression models predicted Patient Health Questionnaire (PHQ-9; 6.57 ± 5.19) or Generalized Anxiety Disorder screener (GAD-7; 6.53 ± 5.84) without sleep items. Logistic regression predicted probable PTSD (PC-PTSD ≥ 3; n=36) vs. no PTSD (PC-PTSD < 3; n=20). Block 1 included demographic covariates (age, gender, race, education, marital status, BMI), Block 2 included level of injury (cervical vs. thoracic and below), and Block 3 included Insomnia Severity Index (ISI) total score.

Results: Block 1 explained significant variance in GAD-7 (p=.05), but not PHQ-9 (p=.17). Level of injury did not explain significant variance in GAD-7 (p=.34) or PHQ-9 (p=.94) over and above Block 1. ISI explained an additional 13% of variance in GAD-7 (p=.003) and 12% in PHQ-9 (p=.007) over and above blocks 1 and 2. All variables in Blocks 1-3 were jointly associated with GAD-7 (R²=0.37, adjusted R²=0.26) and PHQ-9 (R²=0.29, adjusted R²=0.20). Odds of probable PTSD were increased 1.51 fold for each 1 unit increase in ISI (p=.004).

Conclusion: In Veterans with SCI/D, insomnia symptom severity was associated with anxiety and depression severity and higher odds of PTSD. Endorsement of difficulty falling and staying asleep in SCI/D should prompt mental health screening in addition to screening for sleep-related breathing disorders. Further research should evaluate whether insomnia interventions may benefit mental health symptoms in SCI/D.

Support (If Any): VA Rehabilitation Research and Development Service (RX002116; PI Badr) and NIH/NHLBI (K24HL143055; PI Martin)

8056 HIGHER SLEEP EFFICIENCY IMPROVES ATTENTION AND PROCESSING SPEED IN PATIENTS WITH SEVERE PAIN AND IMPLANTABLE CARDIOVERTER DEFIBRILLATORS

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Introduction: Patients with implantable cardioverter defibrillators (ICDs) commonly experience sleep disruption, and research suggests they may perceive physical pain more strongly than individuals without ICDs. Prior work points to associations between objective (i.e., actigraphic) sleep and cognitive performance in patients with ICDs, but whether pain affects associations between measures of sleep fragmentation (e.g., sleep efficiency, SE) and cognition is unknown. The goal of the present study was to examine the independent and interactive associations between SE and pain on cognition in patients with ICDs.

Methods: Thirty-seven patients with ICDs (Mage=60.0, SD=12.4) and self-reported sleep disturbance completed T4 days of actigraphy. Sleep efficiency (SE) was computed as the total sleep time/time in bed x 100%. Patients completed the pain section of the Short Form 36 Health Survey (SF36), with lower scores indicating worse pain. Patients also completed computerized tasks measuring executive functioning (i.e., letter series, n-back task), and attention/processing speed (i.e., simple reaction time; symbol digit modality task, SDMT). Multiple linear regressions examined whether SE independently predicted or interacted with pain ratings to predict performance across cognitive tasks.

Results: SE interacted with pain ratings to predict SDMT performance (B=.−.0001, SE=.−.00, p=.04), accounting for 12% of the
unique variance in performance. In patients reporting more severe pain, higher SE was associated with better SDMT performance ($B=0.04, SE=0.02, p=0.03$). Similar patterns of association between SE and pain on SDMT were not observed in patients with average or low pain (ps>0.05). SE and pain ratings did not independently predict SDMT performance (ps>0.05). Performance on other cognitive tasks was not associated with any predictors (ps>0.05).

**Conclusion:** Better sleep efficiency may play an important role in improving attention/processing speed performance in patients with ICDs and perceived severe pain. Future research should examine whether interventions aimed at improving sleep fragmentation provide benefit to lower order cognition, particularly in patients with more severe pain.

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**0857**

THE INFLUENCE OF OBESITY ON THE ASSOCIATION OF SLEEP APNEA AND ATRIAL FIBRILLATION

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**Introduction:** The association of obstructive sleep apnea (OSA) with atrial fibrillation (AF) has been well-described. However, obesity is a powerful confounder in the causal relationship between OSA and cardiovascular disease. The role of obesity in the relationship of OSA and AF remains unclear.

**Methods:** We identified an equal number of consecutive patients with and without AF who underwent clinically indicated diagnostic polysomnography at a single academic sleep center. OSA was defined by AHI $>15$/hr, with severe OSA being AHI $>30$/hr. Obesity was defined as BMI $>30$kg/m². Multivariable logistic regression adjusting for age, sex, hypertension, and heart failure (HF) was performed to examine the independent association between OSA and AF stratified by obesity.

**Results:** A total of 457 patients (male: 56%, mean age 62.6±14.0 years) were included. There was a high prevalence of HF in the AF cohort (67.7%; low vs. high BMI group; 56.3% vs. 80%, p=0.0001). OSA prevalence was similar between those with and without AF (57.2% vs. 51.8%, p=0.24). The prevalence of OSA was higher in patients with AF in the non-obese group (47.1% vs. 60.5%, p=0.037), but not in obese patients (57.0% vs. 53.6%, p=0.62). This, however, this association in non-obese group was lost in multivariable logistic analysis (OR 1.11 [0.59-2.08], p=0.74). Sensitivity analysis showed that presence of AF was associated with severe OSA in the non-obese group (47.1% vs. 60.5%, p=0.037), but not in obese patients (57.0% vs. 53.6%, p=0.62). This association in non-obese group was lost in multivariable logistic analysis (OR 1.11 [0.59-2.08], p=0.74). Sensitivity analysis showed that presence of AF was associated with severe OSA in the non-obese group (47.1% vs. 60.5%, p=0.037), but not in obese patients (57.0% vs. 53.6%, p=0.62). However, this association in non-obese group was lost in multivariable logistic analysis (OR 1.11 [0.59-2.08], p=0.74). Sensitivity analysis showed that presence of AF was associated with severe OSA in the non-obese group (47.1% vs. 60.5%, p=0.037), but not in obese patients (57.0% vs. 53.6%, p=0.62).

**Conclusion:** While SDB severity defined by AH1 was associated with reduced FEV1% predicted and a nonsignificant 0.65% reduction of right ventricular ejection fraction (cardiac MRI) (-0.13: -0.28, 0.01, p=0.068). For every 5% increase in TRT<90, there was a 0.9mmHg increase in mPAP (0.18: 0.11,0.35, p<0.001), a 1.15 mmHg increase in right ventricular systolic pressure (echocardiogram, ECHO) (0.23: 0.11,0.35, p<0.001) and a 0.60% reduction in FEV1 (-0.12: -0.24, -0.01, p=0.036).

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**0858**

SLEEP DISORDERED BREATHING AND CARDIOPULMONARY INDICES IN WORLD SYMPOSIUM OF PULMONARY HYPERTENSION GROUP 1 PULMONARY HYPERTENSION

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**Introduction:** Few studies have systematically investigated sleep disordered breathing(SDB) and rigorously collected cardiopulmonary measures in pulmonary hypertension(PH). We leveraged data from the NHLBI-funded multicenter Pulmonary Vascular Disease Phenomics(PVDOMICS) study focused on deep PH phenotyping to examine SDB and cardiopulmonary physiologic and structural measures in World Symposium of PH(WSPH) Group 1 PAH.

**Methods:** The PVDOMICS study (NCT02980887) enrolls subjects ≥18 years of age referred for right heart catheterization (RHC) with mean pulmonary artery pressure ≥25mmHg across seven clinical sites in the U.S. Sleep studies were included if conducted at home within 6 months of study enrollment using the NOX T3 (Carefusion®) or if available historically ≤1 year prior to enrollment. Linear regression was used to assess the association of sleep indices (apnea hypopnea index (AHI),% desaturation) and percentage total recording time (<90%/SaO2(TrT<90)) and cardiopulmonary measures (mean pulmonary artery pressure (mPAP), cardiac output, right ventricular wall measures and lung physiology) adjusted for supplemental oxygen and/or positive airway pressure usage (beta coefficients±95% confidence intervals).

**Results:** 165 WSPH Group 1 participants comprise the sample to date: age 52.0±14.1 years, 53% female, 78.2% Caucasian, body mass index(BMI) of 29.9±7.7 kg/m² and 53.7% with AH1≥5. Each 5-unit increase in AHI was associated with a 0.80% reduction in FEV1% predicted (-0.16:-0.31,-0.02, p=0.002) and a nonsignificant 0.65% reduction of right ventricular ejection fraction (cardiac MRI) (-0.13: -0.28, 0.01, p=0.068). For every 5% increase in TRT<90, there was a 0.9mmHg increase in mPAP (0.18: 0.11,0.35, p<0.001), a 1.15 mmHg increase in right ventricular systolic pressure (echocardiogram, ECHO) (0.23: 0.11,0.35, p<0.001) and a 0.60% reduction in FEV1 (-0.12: -0.24, -0.01, p=0.036).

**Conclusion:** While SDB severity defined by AHI was associated with reduced FEV1% predicted and a trend toward reduced RV E (MR1), nocturnal hypoxia was associated with increased mPAP (RHC) and RVSP (ECHO) in WSPH Group 1 patients. These data show links between SDB severity and diminished pulmonary function and of nocturnal hypoxemia and severity of mPAP elevation; nocturnal hypoxia therefore could represent a therapeutic target in Group 1 PAH.

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Support (If Any): Communicatie en beweging in a general population sample.

Introduction: Although several cross-sectional studies suggest an association between sleep-disordered breathing (SDB) and increased cardiovascular (CV) risk, recent large randomized controlled trials failed to show beneficial effects of positive airway pressure treatment in SDB patients. This study aimed to assess the sleep determinants of incident cardiovascular events in a general population sample.

Methods: HypnoLaus is a prospective middle-to-older-age population-based cohort in which subjective sleep characteristics (assessed by questionnaires) and objective sleep parameters (by complete polysomnography at home), and CV profile were assessed at baseline and after a 5-years follow-up. A local committee adjudicated the development of any CV event (including myocardial infarction, acute coronary syndrome or stroke) following international recommendations. Pittsburgh Sleep Quality Index (PSQI) score >5 was used to define poor sleep quality. Fast Fourier transformation of non-rapid eye movement (NREM) electroencephalogram (EEG) assessed relative power spectrum components according to the EEG bands: delta (1-4 Hz), theta (5-8 Hz), alpha (8-12 Hz), sigma (12-16 Hz), and beta (18-30 Hz). Autonomic activation during sleep was evaluated through pulse wave amplitude (PWA) drops based on the photoplethysmographic signal of pulse oximetry. A validated algorithm automatically detected PWA drops based on the photoplethysmographic signal of pulse oximetry. A validated algorithm automatically detected PWA drops based on the photoplethysmographic signal of pulse oximetry. A validated algorithm automatically detected PWA drops based on the photoplethysmographic signal of pulse oximetry.

RESULTS: Of the 1,939 participants (56.4±17.7 years, 53.0% women) free of any CV disease at baseline, 74 (3.8%) developed a CV event over a 5-year follow-up. After adjustment for age, sex, body mass index, baseline systolic blood pressure, smoking, alcohol, metabolic syndrome, dyslipidemia, and hypertension, the following sleep parameters were independently associated with the development of incident CV events: PWA drop index (HR for 1 event/h increase: 0.986 [0.974 - 0.999], p=0.033), NREM delta EEG power (HR for 1% increase: 0.951 [0.918 - 0.985], p=0.005), and PSQI ≥5 (HR vs PSQI≤5: 2.275 [1.342 - 3.855], p=0.002).

Conclusion: Impaired vascular reactivity assessed by PWA variations, low NREM delta power, and subjective poor sleep quality are independent predictors of incident CV events in the HypnoLaus cohort.

Support (If Any): Leenaards foundaion, FBM, and SNF.

0860 PULSE WAVE AMPLITUDE DROPS DURING SLEEP: REFERENCE VALUES AND CLINICAL ASSOCIATIONS IN A GENERAL POPULATION

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Introduction: This study aimed to establish reference values of PWA-drop frequency and characteristics as well as their clinical associations in a general population sample.

Methods: HypnoLaus is a population-based cohort in which 2,162 individuals underwent full polysomnography (PSG) at home, clinical assessment and blood collection for biochemical analysis. Hypertension (HT) was defined as systolic blood pressure ≥140mmHg, diastolic blood pressure ≥90mmHg, or anti-HT treatment. Diabetes was defined as fasting glucose levels >7.0 mmol/L or use of anti-diabetic treatment. The occurrence of myocardial infarction, acute coronary syndrome or stroke were assessed and adjudicated by a panel of expert. PWA-drops with amplitude >30% and duration >4 heartbeats derived from photoplethysmography, were identified as autonomic arousal (AA) by a validated algorithm. AA mean duration (s) and index (number per hour of sleep) were divided into quartiles and included in multivariable-adjusted logistic regression analysis.

Results: 2,143 participants (56.5±17.8 years, 51.0% women, 9.9% diabetes, 41.3% hypertension, 4.4% CVD) were included in the study. Median (interquartile range) of AA mean duration and AA index were 13.5 (12.0-15.4) s and 50.1 (36.1-63.5) events/h, respectively. After adjustment for sex, age, body mass index, diabetes, and the common covariates, increasing AA mean duration (p-for-trend=0.006) and decreasing AA index (p-for-trend=0.037) were independently associated with prevalent HT and CVD, respectively. After adjustment for alcohol consumption and the same covariates, increasing AA mean duration was independently associated with prevalent diabetes (p-for-trend=0.012).

Conclusion: PWA-drops are commonly observed during sleep and are independently associated with HT, CVD and diabetes in the general population.

Support (If Any): Leenaards foundation, FBM, and SNF.

0861 THE RELATIONSHIP BETWEEN CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT IN OBSTRUCTIVE SLEEP APNEA SYNDROME PATIENTS AND SENSORINEURAL HEARING LOSS: A PROSPECTIVE COHORT STUDY

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Introduction: Obstructive sleep apnea syndrome (OSAS) may be related to tinnitus and hearing loss. However, there are no prospective cohort studies to discuss the relationship between sensorineural hearing loss (SNHL) and continuous positive airway pressure (CPAP) treatment in OSAS patients. Our study is to analyze the correlation between these.

Methods: 100 participants who had SNHL and clinical symptoms of OSAS from Sep 1st 2016 to Jun 1st 2018 were included and followed at least 1 year. AHI <5 (N=19) and surgery treatment (N=4) were excluded. The 77 participants were categorized into 2 groups: OSAS with CPAP treatment (N=28) and OSAS without treatment (N=49). Pure tone audiometry (PTA) with different frequencies (low, medium, high, and average tone) for a period of time (3, 6, 9, and 12 months) was recorded. The risk factors, such as onset of hearing loss, severity of OSAS, hypertension, diabetics, stroke, depression, smoking, and alcohol drinking, were also included. Valid samples were analyzed in generalized estimating equation by SPSS for windows 17.0.
Results: Analysis included 77 participants. Unilateral SNHL can be alleviated by CPAP therapy for 6 months (Average tone: p=0.021; Low tone: p=0.003; Medium tone: p=0.012; High tone: p=0.007); 9 months (Average: p=0.035; Low: p=0.002; Medium: p=0.005; High: p=0.004); 12 months (Average: p=0.03; Low: p=0.006; Medium: p=0.008; High: p=0.058). There was no benefit to CPAP therapy in high tone SNHL. CPAP short-term treatment (3 months) cannot benefit SNHL, either.

Conclusion: CPAP treatment for at least 6 months in OSAS patients can improve unilateral hearing ability (average, low, and medium tone). There is no any benefit to CPAP therapy in high tone SNHL. CPAP short-term treatment (3 months) cannot benefit SNHL, either.

Support (If Any): Taichung Hospital, Ministry of Health and Welfare Study Program

0862 DOES NAPPING FOR HEADACHE RELIEF LEAD TO SLEEP DISTURBANCE AT NIGHT?
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Introduction: Compensatory sleep behaviors (e.g., naps, going to bed earlier) are often used to cope with headaches. However, it is not known if these coping behaviors lead to subsequent disturbances in nocturnal sleep. We tested this hypothesis by examining the temporal relationships between headaches, daytime naps, and nocturnal sleep in women with chronic migraines.

Methods: Twenty women with chronic migraine (Mean age = 32.2) and 20 age-matched female controls (mean age = 31.7) completed daily diaries on nocturnal sleep, daytime naps, and headache severity ratings (0-10, severity > 2 classified as headache) for approximately one month (M=28.20 days, range=21-36). T-tests were conducted to compare groups and linear mixed models were used to examine temporal relationships within the migraine group.

Results: Compared to controls, participants with migraines napped more often (28.54% of days vs 7.25%, p=0.0113) and had worse subjective sleep including longer sleep onset latency (SOL; 29.11 minutes vs 10.15, p=0.0015) and lower subjective sleep efficiency (SE; 80.39% vs 90.98%, p=0.0002). Within the migraine group, headache severity predicted taking a nap (p=0.0236), taking longer naps (p=0.0003) and an earlier nocturnal bedtime (BT; p=0.0171) on the same day. Napping predicted longer SOL (p=0.0244) and earlier BT predicted lower SE (p=0.0038) and longer total sleep time (TST; p=0.001), but did not predict SOL (p=0.2815). Longer TST was associated with lower likelihood of next-day headache (p=0.0444) but no significant relationship was found between SOL (p=0.4363) or SE (p=0.973) and next-day headache.

Conclusion: The results support the hypothesis that using naps and an earlier bedtime to cope with headaches would be associated with nocturnal sleep disturbance. Interestingly, going to bed earlier was also associated with longer nocturnal sleep, which was associated with lower likelihood of next-day headache. These findings provide novel insights into the use of compensatory sleep behaviors to cope with headache pain which could serve as a precipitating factor for comorbid insomnia.

Support (If Any): This study was supported by grant R21NS081088 from the National Institutes of Health.

0863 MORNING BRIGHT LIGHT TREATMENT IMPROVES FUNCTION AND REDUCES PAIN SENSITIVITY IN VETERANS WITH CHRONIC LOW BACK PAIN
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Introduction: There is an urgent need to develop readily available and safe non-pharmacological treatments for chronic pain. This is particularly the case for US military veterans, of which ~50% report experiencing chronic pain, most commonly in the back and head. Previous research found that morning bright light treatment improved function and reduced pain sensitivity in women with fibromyalgia. To further explore the potential benefits of morning bright light treatment for chronic pain, we tested a home-based morning bright light treatment in US military veterans with chronic low back pain and examined changes in function, pain sensitivity, sleep, and circadian timing.

Methods: Thirty-seven US military veterans (27 males, 10 females, mean age 48 years) with medically verified chronic low back pain participated in a 3-week protocol. Each subject slept at home on their usual sleep schedule for 1 week before 13 days of a self-administered home-based 1-hour morning light treatment. Function, pain sensitivity (heat threshold and tolerance), sleep (questionnaires, wrist actigraphy) and circadian timing (dim light melatonin onset, DLMO) were assessed at baseline, mid-treatment (after 6 days of light treatment) and post-treatment (after 13 days of light treatment).

Results: As verified with objective measures, subjects completed 88% of the scheduled light treatments. Average treatment satisfaction was 8/10. No side effects were reported. Morning bright light treatment led to improvements in function, pain intensity, pain sensitivity, and subjective sleep quality (p<0.05). Phase advances in circadian timing were also observed (p<0.05). Reductions in pain interference were associated with improvements in sleep quality (r=0.46, p<0.05) and circadian phase advances (r=0.55, p<0.05).

Conclusion: Morning bright light treatment should continue to be explored as a feasible, acceptable and effective adjunctive treatment for chronic pain. Positive treatment effects on pain may result from improved sleep, advanced circadian timing, and also potentially via direct projections from the circadian photoreceptors to brain pain centers.

Support (If Any): Grant awarded from NCCIH R34 AT008347.

0864 OBJECTIVE SHORT SLEEP DURATION INCREASES THE RISK OF ALL-CAUSE AND CAUSE-SPECIFIC MORTALITY ASSOCIATED WITH COGNITIVE IMPAIRMENT
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Introduction: Short sleep duration has been associated with cognitive impairment (CI) as well as cardiovascular (CVD) and cerebrovascular (CBV) disease. However, its role in predicting mortality is still not well-established given the lack of studies using objective sleep measures. We hypothesized that objective short sleep duration increases the impact of CI on mortality.

Methods: 1,741 men and women (48.8±13.6y) from the Penn State Adult Cohort, a random, general population sample studied in the sleep laboratory and followed-up 19.2 ± 5.2 years later for cause of death as ascertained through the National Death Index. Polysomnographic (PSG) total sleep time was classified as normal (≥6 h) and short (<6 h) sleep duration. CI (n=152) was ascertained using a comprehensive neuropsychological battery assessing processing speed (symbol digit modalities test, trail making test TMT-A), executive attention (TMT B/A, TMT B-A), short-term visual memory (benton visual retention test), verbal fluency (thurstone word fluency test) and global cognitive status (mini-mental state examination). Cox proportional hazard models controlled for age, sex, race, education, apnea/hypopnea index, mental health problems and physical health problems, including CBVD at baseline.

Results: The hazard ratios (95%CI) of all-cause mortality associated with CI were 0.97 (0.51-1.62) and 1.95 (1.47-2.57) for individuals with normal sleep duration and short sleep duration, respectively (P-interaction=0.02). For cause-specific mortality, the risk of CBVD mortality associated with CI was significantly increased in short sleepers (HR=2.13, 95%CI=1.43-3.16) but not in normal sleepers (HR=1.07, 95%CI=0.49-2.35). The risk of cancer mortality associated with CI was not significantly modified by sleep duration.

Conclusion: The risk of mortality associated with CI in middle-age is significantly increased in adults with objective short sleep duration and this risk is primarily for CBVD mortality. These data suggest that adults with early signs of CI who sleep objectively short may be suffering from subclinical forms of CBVD. Future studies should test whether early detection of such brain health biomarkers and objective sleep changes can predict the long-term prognosis of adults with CI.

Support (If Any): AHA (14SDG19830018), NIH (R01 HL51931, R01 HL40916)
0865
WHEN NIGHTMARES OCCUR
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Introduction: Posttrauma nightmares (PTNs) are nightmares that begin after a trauma and can reoccur as often as five times per week. As of now, research has yet to identify variables that may explain why PTNs occur on the nights they do. Thus, we conducted an exploratory study (Study-E) to identify variables that may influence their occurrence. Results led us to formulate the Nightmare Cognitive Arousal Processing Model (night-CAP), which suggest that cognitive arousal and sleep latency may influence the occurrence of PTNs. To test this model, a pilot study was conducted (Study-P) to see if exposure conditions replicated Study-C.

Methods: Study-E collected N=146 observations nested within 27 female sexual assault survivors. Methods used to identify predictors of PTN were pre/post sleep surveys administered to each participant for 6 consecutive days/nights. Study-P collected N=20 observations nested within 10 female participants (non-trauma survivors). Participants were run through a haunted house attraction and then completed pre/post sleep surveys for two consecutive nights. In both studies, participants completed baseline measures of psychopathology and trauma history.

Results: Study-E used multi-level modeling to discover that post-sleep cognitive arousal (PCA; \( z = 2.39, p < .05 \)) and sleep latency (SL; \( z = 2.58, p < .05 \)) predicted the occurrence of PTNs. For each unit increase in PCA participants were 1.75 times more likely to experience a PTN. In regards to Study-P, the power was to small to conduct MLM, but correlation analyses revealed a significant correlation between PCA and nightmare occurrence \( r = .63, p < .05 \) and a means-difference test demonstrated there were significantly different levels of PCA \( t = 3.22, p < .05 \) and SL \( t = 4.90, p < .05 \) on nights where nightmares occurred.

Conclusion: Results of both studies support the night-CAP model by providing evidence that PCA and SL play a pivotal role in the manifestation of nightmares. This information is crucial because it may help improve upon current treatments for PTNs.

Support (If Any): None.

0866
DOES OBSTRUCTIVE SLEEP APNEA MEDIATE THE RELATIONSHIP BETWEEN POST-TRAUMATIC STRESS DISORDER AND LOW BACK PAIN IN VETERANS?
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Introduction: Low back pain (LBP) is a common complaint among veterans, leading to notable limits in function, quality of life, and an increase in healthcare cost. The incidence and prevalence of LBP have been increasing in the veterans over the past several years. Obstructive sleep apnea (OSA) has been shown to be associated with LBP and there are notable associations among post-traumatic stress disorder (PTSD), OSA and LBP in this population.

Methods: A random sample of veterans stratified by quarter was taken between 2007 and 2011 (index date), collecting records from 2006 to 2016. Veterans were excluded if they had a prevalent case of LBP, and/or OSA in the year of or year before to their index date (index period), or PTSD, OSA and/or LBP prior to the index period. Associations among the PTSD, LBP, and OSA were calculated using SAS PROC LOGISTIC. SAS PROC PHREG was used to calculate hazard ratios (HR) for mediation analysis and the percent of 4-year LBP risk explained by OSA in those with PTSD.

Results: PTSD predicted LBP diagnosis (OR 1.52 [95% CI: 1.27, 1.83]) and OSA diagnosis (OR 2.05 [1.48, 2.88]). Additionally, OSA diagnosis was predictive of LBP diagnosis (OR 8.99 [95% CI: 7.07, 11.35]). The HR for the effect of PTSD on the risk LBP diagnosis was 1.47 (95% CI: 1.25, 1.74) without adjustment for OSA. The HR for the effect of PTSD on the risk LBP diagnosis adjusted for the mediator was 1.35 (95% CI: 1.15, 1.60). The resulting percent of excess LBP risk explained by OSA is 25.5% (95% CI: 19.6%, 31.1%). All analyses were adjusted for potential confounders.

Conclusion: OSA may mediate a significant amount of the risk of LBP diagnosis in veterans with PTSD. Prevention of OSA among veterans with PTSD may significantly reduce the risk of future LBP in veterans with PTSD.

Support (If Any): This material is the result of work supported with resources and the use of facilities at the James A. Haley Veterans’ Hospital.

0867
RELATIONSHIPS OF SLEEP WITH CORTICAL THICKNESS IN TRAUMA EXPOSED INDIVIDUALS WITH AND WITHOUT PTSD
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Introduction: Little is known about associations between cortical thickness and sleep difficulties in posttraumatic stress disorder (PTSD). We examined sleep, hyperarousal, and cortical thickness in trauma-exposed individuals.

Methods: Individuals exposed to trauma within the past 2 years (N=77) completed the Structured Clinical Interview for DSM, the Clinician Administered PTSD scale (CAPS), and PTSD Checklist-5 (PCL-5). They completed 2 weeks of actigraphy and sleep diaries, ambulatory polysomnography (PSG) and a 3T structural MRI scan. Combined hyperarousal items from CAPS and PCL-5 formed a composite hyperarousal index (CHI). Slow wave sleep (SWS)% and REM% were computed from PSG and mean sleep efficiency (SE) from actigraphy. Cortical reconstruction and parcellation were performed with FreeSurfer V6. Cortical thickness was the distance between the gray/white matter boundary and the pial surface. Regional cortical thickness was compared between individuals with PTSD (N=25) and trauma-exposed controls (TEC; CAPS<10; N=22). Among all 77 subjects, correlation maps were generated between cortical thickness, CHI and sleep measures.

Results: Compared to TEC, subjects with PTSD exhibited greater cortical thickness in the left insula and lesser thickness in the left paracentral/precentral. CHI was negatively correlated with cortical thickness in the left paracentral/precentral and middle frontal cortex (MFC), and positively correlated with thickness in the left insula. SE was positively correlated with cortical thickness in the insimum-cingulate/precentral, medial orbitofrontal cortex, and bilateral insula. SWS% was negatively correlated with cortical thickness.
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in posterior cingulate cortex (PCC)/precuneus, right lateral occipital lobe, and right MFC. REM% was positively correlated with cortical thickness in the PCC, anterior cingulate cortex (ACC), and precuneus, but negatively correlated in the left MFC, ACC, and right lingual gyrus.

**Conclusion:** Because thickness of corresponding areas varied with CHI, hyperarousal might play a role in cortical-thickness differences between PTSD and TEC. Notably, thickness in the insula (in which elevated activity is associated with anxiety disorders), was both greater in PTSD and varied positively with CHI. In certain midline portions of the default network, SE and REM% positively correlated with cortical thickness whereas SWS% correlated negatively.

**Support (If Any):** Funding: R01MH109638

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**0868 PATIENTS WITH PTSD AND OSA TREATED WITH APAP: EVALUATING COMPLIANCE BASED ON MASK TYPE IN THE NEW MEXICO VA POPULATION: QUALITY IMPROVEMENT PROJECT TO HELP IN ORDERING DME MASK SUPPLIES**

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**Introduction:** Approximately 40-50% of patients with PTSD also have OSA. Overall, this population is less compliant with PAP therapy. This is likely multifactorial related to hypervigilance, claustrophobia, nightmares, patient therapy perception, and healthcare response to patients with PTSD. Patients with worse nightmares have poorer PAP compliance. Additionally, REM-rebound can be seen in patient’s initially starting therapy leading to perceived heightened nightmares with PAP use. With better compliance, over time, a decrease in nightmare frequency is associated with better PAP compliance. In the first week of wearing PAP, patients with claustrophobia had a fivefold increase in the odds of using PAP therapy less than 4 hours/night. Current literature supports a bidirectional relationship between PTSD and OSA, such that PTSD is an obstacle in OSA treatment whereas, untreated OSA can be an obstacle in treating PTSD successfully. It was hypothesized that patients using APAP with PTSD would have better compliance with masks that did not obscure the patient’s peripheral vision. The primary evaluation assessed OSA with PTSD, APAP compliance, and mask type.

**Methods:** In October 2018 appointments, veterans diagnosed with OSA, concurrent PTSD, and APAP treatment were reviewed on mask selection and compliance of greater than 4 hours of usage for 70% of the time. Mask usage determined by prosthetic inventory. Masks not interfering with patient’s peripheral vision did not elevate around the patient’s nose. Of 34 patients, 17 met this criteria.

**Results:** Less restrictive masks were not associated with improved compliance. Results showed higher compliance to severer OSA regardless of mask usage.

**Conclusion:** My hypothesis was not supported. Multiple identifiable study limitations were present including male veterans only, sleep technologist’s mask preference, and patients’ length of time with APAP usage prior to visit. This short timeframe analysis and only patients seen with an identifiable PAP problem, created a selection bias. Additional study could include a longer time frame, patient’s BMI, the severity of PTSD, and APAP settings.

**Support (If Any):**

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**0869 MORNING BRIGHT LIGHT IMPROVES INSOMNIA, MOOD, AND PAIN IN VETERANS WITH TBI AND PTSD**

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**Introduction:** Insomnia is common among Veterans with Traumatic Brain Injury (TBI) and Posttraumatic Stress Disorder (PTSD). This study sought to determine the effect of morning bright light therapy (MBLT) on sleep, mood, pain, and other quality of life measures in Veterans with and without TBI and PTSD. We also determined which factors best predicted response to MBLT.

**Methods:** Self-report data was collected from n=45 Veterans (n=7 with TBI, n=10 with PTSD, n=10 with comorbid TBI+PTSD, and n=18 Controls) before and after 4-weeks of MBLT. Questionnaires included the Insomnia Severity Index (ISI), NIH PROMIS Pain surveys, Patient Health Questionnaire (PHQ-9), Neurobehavioral Sleep Inventory (NSI), Sleep Hygiene Index (SHI), and PTSD Checklist-5 (PCL-5). A Random Forest machine learning model predicting changes in ISI scores following MBLT was used to evaluate which variables were associated with response to therapy.

**Results:** MBLT significantly improved ISI (P=0.007), PHQ-9 (P=0.049), PCL-5 (P=0.009), NSI (P=0.004), and pain (P=0.005) scores in TBI+PTSD subjects. Random Forest modelling found baseline ISI, SHI, NSI, PHQ-9, and pain symptoms to be the strongest predictors of response to MBLT. Both ISI (r=0.350; P=0.018) and SHI (r=0.336; P=0.030) were significantly correlated with response to MBLT. Surprisingly, the diagnosis of TBI and/or PTSD did not significantly affect response to MBLT.

**Conclusion:** This study demonstrates the feasibility and potential for MBLT to improve insomnia, mood, and pain in Veterans, while also improving TBI- and PTSD-related symptoms. Random Forest predictive model analysis indicated that MBLT may have the strongest effect on those with severe insomnia and poor sleep hygiene at baseline, and is still effective in individuals carrying diagnoses of TBI and/or PTSD. These data highlight a potentially viable sleep intervention to improve sleep and quality of life in Veterans with TBI and PTSD.

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IX. Sleep and Psychiatric Disorders

**0870 GRATITUDE AND FREQUENCY OF NAPS PREDICT RESILIENCE FOR INDIVIDUALS WITH PTSD**

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**Introduction:** Resilience, the ability to bounce back from adversity, has been found to be a protective factor against the development of Post-Traumatic Disorder (PTSD). Positive emotions such
as gratitude (i.e. the ability to appreciate positive aspects of one’s life) can promote the development of critical resilience capacities. Moreover, sleep may play a role in resilience. For instance, napping can facilitate the retention of fear extinction memories. We hypothesized that both gratitude and weekly napping frequency would predict self-reported resilience in patients with PTSD.

Methods: Twenty-seven individuals who had reported habitually napping (63% female; Mean age = 31.7 years, SD = 9.0) with a clinical diagnosis of PTSD were administered the Gratitude Questionnaire-6 as a measure of trait gratitude, and also reported how many times they nap per week. These were used to predict scores on the Connor-Davidson Resilience Scale, a self-report measure of resilience.

Results: Multiple linear regression was used to predict resilience from gratitude and frequency of napping (for those who take naps during the week). Each variable was entered in a separate step. Individually, gratitude significantly predicted resilience ($R^2 = .594$, $p = .0002$), $R^2 = .35$. However, when added to the model, the frequency of weekly napping significantly increased prediction ($R^2$ Change = .135). In the final model, both gratitude ($R^2 = .403$, $p = .029$) and napping ($R^2 = .414$, $p = .025$) significantly predicted resilience ($R^2 = .487$).

Conclusion: Of those who indicate being habitual nappers, it was found that increased gratitude, combined with greater frequency of naps taken per week, predicted higher resilience levels than gratitude alone. These findings may be explained by the combination of higher trait gratitude, which would allow one to be able to reframe a negative situation positively, and the increased frequency of naps taken by individuals, promoting the retention of fear extinction. This combination appears to promote resilience. Combining naps with gratitude training interventions may prove useful in building resilience among patients recovering from PTSD.

Support (If Any): This project was supported by an USAMRMC grant to WDSK (W81XWH-14-1-0570).

0871

PTSD SEVERITY AND USE OF NEGATIVE EMOTION WORDS IN TRAUMA NARRATIVES PREDICT NIGHTMARES IN INDIVIDUALS WITH PTSD

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Introduction: Recurring, distressing nightmares are commonly experienced by individuals with PTSD. Previous research shows that higher use of positive than negative emotion words while describing traumatic experiences is associated with better health outcomes. We hypothesized that greater use of negative words in trauma narratives, along with higher PTSD severity, would predict the severity and frequency of nightmares in individuals with PTSD.

Methods: Sixty-three individuals (38 Females; $M_{age} = 31.60$, $SD_{age} = 8.91$) with a clinical diagnosis of PTSD were administered the Disturbing Dream and Nightmare Scale (DDNSI) and Clinician-Administered PTSD Scale for the DSM-5 (CAPS). Participants also typed a brief description of the most traumatic event they had experienced. These trauma narratives were processed with Linguistic Inquiry and Word Count (LIWC) 2015 to categorize positive and negative emotion words used in the descriptions. LIWC is a highly reliable and widely used computerized text analysis system that categorizes text into psychologically valuable (e.g. emotional state) and stylistic dimensions. Multiple linear regression analyses were run using SPSS.

Results: Participants used more negative than positive emotion words when describing their traumatic event ($M_{positive} = 0.55$, $SD = 1.41$; $M_{negative} = 10.11$, $SD = 13.48$). PTSD severity was a significant predictor of nightmares ($R^2 = .049$, $F = 17.61, p < .001$), with an overall model fit of $R^2 = .24$. When use of negative emotion words was entered as a second variable, both PTSD severity ($R^2 = .455$, $t = 3.92, p < .001$) and the use of negative language in trauma narratives ($R^2 = .23$, $t = 2.03, p < .05$) were significant predictors of DDNSI, accounting for an additional $5\%$ of the variance in the data ($F = 11.34, p < .001, R^2 = .29$).

Conclusion: These preliminary findings suggest that not only PTSD severity, but also the manner in which individuals with PTSD conceptualize and disclose their traumatic experiences might have implications for the severity and frequency with which these individuals have nightmares. The reappraisal of trauma narratives might be an important target in interventions for individuals with PTSD who experience nightmares.

Support (If Any): This project was supported by an USAMRMC grant to WDSK (W81XWH-14-1-0570).
using unobtrusive methods could be informative regarding changes in suicidality over time.


0873
OBSTRUCTIVE SLEEP APNEA AND PTSD SYMPTOMS IN VETERANS WITH TBI
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Introduction: There is a high incidence of obstructive sleep apnea (OSA) among Veterans, including those with posttraumatic stress disorder (PTSD) and/or traumatic brain injury (TBI). Sleep disruption from OSA may impede neurologic recovery in TBI and traumatic memory processing in PTSD (i.e., consolidation of emotional memories and promotion of fear extinction). However, few studies have examined the relationship of OSA to PTSD among Veterans with TBI and none in the context of moderate-to-severe TBI. In this study, we explored the relationship between OSA and PTSD symptoms at 1-year post-TBI, leveraging the Veterans Affairs (VA) TBI Model Systems longitudinal study.

Methods: Participants (n=65) were from a single study site, received polysomnography (PSG) during inpatient hospitalization, and completed a 1-year post-TBI follow-up assessment via telephone which included the PTSD Checklist-Civilian Version (PCL-C). Participants were primarily male (97%), with a median age of 31 years (IQR=24-53). Results: Fifty-two percent of participants had OSA diagnosed during inpatient rehabilitation. Of these, 32% had mild OSA (median AHI=11; IQR=6-15). Desaturation Index median was 7 (IQR=3-22). At one-year postinjury, PCL-C median was 27 (IQR=18-42). There were statistically significant correlations between the PCL-C and the Desaturation Index (p=.26, p=.038) and PCL-C and total sleep time (p=.35, p=.05). PCL-C scores were not associated with AHI, nadir, sleep efficiency, or arousal index.

Conclusion: In Veterans with moderate-to-severe TBI requiring inpatient hospitalization and who recovered sufficiently to complete psychological measures at 1-year post-injury, OSA severity, as measured by frequency of desaturations, was associated with greater PTSD symptoms at one-year post TBI. Veterans who slept longer during inpatient rehabilitation while undergoing PSG also reported greater PTSD symptoms. This finding may represent a sample bias, as Veterans who improved neurologically enough to complete self-report measures may have had better sleep early in recovery. Other OSA indices may not have been significant, as OSA severity was primarily mild in this sample. These findings were unexpected and should be replicated in future studies.

Support (If Any): This work is supported by VA TBIMS; GDHS; DVBIC; CDMRP. Award: W91YVZ-13-C-0015.

0874
THE RELATIONSHIP BETWEEN PSYCHOPATHOLOGY AND SLEEP PROBLEMS DIFFER BETWEEN RACIAL MAJORITY AND MINORITY GROUPS
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Introduction: Individuals with PTSD often experience lower sleep quality and higher rates of insomnia in comparison to the general population. In the U.S., when controlling for socioeconomic covariates, racial minorities consistently show worse sleep quality relative to the majority group. Here, we examine how anxiety, depression, and PTSD severity correspond with sleep problems between majority and minority racial groups.

Methods: Sixty-four individuals meeting criteria for PTSD (39 female; Age=31.3, SD=9.0) completed the Clinician-Administered PTSD Scale for DSM-5 (CAPS-5) as a measure of PTSD severity, the Beck Anxiety Inventory (BAI), and the Beck Depression Inventory (BDI). Participants also completed the Pittsburgh Sleep Quality Index (PSQI), and the Insomnia Severity Index (ISI) as measures of sleep quality. Forty of these participants identified as the culturally dominant racial group of White/Caucasian while 24 participants identified as a minority (e.g. Hispanic/Latino).

Results: There were no significant differences between majority and minority racial groups on any of the measures. However, the strengths of association between PSQI and BAI scores were significantly different (z=2.00, p=.045) between majority (r=.525, p<.001) and minority groups (r=.066, p=.772). A similar pattern was observed between the majority (r=.455, p=.004) and minority (r=.200, p=.373) groups on CAPS scores (z=1.98, p=.047). Similarly, the association between ISI and CAPS scores was significant (z=2.9, p=.003) for individuals in the majority group (r=.567, p<.001), but not the minority group (r=-.149, p=.486). Although BDI was significantly correlated with ISI (r=.445, p=.005) and with PSQI (r=.401, p=.014) within the majority group and not the minority group, the strength of association for depression (i.e., BDI) did not differ between groups.

Conclusion: Anxiety and PTSD severity were significantly correlated with sleep problems and insomnia for those in the majority group, but not among the racial minority group. This suggests that other psychosocial factors besides psychopathology, such as discrimination or acculturative stress, should be explored to better explain adverse sleep outcomes in minority populations. Further research investigating the effect of depression on sleep quality across racial groups should be conducted.

Support (If Any): .

0875
USE OF ANGER WORDS IN TRAUMA NARRATIVES IS NEGATIVELY ASSOCIATED WITH SLEEP QUALITY FOR SINGLE INDIVIDUALS WITH PTSD
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Introduction: Irritability and sleep problems are commonly experienced by individuals with PTSD. Research shows that anger increases cognitive agitation and psychological arousal, negatively affecting sleep quality. Prior research has shown that individuals in healthy romantic relationships report better sleep than single individuals, and there appears to be a bidirectional relationship...
B. Clinical Sleep Science and Practice

between sleep and relationship quality. Here, we examine the relationship between sleep quality and the use of anger words (e.g., hate) in trauma narratives among individuals with PTSD who are single or in stable romantic relationships.

**Methods:** Forty-six individuals meeting criteria for PTSD (26 Female; M\(_{\text{age}}\) = 31.30, SD = 9.00) were administered the Pittsburgh Sleep Quality Index (PSQI) and provided brief narratives of lifetime traumatic events. Linguistic Inquiry and Word Count (LIWC) 2015 was utilized to compute percentage values for anger words in these narratives. Twenty-five participants reported that they had never been married and were currently not in a relationship (15 Female; M\(_{\text{age}}\) = 25.80, SD = 5.13), and twenty-one participants indicated that they were currently married or were in a stable romantic relationship (11 Female; M\(_{\text{age}}\) = 32.02, SD = 8.14).

**Results:** The percentage of words relating to anger in trauma narratives was positively correlated with PSQI scores for individuals within the single group (r = 0.51, p<0.01), but not for individuals with significant others (r = −0.25, p > 0.33), when controlling for age. The strength of association between PSQI and percentage of anger words was significantly different (z = −2.24, p < 0.03) between groups. The groups did not differ significantly in the percentages of anger word use (M\(_{\text{married}}\) = 3.33, SD = 5.05, M\(_{\text{non-married}}\) = 3.55, SD = 4.34) or PSQI scores (M\(_{\text{married}}\) = 9.74, SD = 3.52, M\(_{\text{non-married}}\) = 9.75, SD = 2.69).

**Conclusion:** These preliminary results suggest that expressing anger in relation to traumatic events may be associated with worse sleep quality among single individuals with PTSD. Having a significant other is typically associated with emotional support and validation, possibly allowing these individuals to express anger in a healthy manner that does not impact sleep quality. Future research could benefit from clarifying the potential benefits of romantic relationships on sleep and recovery from PTSD.

**Support (If Any):** USAMRMC grant to WDSK (W81XWH-14-1-0570).

### 0876

**INDIVIDUALS WITH PTSD WHOSE TRAUMATIC EXPERIENCES OCCURRED WITHIN THE HOME HAVE WORSE SLEEP OUTCOMES**

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**Introduction:** For most people, the concept of “home” is associated with feelings of safety, privacy, and control. However, this may not be the case for individuals who have been traumatized in their home. We hypothesized that among individuals with PTSD, mentioning words related to “home” in trauma narratives would be associated with worse sleep outcomes.

**Methods:** Sixty-three individuals (38 Females; M\(_{\text{age}}\) = 31.60, SD\(_{\text{age}}\) = 8.91) with a clinical diagnosis of PTSD were administered the Functional Outcomes of Sleep Questionnaire (FOSQ), Insomnia Severity Scale (ISI), and Clinician-Administered PTSD Scale for the DSM-5 (CAPS), and provided descriptions of lifetime traumatic events. Higher scores on the FOSQ denote better sleep outcomes. Linguistic Inquiry and Word Count (LIWC) 2015, a computerized text analysis tool, was used to quantify the percentage of references to “home” within each participant’s narrative.

**Results:** Out of the sixty-three participants, 28 participants referred to “home” several times in their narratives (M = 3.94, SD = 3.30). These individuals had significantly higher ISI scores (M = 17.29, SD = 5.18 t(62) = 2.01, p < 0.05) and significantly lower FOSQ scores (M = 13.22, SD = 3.44, t(61) = −2.80, p < 0.01) compared to individuals who did not have “home” references (ISI: M = 14.61, SD = 5.37; FOSQ: M = 15.45, SD = 2.88). There was no significant difference in CAPS scores between the two groups.

**Conclusion:** These findings suggest that individuals with PTSD who experienced traumatic events in the context of their homes have significantly worse sleep outcomes and their insomnia problems are associated with more difficulty performing day-to-day activities. It is possible that individuals who experienced traumatic events at home may have difficulty falling and staying asleep due to increased hypervigilance while at home. Interventions aimed at helping such individuals reclaim their homes as safe havens might be worthwhile for improving sleep outcomes.

**Support (If Any):** USAMRMC grant to WDSK (W81XWH-14-1-0570)

## IX. Sleep and Psychiatric Disorders

### 0877

**LOWER REM PARASYMPATHETIC ACTIVITY ACCOMPANIES PTSD DIAGNOSIS AND GREATER HYPERAROUSAL IN TRAUMA-EXPOSED INDIVIDUALS**

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**Introduction:** Hyperarousal and abnormal autonomic functioning are core manifestations of posttraumatic stress disorder (PTSD). We examined associations of heart rate variability measures of parasympathetic activity during REM with PTSD diagnosis, self-reported hyperarousal and general psychopathology in recently traumatized individuals.

**Methods:** Individuals exposed to a PTSD Criterion-A trauma within the past 2 years (N=56, 35 females) aged 18-40 (mean 23.2, SD 4.6) underwent a night of ambulatory polysomnography (PSG) following an acclimation night. ECG recordings during REM-sleep periods of at least 5 min were analyzed using Kubios software. Each participant’s average Root Mean Square of the Successive Differences (RMSSD) and High Frequency (0.15-0.4Hz) power (HF) were calculated. Participants completed the Clinician-Administered PTSD Scale (CAPS-5, range 0-45, mean 20.1, SD 12.9) and the PTSD Checklist for DSM-5 (PCL-5). Twenty-three met DSM-IV-TR criteria for PTSD. Hyperarousal items from CAPS-5 and PCL-5 were combined into a Composite Hyperarousal Index (CHI). Likewise, a Composite Psychopathology Index (CPI) was created from the Symptom Checklist-90, the WHO Disability Assessment Schedule 2.0, and the Depression, Anxiety and Stress Scale. RMSSD and HF were compared between PTSD-diagnosed and non-diagnosed participants using unpaired t-tests. Their associations with CHI and CPI were analyzed with simple regression.

**Results:** Of sixty-five PTSD-diagnosed participants (M = 32.51, SD = 5.37) and non-diagnosed participants (M = 31.00, SD = 5.37), RMSSD was significantly lower for PTSD-diagnosed participants (t(60) = −2.61, p < 0.01). HF was not significantly different between the two groups (t(60) = −2.01, p = 0.05).

**Conclusion:** These findings suggest that individuals with PTSD who experienced traumatic events in the context of their homes have significantly worse sleep outcomes and their insomnia problems are associated with more difficulty performing day-to-day activities. It is possible that individuals who experienced traumatic events at home may have difficulty falling and staying asleep due to increased hypervigilance while at home. Interventions aimed at helping such individuals reclaim their homes as safe havens might be worthwhile for improving sleep outcomes.

**Support (If Any):** USAMRMC grant to WDSK (W81XWH-14-1-0570)
Results: Compared to non-diagnosed, trauma-exposed participants, those diagnosed with PTSD showed trends toward lower RMSSD (t(1,54)=1.893, p=0.064) and HF power (t(1,54)=1.987, p=0.052). Across all participants, CHI correlated negatively with both RMSSD (R=-0.31, p=0.023) and HF (R=-0.28, p=0.035). These relationships were driven primarily by PCL-5 hyperarousal items which showed significant negative correlation with RMSSD (R=-0.365, p=0.006) and HF (R=-0.315, p=0.019), whereas CAPS-5 hyperarousal items did not reach significance (RMSSD: p=0.13, HF: p=0.14). Total PTSD symptoms also predicted, but mostly as trends, RMSSD (CAPS-5: R=-0.231, p=0.09; PCL-5: R=-0.301, p=0.025) and HF (CAPS-5: R=-0.249, p=0.067; PCL-5: R=-0.258, p=0.057). CPI did not significantly predict either RMSSD (p=0.13) or HF (p=0.11).

Conclusion: PTSD diagnosis, greater self-reported hyperarousal and total PTSD symptomatology, but not general psychopathology, predicted decreased parasympathetic activity during REM. Decreased parasympathetic activity may lessen putative emotional regulatory functions of REM contributing to development of PTSD.

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0879 NIGHTMARE RECALL RATES CORRELATE WITH HYPERAROUSAL IN TRAUMA-EXPOSED INDIVIDUALS

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Introduction: Trauma-related nightmares are a distinguishing feature of the “re-experiencing” criteria for posttraumatic stress disorder (PTSD). We examined whether “hyperarousal” criterion features also predict rates of negative dreams in recently traumatized individuals.

Methods: Seventy participants aged 18-40 (45 females) exposed to a traumatic event within the past two years completed the Clinician-Administered PTSD Scale (CAPS-5) and the PTSD Checklist for DSM-5 (PCL-5). CAPS-5 scores ranged from 0-50 (mean 21.4, SD 12.8) and 32 met DSM-IV-TR PTSD criteria. All participants completed sleep diaries over 11-27 nights (mean 14.7, SD 2.3) containing questions that asked whether a dream was recalled, whether it was a nightmare (causing awakening) or a bad dream, and resemblance to trauma (exactly, similar, possibly similar, or unrelated). Per-total-diary and per-total-dream percentages for nightmares, bad dreams, and their sum as well as the sum of dreams that were exactly-like/similar to the trauma were calculated. A Composite Hyperarousal Index (CHI) was computed from the hyperarousal items on the CAPS-5, the PCL-5 and a published hyperarousal scale. A Composite Psychopathology Index (CPI) was computed from the Depression, Anxiety and Stress Scale, the WHO Disability Assessment Schedule 2.0 and the Symptom Checklist-90.

Results: CHI significantly predicted per-diary nightmare recall rate (R=0.32, p=0.008), bad dream recall rate (R=0.33, p=0.006), their combined rates (R=0.411, P=0.0007) but not those that were exactly-like/similar-to the trauma (R=0.18, p=0.15). For percentages on a per-dream basis, although CHI didn't predict nightmares alone (R=0.17, p=0.17), it did predict bad dreams (R=0.29, p=0.02), combined nightmares and bad dreams (R=0.41, p=0.0008) and trended for those exactly-like/similar-to the trauma (R=0.24, p=0.059). Relationships of CPI with these dream variables were weaker either on a per-night basis [nightmare rate (p=0.52), bad dream rate (p=0.013), combined rates (p=0.049), and those exactly-like/similar-to (p=0.68)] or a per-dream basis (p=0.51, 0.037, 0.016 and 0.51 respectively).

Conclusion: Hyperarousal predicted total bad dreams and nightmares as well as those specifically trauma-related. Their relationship with general psychopathology was weaker. Hyperarousal symptoms may play a role in generating the intrusion symptoms of PTSD over and above levels of general psychopathology.
Symptom Clusters in PTSD: Differential Relationships with Cognitive-Behavioral Therapy for Insomnia

Introduction: Tinnitus has been studied primarily in war veterans and refugees with PTSD, often exposed to head injury. A 50% tinnitus prevalence is reported in PTSD (versus a 10%-15% general population prevalence). Tinnitus in PTSD patients has been attributed to various factors including increased arousal, mild traumatic head injury including blast exposure, and a conditioned response to memories of being struck in the head. Tinnitus is associated with both cochlear and central nervous pathologies including limbic activation. Overnight polysomnography of non-psychiatric tinnitus patients has revealed lower %REM (6.4%+/-4.9%) in tinnitus patients versus controls (21.5%+/-3.6%) (Attanasio G, 2013). To my knowledge, there are no polysomnographic studies of PTSD patients with tinnitus.

Methods: 57 consenting civilian PTSD patients (52 female; mean +/- SD age: 46.91 +/- 13.09 years), with no head trauma history, underwent ≥1 nights of Level 3 polysomnography (WatchPAT200; Itamar Medical, Israel) and completed a battery of instruments including the Tinnitus Functional Index (TFI), a 25-item instrument that measures both severity and negative impact of tinnitus, the Pennebaker Inventory of Limbic Languidness (PILL), and PTSD Checklist for DSM-5 (PCL-5).

Results: 33/57 (57.9%) endorsed experiencing tinnitus. TFI scores correlated directly (Pearson r=0.520, p=.002) with PCL-5 scores (mean +/- SD PCL-5 score: 37.82 +/- 19.02). Multiple regression analysis using TFI score as dependent variable and PCL-5 clusters, PILL scores and age as independent variables revealed that only PCL-5 Cluster E (hyperarousal) (β=0.524, t=3.372, p=0.002) remained a significant predictor of TFI. Both %REM (r=-0.390, p=0.025) and REM duration (r=-0.430, p=0.012) were significantly inversely correlated with TFI.

Conclusion: Tinnitus was associated with PTSD severity, especially the hyperarousal cluster, in civilian PTSD patients with no head trauma histories. Higher baseline REM sleep has been associated with reduced fear conditioning in humans, therefore an inverse relation of tinnitus with REM sleep percentage and duration may be indicative of a greater propensity for fear conditioning in PTSD patients with higher tinnitus levels. Tinnitus may be a core symptom of activation and limbic dysregulation in PTSD, independent of traumatic brain injury.

Support (If Any): None

Cognitive-Behavioral Therapy for Insomnia in PTSD: Differential Relationships with Symptom Clusters

Introduction: Insomnia is highly prevalent in posttraumatic stress disorder (PTSD), and is associated with greater severity and decreased likelihood of remission. Sleep problems often persist after treatment for PTSD, and treating insomnia has been shown to ameliorate both PTSD and insomnia symptoms. Evidence also suggests that PTSD symptom clusters may exhibit differential relationships with sleep problems. In particular, hyperarousal is thought to impact sleep through increased physiological arousal. However, less is known about potential differential effects of cognitive-behavioral therapy for insomnia (CBT-I) on PTSD symptoms. Thus, we investigated the effect of CBT-I on PTSD DSM-IV symptom clusters. As we were also interested in differential effects of PTSD symptoms on treatment, we examined the effect of baseline symptoms on reduction in insomnia severity following intervention.

Methods: Women aged 18-64 with PTSD and insomnia were included as part of a larger randomized controlled trial of CBT-I in individuals with PTSD following interpersonal violence exposure (N=81, M age=37.15, SD=10.93). Participants completed an initial screening and were randomized to receive either CBT-I or Attention Control. Participants were administered the Clinician Administered PTSD Scale (CAPS), the Insomnia Severity Index (ISI), and the Hamilton Rating Scale for Depression. Sleep items were excluded from the CAPS criterion D score. A series of ANOVA models were used to examine change in CAPS cluster scores between groups. Hierarchical linear regression was used to examine relationship between baseline symptoms and change in ISI.

Results: Re-experiencing (F(1, 79) = 9.325, p= .003) and avoidance/numbing (F(1, 79) = 3.996, p= .049) symptoms significantly improved in the CBT-I group as compared to the control group. CBT-I did not lead to improvements in hyperarousal symptoms (F(1, 77) = 1.873, p= .175). Baseline avoidance/numbing symptoms were significant in predicting improvements in insomnia following CBT-I (F(4, 29) = 5.466, p= .026).

Conclusion: Findings suggest that the effect of CBT-I on PTSD may be due to reduction in re-experiencing and avoidance symptoms. Surprisingly, CBT-I did not improve hyperarousal symptoms. Findings highlight the importance of examining potentially different mechanisms underlying the relationship between insomnia and PTSD symptoms.

Support (If Any): R01NR013909

Characteristics of Nap Sleep in Trauma-Exposed Men and Women with and Without PTSD: Contributions of Biological Sex and PTSD to REM Sleep in a Lab-Based Experimental Study

Introduction: Sleep, Volume 42, Abstract Supplement, 2019
Introduction: REM sleep abnormalities have been reported in PTSD and may contribute to PTSD pathophysiology. Differences in sleep responses to stressful events have also been proposed as predictors of later PTSD. Daytime (nap) sleep has not been studied as a potential avenue for examining sleep abnormalities in laboratory models of PTSD. Here we describe objectively-measured sleep in trauma-exposed adults with and without PTSD studied in an adaptation nap and under two experimental conditions: a stress condition, in which a nap opportunity follows lab-based stressors, and a control condition, in which the nap follows non-stressful activities.

Methods: Thirty-one male and female participants with and without PTSD completed an adaptation, stress-condition and control-condition nap, all separated by at least 1 week, from 1:30-3:30 pm. Sleep was measured using standard polysomnography. Visually scored sleep variables were calculated for all naps. The Clinician-Administered PTSD Scale (CAPS) was performed at baseline and the PTSD Checklist (PCL) was performed prior to experimental naps. MANOVA assessed PTSD group, sex and group-by-sex interaction effects on REM latency and REM duration. Linear regression analyses examined CAPS and PCL effects on REM sleep.

Results: PTSD-positive subjects exhibited shorter REM latency than controls (p<.05). There were no main effects of sex or nap type on REM latency, nor main effects of PTSD status, sex or nap type on REM duration. Analysis of interaction effects demonstrated that the PTSD effect was significant in males only. Linear regression analyses demonstrated that higher CAPS predicted longer REM duration in females (p<.05) and that higher PCL score predicted longer REM duration in males (p<.05), regardless of nap condition or PTSD status.

Conclusion: These findings are consistent with research indicating PTSD effects on REM sleep. These analyses did not indicate an effect of pre-sleep stress on sleep. Laboratory studies of nap sleep may provide an effective approach to understanding sleep in PTSD and the role of sleep in disease-related mechanisms.

Support (If Any): VA Career Development Award (Richards)

0883 EEG CONNECTIVITY MARKERS IN COMBAT-EXPOSED VETERANS WITH PTSD

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Introduction: Measures of brain connectivity using electroencephalography (EEG) have been shown to provide insights into the functional neuroanatomical underpinnings of normal and abnormal cognitive processes during wakefulness, including learning and memory. However, the body of work on EEG connectivity is non-existent for PTSD, despite its well-established association with sleep disturbances. Here, we explore the alterations in EEG connectivity during sleep in PTSD subjects.

Methods: We collected 64-channel EEG recordings from 78 combat-exposed veterans during two consecutive nights of sleep. We computed two connectivity measures, coherence and the weighted phase lag index (wPLI), for each EEG channel-pair across three sleep stages [rapid eye movement (REM) and non-REM stages 2 (N2) and 3 (N3)] and five frequency bands. We examined the median values of these measures in nine region-of-interest (ROI) pairs consisting of six bilateral brain regions (left and right frontal, central, and parietal regions). We split the study data into two subsets of consecutive subjects for: 1) discovery of discriminatory connectivity markers [N = 47, 18 PTSD] and 2) marker validation [N = 31, 13 PTSD].

Results: In the discovery subset, left-right parietal ROI coherence in the theta band (4-8 Hz) during REM sleep was higher in subjects with PTSD compared to controls on both nights [Cohen’s d, effect sizes of 0.89 (night 1) and 0.72 (night 2)]. Connectivity in the N2 and N3 alpha band (8-12 Hz) measured by wPLI was higher in PTSD in five ROI pairs, with effect sizes ranging from 0.52 to 1.44 across both nights. The effect was most prominent for the left-right parietal ROI pair during N2 sleep [effect sizes of 1.27 (night 1) and 1.43 (night 2)]. These results were replicated in the validation subset.

Conclusion: Parietal ROI connectivity was significantly higher in PTSD subjects compared to controls in REM theta and NREM alpha bands. These EEG connectivity markers may relate to sleep disturbances and cognitive impairments in PTSD.

Support (If Any): This work was sponsored by the Military Operational Medicine Program Area Directorate of the U.S. Army Medical Research and Materiel Command, Ft. Detrick, MD.

0884 MORNING BLUE LIGHT EXPOSURE IMPROVES SLEEP AND FEAR EXTINCTION RECALL IN PTSD

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Introduction: Sleep disruption is considered to be the “hallmark symptom” of post-traumatic stress disorder (PTSD). In addition to sleep deficits, patients with PTSD who undergo experimental fear conditioning also typically show a deficit in the ability to recall extinction memories relative to those without the disorder. As memory consolidation is strongly influenced by sleep, we hypothesized that an intervention that regulates sleep and circadian rhythms (i.e., morning exposure to blue-wavelength light) might enhance consolidation and retention of learned extinction memory during a fear conditioning/extinction protocol among patients with PTSD.

Methods: Thirty-eight individuals with PTSD (18 male; Age=30.8, SD=9.0) underwent a well-validated fear conditioning and extinction protocol and were then randomly assigned to receive either BLUE (469 nm; n=20) or placebo AMBER (578 nm; n=18) morning light therapy for 30-minutes daily for 6-weeks. Participants returned after 6 weeks to undergo post-treatment extinction recall when exposed to the same previously conditioned stimuli. Extinction recall magnitude (ERM) at follow-up was calculated as the difference in skin conductance response (SCR) between the “extinguished” and the “never-extinguished” stimuli.

Results: BLUE light was associated with an increase in sleep duration relative to AMBER (p=.016). Based on the ERM, participants in the BLUE group showed sustained retention of extinction memory, while those in the placebo AMBER group showed a resurgence...
of the fear response after 6-weeks (p=.016). Moreover, retention of ERM was correlated with improvement in sleep on the Insomnia Severity Index for the BLUE (r=.44, p<.05) but not the AMBER group (r=.39, ns).

**Conclusion:** Compared to placebo, 6-weeks of daily morning BLUE-wavelength light exposure was associated with increased sleep duration and greater retention of extinction learning in patients with PTSD. We speculate that increased sleep quantity or quality during the interventional weeks after learning led to greater consolidation of the fear extinction memory. Prominent exposure treatments for PTSD are based on principles of fear extinction, and our findings suggest that blue light treatment may facilitate treatment gains by stabilizing sleep in a manner that promotes consolidation of extinction memory.

**Support (If Any):** USAMRMC (W81XWH-14-1-0570)

**0885**

**IS RESILIENCE A PROTECTIVE FACTOR FOR SLEEP DISTURBANCES AMONG EARTHQUAKE SURVIVORS?**

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**Introduction:** The prevalence of insomnia complaints in populations exposed to trauma is estimated to range from 41% to 91%. Posttraumatic stress disorder (PTSD) has been associated with elevated autonomic nervous system arousal during sleep and alterations in sleep stages. The protective effect of psychological resilience on PTSD and depression has been demonstrated. However, a critical gap remains as to the influence of resilience on sleep among survivors of natural disasters. This study investigated the relationships among psychological resilience, peritraumatic distress, PTSD and depression symptoms severity, and sleep disturbances among survivors of the 2010 earthquake in Haiti two years later.

**Methods:** The sample comprised 165 participants living in Port-au-Prince, Haiti, one of the areas affected by the 2010 earthquake. Measures included demographic factors, the Peritraumatic Distress Inventory, the PTSD Checklist Specific, the Beck Depression Inventory and the Connor-Davidson Resilience Scale. Spearman correlations and multilinear regressions were used to explore associations among resilience, PTSD, depression, and sleep disturbances among survivors of the 2010 earthquake in Haiti two years later.

**Results:** The majority of the population was male (52.1%) and the mean age was 30.7 (SD=11.07) years. Of the sample, 60.4%, 94% and 43% reported fearing for their life during the event, experiencing subsequent insomnia symptoms, or having nightmares, respectively. Among our participants, 42.4% and 21.8% showed clinically significant levels of PTSD and symptoms of depression. There were significant positive correlations between sleep disturbances and peritraumatic distress (r=0.41, p<0.001), PTSD (r=0.76, p<0.001), symptoms of depression (r=0.32, p<0.001), and age (r=0.15, p<0.001), but not with resilience factors. The most significant risk factors for sleep disturbances were peritraumatic distress, PTSD and depression symptoms, explaining 58% of the variance (F 4, 157 =0.57, R²=0.59, adjusted R² =0.58, p <0.001).

**Conclusion:** This is one of the first epidemiological study to investigate prevalence of sleep disturbances among survivors of the 2010 Haiti earthquake and its associations with peritraumatic distress, PTSD, depression and resilience. The findings provide evidence supporting the importance of sleep in interventions aiming at improving daily functioning and quality of well-being in the affected population.

**Support (If Any):** T32HL129953; K07AG052685

**0886**

**RECOVERY SLEEP SIGNIFICANTLY DECREASES BDNF IN MAJOR DEPRESSION FOLLOWING THERAPEUTIC SLEEP DEPRIVATION**

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**Introduction:** Sleep deprivation results in rapid antidepressant effects in 50% of individuals with Major Depressive Disorder (MDD). However, this antidepressant effect is typically reversed by recovery sleep. More recently, it has been shown that BDNF, a key component in regulating neuroplasticity, is both reduced in MDD, and increases following treatment including therapeutic sleep deprivation. What remains to be established is if changes in BDNF show a similar pattern of decrease following recovery sleep. Therefore, the aim of this study was the examine serum BDNF in individuals with and without MDD before and after therapeutic sleep deprivation.

**Methods:** 16 individuals with MDD (14 female; mean age=34.06, SD=10.16), and 7 healthy controls (HC) (2 female; mean age=38.14, SD=9.56) participated in the study. Participants completed a 5 day/4 night protocol consisting of adaptation, baseline, total sleep deprivation, and recovery phases. Serum BDNF was collected at 7 am following adaptation sleep, during sleep deprivation, and following recovery sleep. Mood was assessed using the modified Hamilton Rating Scale for Depression (HAM-D) each day at 10:30am.

**Results:** Results from repeated measures ANOVA revealed a significant condition (Post Adaptation, During Sleep Deprivation, Post Recovery) by group (HC, MDD) interaction, F (2, 42) = 4.88, p<0.05. Post-hoc tests revealed that individuals with MDD showed a significant decrease in BDNF following recovery sleep, t(15)=2.09, p<0.05, while HC did not. Means for sleep deprivation BDNF were 4771.13 ng/ml (SD=4689.49) for MDD and 2571.18 ng/ml (SD=2679.67) for HC while recovery BDNF were 3577.48 ng/ml (SD=3208.20) for MDD and 6075.49 ng/ml (SD=7792.01) for HC. Correlational analysis also revealed that the higher the initial HAM-D score, the lower the BDNF level was following recovery, r=-.515, p<0.05.

**Conclusion:** The results of this study demonstrate that following recovery sleep, BDNF significantly decreases in those with MDD. As the improvements in mood associated with therapeutic sleep deprivation have been shown to decrease following recovery sleep, these results may suggest that changes in neuroplasticity mediate the relationship between sleep and mood in MDD.

**Support (If Any):** T32HL007713-24 (JG), R01MH107571-03 (PG)

**0887**

**SHOULD SLEEP APNEA TESTING BE A COMPONENT OF THE DIAGNOSTIC EVALUATION FOR TREATMENT RESISTANT DEPRESSION?**

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**Conclusion:** Resistance to standard antidepressant treatment is common for major depressive disorder (MDD), as up to 50% of MDD patients have treatment-resistant depression (TRD). The presence of undetected obstructive sleep apnea (OSA) is thought to contribute to TRD. We examined the rate of unsuspected OSA in MDD outpatients.

**Methods:** One hundred and twenty-five adults aged 18-65 years with MDD were examined either with full in-lab polysomnography (PSG), or limited home OSA testing. All participants had significant insomnia and suicidality, and were excluded for BMI > 30, prior diagnosis of OSA or restless leg syndrome. The apnea hypopnea index (AHI) was calculated with a denominator of EEG total sleep time for full PSG, and with a denominator of time in bed for home OSA testing. AHI > 10 served as a diagnosis of OSA.

**Results:** Fourteen % of subjects met diagnosis for OSA. Linear regression revealed that older age, male gender, and greater BMI were associated with higher AHI.

**Conclusion:** OSA occurred at clinically meaningful rates in this sample of MDD patients who were otherwise not suspected to have OSA. Although the standard risk factors of age, gender and BMI were relevant in this sample, still, the patients were not suspected to have OSA. A high index of suspicion for OSA is warranted in MDD, perhaps especially in TRD.

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**0888 DEPRESSION IN AFRICAN AMERICANS WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Obstructive sleep apnea (OSA) is often associated with depression. Identifying and treating depression improve the quality of life of patients with OSA. African Americans (AA) tend to have severe OSA and poor access to care. OSA management in the primary care setting has recently gained traction to improve quality of life of patients with OSA. There is a paucity of data on depression screening and outcomes. There is a paucity of data on depression screening and outcomes.

**Methods:** We conducted a retrospective study of all AA patients with a diagnosis of OSA (ICD-9 code 327.23), who visited the primary care sleep clinic of Grady Memorial Hospital between December 2017 and November 2018. We examined their medical records for depression screening using the patient health questionnaire (PHQ-9). The PHQ-9 scored from 0-27 is a validated depression screening tool in primary care settings. PHQ-9 score ≥ 10 has a sensitivity and specificity > 85% for major depressive disorder (MDD). Scores of at least 5, 10, 15, and 20 represent mild, moderate, moderately severe and severe depression respectively. We adjusted for patients' co-morbidities in the analysis. Statistical analysis was conducted using STATA 14.

**Results:** 216 AA patients with OSA were identified. The average (±SD) age was 55 years (± 9.3). 60% of patients were females. 201 patients were screened for depression using PHQ-9 out of which 19% were diagnosed with at least mild depression and 14% with MDD. The prevalence of depression was higher in females (69%, P< 0.005) and patients 50 years and older (80%, P< 0.005). Higher odds of MDD were seen in females (AOR 2.06, CI 1.41 - 4.76), patients aged ≥ 50 years (AOR 1.67, CI 1.09 - 3.55), and patients with ≥ 4 co-morbidities (AOR 1.88, CI 1.24 - 3.61)

**Conclusion:** Our study demonstrated that the prevalence rate of MDD in AA patients with OSA managed in the primary care clinic was 14%. Female sex, older age (≥ 50 years) and multiple co-morbidities (≥4) were associated with an increased likelihood of MDD. Future studies should evaluate the appropriate linkage of these patients to mental health care.

**Support (If Any):** -
B. Clinical Sleep Science and Practice

indicate a need to develop and implement sleep interventions to improve emotion regulation outcomes in inpatient populations.

Support (If Any): N/A

0890

RELATIONSHIPS BETWEEN CHANGES IN SLEEP HYGIENE AND CHANGES IN MENTAL HEALTH FACETS

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Introduction: Sleep disruption is a recognized risk factor for impaired mental health and sleep hygiene is a recognized treatment component for sleep disruption. We examined correlational changes in sleep hygiene to determine if they predicted changes in mental health. Finding these modifiable behaviors to be related to mental health changes could help establish a basis for modifying sleep hygiene in efforts to improve well-being.

Methods: Students (N=68) and faculty/staff (N=39) from the same institution on two consecutive years completed a 45-minute well-being survey for chances to win prizes. Participants completed measures of negative mental health (Patient Health Questionnaire-9 for depression; General Anxiety Disorder-7, and Perceived Stress Scale), positive mental health (Mental Health Continuum-Short Form; experiences of 10 positive emotions; a 3-item measure of resilience, and a satisfaction with personal relationships rating), and sleep hygiene. To examine the relationship of changes in sleep hygiene and mental health, multiple regression analyses were conducted predicting Year2 mental health from Year2 sleep hygiene scores, controlling for Year1 scores.

Results: Sleep hygiene: 26.2% of students and 27.5% of faculty/staff reported worsened sleep hygiene at Year2, and 25% and 22.5% of each group reported improved sleep hygiene, respectively. Negative mental health: Worsening sleep hygiene significantly predicted increases in depressive symptoms (b=.41, p<.001), anxiety symptoms (b=.52, p<.001), and stress (b=.67, p<.001) in students but not in faculty/staff (all ps>.25). Positive mental health: In students, worsening sleep hygiene significantly decreased frequency of positive emotion experiences (b=-.04, p=.01), but did not significantly predict changes in any other positive mental health measures (all ps>.13).

Conclusion: Worsening sleep hygiene was related to worsening negative mental health symptoms in students, but not faculty/staff. Worsening sleep hygiene was largely unrelated to changes in positive mental health. These data suggest sleep hygiene as a potential target of therapeutic intervention for negative mental health issues in students. However, given the small number of respondents participating at both time points, further research is recommended.

Support (If Any): Nancy and Craig Wood Odyssey Professorship

0891

NIGHTMARES PREDICT CROSS-SECTIONAL RISK FOR SUICIDAL IDEATION, BUT NOT PERCEIVED STIGMA IN A HIGH-RISK SAMPLE OF U.S. MILITARY VETERANS

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Introduction: Military suicide is a major public health problem, with veterans comprising 22.2% of all suicide deaths in the United States. Sleep disturbance, widely prevalent in veterans, is a well-established risk factor for suicide. Stigma is well documented as a barrier to treatment, with greater psychopathology linked to higher perceived stigma. Nightmares have utility as a novel treatment target, but have yet to be researched in association with suicidal behaviors and perceived stigma toward treatment.

Methods: Participants were screened for high suicide risk and insomnia for inclusion in a suicide prevention trial. Baseline measures included the Quick Inventory of Depressive Symptomatology (QIDS-SR), Suicidal Ideation Intensity Scale (SIS), Beck Scale for Suicide (BSS), Disturbing Dream and Nightmare Severity Index (DDNSI), and Perceived Stigma Scale (PSS). DDNSI scores were hypothesized to predict greater suicidal ideation, independent of depression. Exploratory analyses examined PSS relationships to suicide risk and nightmares.

Results: Eighty-one percent of participants (N=77 veterans, 12.9% female) reported lifetime SI (M=44.8, SD=14.1). Clinically significant nightmares were common (>55.8%), consistent with a nightmare disorder (M=11.9, SD=9.1). On average, perceived stigma fell in the moderate range (M=14.12, SD=6.46). Bivariate correlations revealed positive correlations between DDNSI, BSS (r=.36, p<.001) and SIS scores (r=.31, p<.01). Multiple linear regression analyses showed that nightmares remained significantly associated with suicidal symptoms (b=.25, t=2.3, p=.025), independent of QIDS-SR scores. Finally, results revealed significant associations between PSS and suicidal symptoms, but not DDNSI (r=.19, p=.05).

Conclusion: Results revealed significant cross-sectional associations between nightmares and elevated suicidal symptoms, independent of depression. Perceived stigma toward psychological problems was predictive of greater suicidal ideation, but not nightmare symptoms, suggesting utility as a non-stigmatizing treatment target. Results highlight the potential importance of nightmares as a highly prevalent and modifiable therapeutic target within military suicide prevention.

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IX. Sleep and Psychiatric Disorders

0892

THE ROLE OF SLEEP ARCHITECTURE IN POSITIVE AND NEGATIVE AFFECT FOLLOWING A MID-DAY NAP

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Introduction: Brief daytime naps have been associated with greater frustration tolerance and improvements in mood. Less understood is how sleep architecture is related to post-nap mood and affect. The present study examined the relationship between sleep stages and self-reported negative and positive affect during a 60-minute daytime nap. Understanding which stages of sleep are most associated with improved mood can help bring us closer to developing methods that exploit the mood-improving effects of daytime naps.

Methods: Participants were 19 individuals ages 18-50 with regular habitual sleep schedules. Beginning at 1:00pm, EEG electrodes
were applied while subjects completed visual analogue scales (VAS) of positive and negative affect, and the Positive and Negative Affect Schedule (PANAS). Participants then napped for 60 minutes while undergoing an EEG recording, later scored using R&K criteria. VAS and PANAS measures were repeated within 10 minutes of waking.

**Results:** All participants experienced stage 2 sleep. Greater percentage of stage 2 sleep was associated with decreased negative affect via both the VAS (B = .332, p = .04) and PANAS (B = .05, p = .02). No significant associations were observed for positive affect on either measure. Nine participants experienced stage 4 sleep while napping. Greater percentage of stage 4 sleep was associated with increased negative affect on the VAS only (B = -.29, p = .048). Associations between stages 1 and 3 sleep and positive or negative affect were not significant for either measure.

**Conclusion:** Naps consisting of predominantly stage 2 sleep may be beneficial in reducing negative affect, while longer naps with greater potential for slow-wave sleep may worsen affect. Given that slow-wave sleep is more likely to occur following poor or restricted sleep, brief naps may be contraindicated for individuals with poor nighttime sleep. The specific mechanisms of the association of stage 2 sleep and mood improvement warrant further study.

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**0893**

**SLEEP HEALTH AS A PREDICTOR OF MENTAL HEALTH AND QUALITY-OF-LIFE AMONG INFORMAL CAREGIVERS**

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**Introduction:** Caregiving is associated with sleep disturbance and poorer mental health, both of which are linked to lower quality-of-life. However, prior work has focused on insomnia symptoms, neglecting the potentially important role of sleep health. The purpose of the present study was therefore to examine the relationship between sleep health, mental health, and quality-of-life among caregivers.

**Methods:** Data from an online study investigating sleep across normal development (ISLAND Study) were used for secondary data analysis. Participants included 339 informal caregivers (mean age = 44.62, male = 41.6%). Structural equation modeling (SEM) was used to examine whether sleep health predicted quality-of-life via mental health. Sleep health was measured using the RU-SATED scale, while mental health was measured using the GAD-2, PHQ-2, and negative affect items from the PANAS. Finally, quality-of-life was measured using the PQOL-5.

**Results:** The SEM, which yielded excellent fit indices, suggested that individuals with poorer sleep health have lower perceived quality-of-life (β=.11, p=.03). Further, the relationship between sleep health and quality-of-life was mediated by mental health (β=.15, p<.001). Specifically, the model accounted for 12.5% of the variance in mental health and 20.8% of the variance in quality-of-life.

**Conclusion:** Results suggest that sleep health among caregivers has important consequences on both mental health and quality-of-life. Therefore, researchers and clinicians may benefit from routinely assessing sleep health among this population. Further research is needed to determine whether caregiver factors (e.g., hours of care, relationship) moderate the relationships between these constructs.

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**0894**

**SELF-REPORTED SLEEP QUALITY MEDIATES THE RELATIONSHIP BETWEEN DYSFUNCTIONAL BELIEFS ABOUT SLEEP AND SEVERITY OF DEPRESSION SYMPTOMS**

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**Introduction:** Dysfunctional beliefs about sleep and poor sleep quality have both been linked with depression. Individuals with depression may endorse dysfunctional beliefs about sleep either (1) because of generally dysfunctional and depressogenic thinking, or (2) because of actual sleep disruption during a mood episode. To test the second model, we hypothesized that self-reported sleep quality and behaviorally-assessed sleep efficiency would mediate the association between depression and dysfunctional beliefs and attitudes about sleep.

**Methods:** We recruited 87 participants aged 18-66 years from the greater Pittsburgh area during the Winter. We included 13 participants with Major Depressive Disorder, 36 participants with Major Depressive Disorder, with Seasonal Pattern (Seasonal Affective Disorder), and 36 healthy controls. Participants completed the Beck Depression Inventory and the Dysfunctional Beliefs and Attitudes about Sleep scale. Self-reported sleep quality was measured using the global score of the Pittsburgh Sleep Quality Index and sleep duration was measured via actigraphy (X =10 days). We tested multiple mediation using a Structural Equation Model analysis with bootstrapping (n = 10,000).

**Results:** Controlling for age and gender, dysfunctional beliefs about sleep were significantly associated with depression severity (β = 0.403; p < 0.001) but not when sleep quality and efficiency were also included (β = 0.142; p > 0.05). Self-reported sleep quality significantly mediated the relationship between dysfunctional beliefs about sleep and depression severity (β = 0.257; p < 0.001) and explained 63.77% of the total variance; however, objective sleep efficiency did not (β = 0.004; p >0.05).

**Conclusion:** Our results suggest that the covariance between dysfunctional beliefs about sleep and depression severity can be explained by self-reported sleep quality, but not actigraphically-measured sleep efficiency. However, due to the cross-sectional nature of these data, directionality cannot be determined. Future research could examine the temporal relationship between dysfunctional beliefs about sleep, self-reported sleep quality, and depression.

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**0895**

**NEUROPSYCHOLOGICAL PERFORMANCE IN INSOMNIA WITH SHORT SLEEP DURATION COMORBID WITH MAJOR DEPRESSIVE DISORDER**

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**B. Clinical Sleep Science and Practice**

**Introduction:** Insomnia has been associated with impairment in several cognitive domains such as attention, working memory, episodic memory and problem solving. Recent research has suggested that these neurocognitive deficits may be predicted by short sleep duration. Given the highly frequent comorbidity between insomnia and major depressive disorder, we aimed to assess neuropsychological performance in patients with major depression comorbid with insomnia with short sleep duration.

**Methods:** Eligible subjects were outpatients with insomnia comorbid with major depressive disorder. To be included, patients were required to be female or male, 18 to 60 year-old, without comorbid psychiatric/sleep disorders, and without drug treatment. Participants were assessed with a structured psychiatric interview, 7-14 days sleep diaries, sleep and depression related scales, and two consecutive nocturnal polysomnographic recordings. They also completed neuropsychological test covering attention, memory, and executive functions. All patients gave their signed informed consent. On the basis of sleep duration reported in sleep diaries, patients were divided in short (<6 hours) and normal (26 hours) sleep duration.

**Results:** Major depressed patients with insomnia with short sleep duration (n=10) were not significantly different from patients with normal sleep duration (n=10) in age (40.9±15.4 vs 34.8±12.3, p=.34), gender (60% female: 70 vs 50, p=.36), body mass index (25.9±3.7 vs 23.1±2.5, p=.06), insomnia severity index (20.8±4 vs 20.5±4.3, p=.87) and depression scores (23.3±6.2 vs 19.5±2.9, p=.09). The group with short sleep duration showed a worse performance on: d2 test of attention (Correct responses: 149.1±34.5 vs 200.7±41.3, p=.01); errors of commission: 524.6 vs 1.1±9, p=.03; concentration performance: 143.8±38.7 vs 194.2±48.8, p=.03); Tower of London test (Total moves: 99.6±12.8 vs 83.2±12.7, p=.01; additional moves 43.9±15.8 vs 24.9±13.5, p=.01)

**Conclusion:** These preliminary results suggest that major depressed patients with insomnia with <6 hours of sleep duration present with impairment in selective and sustained attention, problem solving, and planning. Some of these neurocognitive deficits are similar to those observed in insomnia disorder with short sleep duration.

**Support (If Any):** NA

**0896**

**THE TEMPORAL DYNAMICS OF THE ASSOCIATION BETWEEN SLEEP CONTINUITY DISTURBANCE AND DEPRESSIVE SYMPTOMS**

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**Introduction:** Sleep continuity disturbance (i.e., insomnia) is a significant risk factor for the development and recurrence of a depression. Few studies, however, have assessed the temporal dynamics of insomnia and depression (e.g., how changes in sleep continuity are related to episodes of dysthymia).

**Methods:** Analyses were conducted on a sub-sample of subjects (n=190, 79% female) that participated in a larger study on the natural history of insomnia. Subjects included 95 adults who developed an acute dysthymic episode (i.e., PHQ-9 ≥ 10; DEP10 Group), and an equivalent gender, age, and BMI-matched control group. Controls were also matched by time of assessment. Sleep continuity disturbance was quantified as total wake time (TWT, in minutes) as assessed by daily sleep diaries. The data was anchored in time to the onset of the dysthymic episode (Time 0) in order to compare group differences in TWT prior to (3 weeks), during (2 weeks), and following (3 weeks) the acute episode. A 2 x 8 repeated measures ANOVA (group x time) and linear mixed modeling were used to assess whether there were any group differences in TWT during any of the weekly intervals.

**Results:** The DEP10 group, relative to controls, reported significantly greater TWT during the two weeks prior to the endorsement of a dysthymic episode (the main effects of time and group and the time by group interaction were all significant, p’s < .05; mean change in TWT from baseline to Time 0, in minutes: DEP 10 = 24.7; Controls = -4.6). Mixed effects models also showed that there was a significant difference in the linear slope to Time 0 (p = 0.04).

**Conclusion:** These results indicate that sleep continuity disturbance may significantly account for a portion of the variance in week-to-week fluctuations in depressive symptoms, at least for acute increases in dysthymia. Analyses are ongoing to determine whether these effects vary by insomnia sub-type (i.e., initial, middle, and late insomnia) or depression severity (PHQ-9 ≥ 15).

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**IX. Sleep and Psychiatric Disorders**

**0897**

**LOW STABILITY IN REST ACTIVITY RHYTHMS IS ASSOCIATED WITH HIGHER SUICIDAL IDEATION IN ADOLESCENTS WITH BIPOLAR DISORDER**

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**Introduction:** Previous research has shown consistent evidence of disturbed sleep among youth with bipolar disorder (BP). Decreased need for sleep is a symptom of mania, while insomnia and hypersomnia characterize depressive episodes. Further, sleep disturbance has been consistently linked with suicide, and youth with BP are among the group at highest risk for suicide.

**Methods:** Youth (age 12-22) with (n=37) and without (n=26) bipolar I, II, or NOS disorder wore an Actiwatch Spectrum Plus to estimate daily rest-activity rhythms (RARs) over 2 weeks (mean=14.8 days). Depressive symptoms and suicidal ideation were measured with the Mood Feelings Questionnaire (MFQ) and Suicidal Ideation Questionnaire (SIQ) scales. We examined three non-parametric parameters derived from the minute-by-minute activity counts: inter-daily stability (IS), consistency of activity across successive days; intraday variability (IV) of activity; and relative amplitude (RA), the relative difference between most active 10 and least active 5 hours. IS, IV, and RA were compared across groups, and within the BP group, the associations between RARs and MFQ and SIQ were examined.

**Results:** RARs did not differ between the BP and Control groups (p’s > .25). In the BP group, youth with lower IS and higher RA reported more suicidal ideation (r=-0.69, p<0.001; r=0.468, p<0.009). Lower IS was also associated with more depressive symptoms (r=-0.405, p < .03).

**Conclusion:** Youth with BP who exhibited less consistent 24-hour rest-activity rhythms concurrently reported greater suicidal ideation and more depressive symptoms. Prospective evidence is needed.
to confirm the direction of these associations. Irregular sleep-wake patterns are a modifiable risk factor. Interventions targeting these factors may therefore help reduce suicidality in high-risk youth. In addition, platforms to provide real-time feedback of activity patterns to patients/clinicians could be developed.

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0898
SLEEP POLYSOMNOGRAM BIOMARKERS FOR IDENTIFYING ANXIETY AND DEPRESSION
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Introduction: Disorders of anxiety and depression play an important role in disorders of sleep, but are often undiagnosed. Previous studies note an association between depressed patients and distinct changes in polysomnogram parameters, a result similarly demonstrated in patients with anxiety. However, these studies focused on patients already diagnosed with depression or anxiety. If undiagnosed patients complaining of sleep disturbances display these specific polysomnogram biomarkers, they could help diagnose future patients with similar baseline patterns. We hypothesized that subjects from a general clinical population with higher scores on anxiety and depression scales will have distinct polysomnogram biomarkers from subjects with lower scores.

Methods: A retrospective chart review of 129 patients referred for a baseline sleep evaluation in a 1.5 year period, who had completed the Hospital Anxiety and Depression Scale and were found to have an HADS <15, was performed. Specific polysomnogram parameters studied include total sleep time, efficiency, and latency; wake after sleep onset; rapid eye movement (REM) latency, duration, and number of episodes; time spent in each stage of sleep; and delta sleep ratio. The Wilcoxon rank sum test was used to analyze the various parameters based on patients’ scores.

Results: The mean age of a participant in this study was 42 years, with no significant intragroup differences in age. 42 individuals scored highly for both anxiety and depression. Males were significantly less likely to have anxiety than females (p=0.006) but equally likely to have depression. Patients with depression exhibited 4.4% less REM sleep than those without depression (p=0.024). There were no significant polysomnographic differences between patients with and without anxiety.

Conclusion: Although quantitative polysomnogram measures may be used as biomarkers to identify patients with anxiety and/or depression, we were unable to demonstrate its application in a general clinical population. There may have been multiple confounding factors influencing sleep architecture in this population, including the limitations of our inventories or the fact that some subjects exhibited elements of both anxiety and depression. Additional measures of anxiety and depression should be further investigated.

Support (If Any): None

0899
IMPAIRED NEUROBEHAVIORAL ALERTNESS QUANTIFIED BY THE PSYCHOMOTOR VIGILANCE TASK IS ASSOCIATED WITH DEPRESSION IN THE WISCONSIN SLEEP COHORT STUDY
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Introduction: Hypersomnolence plays an important role in the presentation and course of mood disorders. Standard objective measures of daytime sleep propensity are of little to no value in predicting depressive illness. This study examined the psychomotor vigilance task (PVT), an objective measure of neurobehavioral alertness, and its cross-sectional and longitudinal associations with depressive symptomatology in the Wisconsin Sleep Cohort (WSC) Study.

Methods: The sample consisted of 1547 separate 10-minute PVT assessments conducted in 932 unique individuals participating in the WSC. Cross-sectional and longitudinal conditional logistic regression models were used to estimate associations between the primary outcome of depression (adjusted Zung scale≥50) and six separate PVT variables: mean reciprocal reaction time (1/RT); total lapses (RTs≥500msec; LAPSE); total false responses (FAKE); reciprocal of the mean of the 10% fastest (FAST) and 10% slowest (SLOW) RTs; and slope of the linear regression line for all transformed 1/RTs (SLOPE). Covariates included age, sex, BMI, chronic medical conditions, antidepressant use, sedative hypnotic medication use, caffeine use, tobacco use, alcohol use, sleep-disordered breathing, and habitual sleep duration.

Results: In fully-adjusted cross-sectional models, 1/RT, LAPSE, FAST, and SLOW were each significantly (all p<0.0001) associated with depression, such that worse neurobehavioral alertness was associated with increased odds of depressive symptomatology. Similar, though attenuated, findings were observed utilizing conditional longitudinal models that examined changes in depression status in the subset of participants with repeated PVT assessments. FALSE and SLOPE were not associated with depression in either cross-sectional or conditional longitudinal models.

Conclusion: These findings suggest components of the PVT, an objective measure of neurobehavioral alertness, are significantly associated with depressive symptomatology. Further research is indicated to clarify the role of the PVT in the assessment of hypersomnolence in mood disorders.

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0900
CHRONOTYPE AND SOCIAL SUPPORT AMONG STUDENT ATHLETES: IMPACT ON DEPRESSIVE SYMPTOMS
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Introduction: Previous studies have shown that chronotype is associated with depression scores, especially in young adults. But reasons for this are unclear. It is possible that students with later
chronotypes are awake when others are sleeping, which can lead to social isolation. This study examined this relationship in a group of student athletes by examining relationships among chronotype, depression, and social support across multiple domains.

**Methods:** Data were obtained from N=189 NCAA Division-I student athletes across all sports. Chronotype was assessed with a single item and ranged from -2 (definitely morning type) to +2 (definitely evening type). Depression was assessed with Center for Epidemiological Studies Depression scale. Social support was assessed with the Multidimensional Scale of Perceived Social Support, which included subscales for Family, Friends, and Significant-Other. A subscale for Team was created using the items from the Friends subscale (changing the word “friends” to “teammates”). Regression analyses adjusted for age, sex, and minority status.

**Results:** Later chronotype was associated with more depression (B=1.01, 95%CI[0.18,1.84], p=0.018). It was also associated with less social support overall (B=-3.31, 95%CI[-5.20,-1.42], p=0.001) and from family (B=-1.24, 95%CI[-1.92,-0.65], p<0.0001), friends (B=-1.06, 95%CI[-1.64,-0.48], p<0.0001), and team (B=-0.68, 95%CI[-1.21,-0.14], p=0.014). Chronotype-by-support interactions on depression were seen, such that the relationship between chronotype and depression were observed only in those with low (but not high) support from family, friends, and teammates.

**Conclusion:** Later chronotype may be associated with social isolation, leading to decreased social support from family, friends, and teammates. (Significant others may be more likely to be present at these times, perhaps explaining a lack of findings in this domain.) This may contribute to the relationship to depression in college student athletes. Perhaps interventions aimed at reducing social isolation may reduce the impact of depression in students with later chronotypes.

**Support (If Any):** R01MD011600, NCAA Innovations Grant

**0901**

**DOSE-RESPONSE RELATIONSHIP BETWEEN INSUFFICIENT SLEEP AND MENTAL HEALTH SYMPTOMS IN COLLEGIATE STUDENT ATHLETES AND NON-ATHLETES**

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**Introduction:** Previous studies have shown that sleep quality is related to mental health. Fewer studies have examined insufficient sleep, especially among student athletes, who frequently experience short sleep duration.

**Methods:** Data were aggregated from the 2011-2014 waves of the National College Health Assessment, conducted by the American College Health Association. These data included N=110,496 individuals who provided complete data, including N=8,462 varsity athletes. Insufficient sleep was assessed as number of nights students did not “get enough sleep so that you felt rested when you woke up,” coded as 0-7. Mental health symptoms were assessed in the past 30 days of feelings of hopelessness, feeling overwhelmed, exhaustion, loneliness, sadness/depressed mood, difficulty functioning, anxiety, anger, desire to self-harm, suicide ideation. Covariates included age, sex, race/ethnicity, and survey year. Logistic regression models examined the complete sample and interaction terms for sleep-x-athlete status. Additional models included controls for insomnia and depressed mood.

**Results:** In adjusted models, insufficient sleep was associated with all mental health variables; when insufficient sleep was treated as categorical (reference=0), a dose-response relationship was seen. Thus, subsequent analyses examined linear trends. More nights of insufficient sleep was associated with greater likelihood of hopelessness (OR=1.24; p<0.0005), feeling overwhelmed (OR=1.23; p<0.0005), exhaustion (OR=1.29; p<0.0005), loneliness (OR=1.19; p<0.0005), depressed mood (OR=1.21; p<0.0005), functional problems (OR=1.28; p<0.0005), anxiety (OR=1.25; p<0.0005), anger (OR=1.24; p<0.0005), desire to self-harm (OR=1.25; p<0.0005), and suicide ideation (OR=1.28; p<0.0005). Sleep-x-athlete interactions were significant for all variables (p<0.0005), but stratified analyses were nominally similar. When insomnia and depressed mood were entered as covariates, results were attenuated but remained significant (all p<0.0005).

**Conclusion:** There is a dose-response relationship between insufficient sleep and many domains of mental health in collegiate students (athletes and non-athletes), and this relationship is not accounted for by insomnia and/or depressed mood alone. Mental health efforts on campuses should focus on achieving sufficient sleep.

**Support (If Any):** R01MD011600, NCAA Innovations Grant

**0902**

**NOCTURNAL HEART RATE VARIABILITY MODERATES THE ASSOCIATION BETWEEN SLEEP-WAKE REGULARITY AND MOOD IN YOUNG ADULTS**

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**Introduction:** Sleep-wake regularity (SWR) is often disrupted in early adult life. Repetitive and long-term misalignment between environmental and behavioral cycles may have subsequent psychological and physical health consequences, including autonomic function. We tested whether SWR was independently associated with mood and autonomic function in a healthy adult cohort. We also explored the relationship between other potential contributors to circadian misalignment (social jetlag, chronotype, and delayed-bedtime) on SWR, mood and autonomic function.

**Methods:** We studied 42 college students over a 3-week period using daily sleep-wake, and physical activity diaries, as well as continuous electrocardiogram via a Holter monitor (DF-010, DELBio, INC.). SWR was quantified for each week by calculating the interdaily stability of sleep-wake timing (ISWk) across 24h periods. Mood was assessed weekly using the Beck Depression Inventory-II (BDI). To assess autonomic function, we quantified the high frequency power (HF) of heart rate variability (HRV). Linear mixed effects models were used to account for repeated weekly measures.

**Results:** Low weekly ISWk predicted subsequent poor mood and worsening mood independently of age, sex, race, sleep duration, and physical activity (b = -0.16, 95% CI -0.24 to -0.08, p = 0.0003). While no association was found between ISWk and HF (p > 0.05), the SWR-mood association was significantly moderated by
nocturnal HF (b = -0.27, 95% CI -0.45 to -0.09, p = 0.005) i.e. mood was poorest after a week with low ISsw and high nocturnal HF. These relationships remained significant after accounting for social jetlag, chronotype, and delayed-bedtime. Prior week mood scores had no bearing on the subsequent week’s ISsw (p > 0.05).

Conclusion: Irregular weekly sleep-wake timing appears to precede poor mood in young adults. Further work is needed to understand the implications of high nocturnal HRV in those with low mood and irregular sleep-wake cycles.

Support (If Any): This work was supported by NIH grants T32GM007592, R01AG048108, and RF1AG059867.

0903
LINKS BETWEEN OBJECTIVE SLEEP MEASURES AND INFLAMMATION IN ADULTS WITH BIPOLAR DISORDER: EXAMINATION OF VARIABILITY ASSESSMENTS
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Introduction: Sleep disturbances are central to bipolar disorder (BD), with clear implications for psychopathology. In the general population, actigraphy-assessed sleep disturbances have been linked with heightened inflammation. However, in BD, relationships of the degree of sleep disturbance and variability to inflammatory biomarker levels has not been shown.

Methods: The cross-sectional study includes 35 euthymic subjects with BD (DSM-IV-TR criteria), and 57 non-psychiatric comparison (NC) subjects (ages 26-65 years). We examined subjective sleep quality (Pittsburgh Sleep Quality Inventory) and objective sleep measures (total sleep time or TST, latency, wake after sleep onset or WASO, and efficiency) using wrist-worn actigraphy for 4 consecutive nights. Blood-based pro-inflammatory markers included levels of C-reactive protein (CRP), interleukin (IL)-6 and Tumor Necrosis Factor-α (TNF-α). Sleep variability included root mean squared successive difference (RMSSD) and standard deviation (SD). General linear models examined the relationships of sleep with inflammatory marker levels.

Results: While comparable on age, sex, race and objective sleep measures, the BD group reported worse subjective sleep quality and had higher inflammation. TST SD was significantly higher in the BD group, though other variability measures did not differ. In the NC group, higher IL-6 was associated with worse efficiency and lower TST, but only in men. The previous night’s TST predicted higher CRP in men with BD, while the previous night’s WASO predicted higher CRP in women with BD. In the NC group, there was a significant TST SD x sex interaction with TNF-α and sex x efficiency SD with CRP. These findings were identical using RMSSD.

Conclusion: Despite worse subjective sleep quality, adults with BD had similar mean and variability of objective sleep measures (excepting TST variability). Objective sleep measures were associated with inflammation, depending on sex, in the BD group. Sleep may be a trackable and modifiable risk factor for inflammation in BD.

Support (If Any): NARSAD Young Investigator grant from the Brain and Behavior Research Foundation (PI: Lee) and the National Institute of Mental Health [T32 Geriatric Mental Health Program MH019934 (PI: Jeste) and R01MH094151-01 (PI: Jeste)].

0904
SLEEP DISORDERS IN VETERANS WITH MILD TRAUMATIC BRAIN INJURY
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Introduction: Military personnel are at high risk for traumatic brain injury (TBI). Hispanics are currently 11.4% of the active-duty military forces and the number of minority veterans is increasing. Hispanic ethnicity was reported to double the risk of mortality among veterans clinically diagnosed with TBI. Sleep disorders are common after traumatic brain injury. The purpose of this study was to characterize a population of Puerto Rican veterans with mild Traumatic Brain Injury (mTBI) and to determine the prevalence of chronic sleep disorders in the sample.

Methods: The study was a retrospective evaluation of all patient records of veterans 21-89 years old with a diagnosis of mTBI enrolled in the Polytrauma Clinic at Veterans Affairs Caribbean Healthcare System from January 2010 to April 2017. There were 333 mTBI records reviewed. The data collected included demographics, medications, comorbidities, sleep disorders, type of TBI injury, brain magnetic resonance imaging (MRI), Epworth Sleepiness Scale (ESS) and Neurobehavioral Functioning Inventory (NFI) results.

Results: Subjects were predominantly male (96%), with a mean age of 41 (range 21-89). Blast injury was present in 54% and non-blast in 45%. Eighty five percent were overweight or obese. Ninety three percent had depression, 93% anxiety, 81% cognitive disorders, 79% chronic pain, 77% post-traumatic stress disorder, 66% hypertension. All subjects were on polypharmacy and most had sleep complaints (84%). Ninety two percent had insomnia, 46% obstructive sleep apnea (OSA), 2.7% restless leg syndrome, 1.5% central sleep apnea, 1.2% narcolepsy, 1.2% REM sleep behavior disorder, 0.9% periodic leg movement disorder. Sixty six percent had other parasomnias such as nightmares or sleepwalking. ESS was abnormal in 82%, NFI in 95% and brain MRI in 16%.

Conclusion: Insomnia, self-reported sleepiness and OSA are more common in Hispanic veterans than what has been published in non-Hispanic veterans. Chronic sleep disorders are highly prevalent in this sample of Puerto Rican veterans. Sleep disorders may contribute to the reported increased risk of mortality among Hispanic veterans with TBI.

Support (If Any):
Introduction: Increased alcohol consumption has been linked to insufficient sleep duration and insomnia in subjects with/without alcohol use disorder (AUD). However, little information exists on the underlying reasons for alcohol consumption in those with insufficient sleep duration and insomnia symptoms in those with AUD. The primary aim of this investigation was to evaluate the association between alcohol consumption situations and habitual sleep duration in patients with alcohol use disorder.

Methods: We analyzed baseline cross-sectional data from a treatment study of AUD patients (N=182). The Inventory of Drug-Taking Situations (IDTS) was used to assess reasons for alcohol consumption over the past year. Habitual sleep duration over the last 4 weeks was assessed using questions 4 from the Pittsburgh Sleep Quality Index. Alcohol consumption was assessed using the Time Line Follow Back interview. Linear regression analyses were used to assess the relationships between the IDTS reasons and sleep-related variables. Significant associations were further assessed in multivariable models adjusted for alcohol consumption, age, race and gender.

Results: The mean age was 42.2 years (SD=11.2), 67.3% were male and 93.7% were Caucasian. The mean habitual sleep duration was 5.9 hours (SD=1.5) with 39.9% reporting short sleep duration (<6 hours/night). About 34.4% (N=64) subjects reported difficulty falling asleep within 30 minutes in the 4 weeks. They drank on 49% (SD=27) of the days at baseline and nearly all of these drinking days were heavy drinking days [mean of 45(SD=27.5)]. Bivariate analyses demonstrated significant associations between IDTS reason-2 (physical discomfort) (β=-3.3; p=0.004) as well as IDTS reason-4 (difficulty with personal control) and sleep duration (β=-3.4; p=0.01). In multivariable models adjusted for covariates, sleep duration remained a significant predictor for IDTS item 2 (β=-2.4, t=-2.0; p=0.04) and item 4 (β=-3.1; p=0.04).

Conclusion: A significant proportion of treatment seeking patients with AUD report short sleep duration and difficulty initiating sleep. Insufficient sleep duration appears to moderate alcohol use in situations of loss of control and discomfort and may be a risk factor for maintaining alcohol consumption.

Support (If Any): None

B. Clinical Sleep Science and Practice

0907
SOCIAL FEAR AND AVOIDANCE IN MORNING-TYPES AND EVENING-TYPES: A MODEL OF SLEEP QUALITY, SAFETY BEHAVIORS AND DISCOUNTING POSITIVE EVENTS
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Introduction: The influence of poor sleep on psychosocial functioning and maladaptive self-regulation, such as safety behaviors (SB) and discounting positive events (DPE), may vary depending on morningness-eveningness preferences. Given research linking morningness-eveningness to social anxiety, examining the influence of these factors on social fear and avoidance may help inform new treatment protocols. Thus, a model of the indirect effect of sleep quality on social fear and avoidance through SB and DPE within morningness-leaning (ML) and eveningness-leaning (EL) groups was examined.

Methods: Data were collected from a sample of undergraduate students (N = 401) using online survey methodology. Morningness-eveningness, three domains of sleep quality, SB, DPE, and social phobia symptoms were assessed using validated measures.

Results: Using Mplus, a multi-group modeling approach was utilized to examine model fit within morningness-eveningness groups. Groups were created using a median split of Morningness-Eveningness Questionnaire scores. The final model demonstrated good fit χ2(12, 251) = 19.28, p=.08; RMSEA=0.07; CFI=0.99; SRMR=0.03. For the ML group, only one domain of SQ (i.e., daily disturbances) was associated with DPE (β=3.07, p=0.00) and SB (β=-3.14, p=0.00). Further, the pathways from SB and DPE to social fear (β=-.73, p=.00; β=-.42, p=.00, respectively) and to social

0906
CHRONOTYPES IN COMORBID INSOMNIA AND ALCOHOL USE DISORDER
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Introduction: Insomnia is by far the most prevalent sleep disorder in patients with Alcohol Use Disorder (AUD) and persisting insomnia during recovery increases their risk of relapse. Emerging data from adolescents and adults has demonstrated that an evening chronotype is linked to drinking and psychiatric disorders. In contrast, very little is known about chronotypes in AUD comorbid with insomnia.

Methods: A cross-sectional study of baseline data from a treatment study. The following rating scales assessed the relevant clinical domains: Composite Scale of Morningness (CSM, for chronotypes), Insomnia Severity Index (ISI, insomnia) and sleep diaries (insomnia symptoms), Time Line Follow Back interview (alcohol consumption in the last 90 days), Penn Alcohol Craving Scale (PACS, alcohol craving in the last 7 days), Short Index of Problems (SIP, psychosocial problems from the drinking), Beck Depression Inventory-II (depressive symptoms), with GAD-7 (anxiety symptoms) and Columbia-Suicide Severity Rating Scale (suicidal behavior). The ISI was evaluated as the total score, insomnia symptoms (Q1a-c) and insomnia ramifications (Q2-5). Linear regression analyses evaluated the association between individual clinical scales (outcomes) and CSM total score (predictor).

Results: The mean CSM total score was 36.6(SD=6.5); they included, morning type (N=9), evening type(N=1) and intermediate(N=47). Their mean ISI total score was 19.4 (SD=3.4) and they consumed 8.9 (SD=8.2) alcoholic drinks per day over the last 90 days. The CSM total score demonstrated inverse relationships with ISI total score (β=-0.2; t=-3.0; 95%CI=-0.3,-0.07), ISI symptoms (β=-0.06; t=-2.0; 95%CI=-0.1,-0.0009), ISI daytime ramifications (β=-0.1; t=-3.0; 95%CI=-0.2,-0.04), sleep onset latency (β=-1.8; t=-2.5; 95%CI=-3.3,-0.3). Furthermore, CSM total score was linked to time spent thinking about alcohol (β=-0.06; t=-2.05; 95%CI=-0.1,-0.001) and a nonsignificant trend for an association with overall alcohol craving (β=-0.05; t=-1.7; 95%CI=-0.1,0.008).

The CSM total score was not associated with sleep duration, drinks per day or with the total scores of BDI, GAD-7, PACS, SIP and CSSRS, although linear trends were seen for increased scores from morning to evening chronotypes.

Conclusion: The predominant chronotype in treatment-seeking AUD patients with insomnia was an intermediate chronotype. Morning-type individuals had lower severity of comorbid complaints.

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avoidance ($\beta=.73, p=.00$; $\beta=.26, p=.00$, respectively) were significant. For the EL group, subjective sleep quality was associated with SB ($\beta=1.15, p=.02$) and sleep efficiency was associated with DPE ($\beta=1.86, p=.04$). Further, the SB and DPE pathways to social fear ($\beta=.75, p=.00$; $\beta=.19, p=.04$, respectively) and to social avoidance ($\beta=.71, p=.00$; $\beta=.23, p=.01$, respectively) were also significant.

**Conclusion:** Findings suggest increased SB and DPE are linked to differential sleep problems among ML- and EL-types. Interestingly, similar social fear and avoidance outcomes were observed in ML- and EL-types despite the differential sleep quality/self-regulatory pathways to these outcomes. Taken together, maladaptive self-regulatory strategies (i.e., SB and DPE) contributing to social fear and avoidance in social anxiety may be reduced by addressing sleep problems specific to ME preferences.

**Support (If Any):**

**0908**

**INSOMNIA SYMPTOMS PREDICT SUICIDE: ARE PATIENTS MORE LIKELY TO REPORT SLEEP DISTURBANCE THAN SUICIDAL IDEAION BEFORE THEIR DEATH?**

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**Introduction:** Insomnia is a risk factor for suicidal ideation, suicide attempts, and suicide. Due to stigma and fear of consequences, some patients who are seriously contemplating suicide may hesitate to report their suicidal ideations. Insomnia symptoms are far less stigmatizing and may serve as a potent marker for suicide even when patients do not report having suicidal ideations. The objective of this study was to determine whether self-reported symptoms of insomnia predict suicide, independent of self-reported suicidal ideation.

**Methods:** The sample included deceased psychiatric patients seen at Weber Human Services since 2008 (n=196) who completed the Outpatient Questionnaire-45.2 (OQ) prior to death. Frequency of suicidal ideation or insomnia prior to death was assessed using items from the OQ. Manner of death (suicide vs. other) was determined by death records; 19 died by suicide. History of suicidal ideation (yes vs. no) and suicide attempts (yes vs. no) were determined through the electronic medical records. With this information, cases were grouped into 4 categories: denied any history of suicidality, history of suicidal ideation only, suicide attempt history, or died by suicide. Insomnia frequency was compared across groups using Mann-Whitney U tests. Logistic regression was used to determine whether OQ reported insomnia frequency predicted suicide, adjusting for frequency of suicidal ideation reported on the OQ.

**Results:** Compared to the non-suicidal group, the suicide attempt group and the suicide group reported significantly higher insomnia frequency, Z=3.3, p=0.001, Z=3.4, p=0.001. Greater insomnia frequency reported on the OQ, but not suicidal ideation, was a significant predictor of suicide, even after adjusting for suicidal ideation, W=3.9, p=0.049.

**Conclusion:** Often overlooked, insomnia is a risk factor for suicidality. As the severity of suicidality increased from suicidal ideation to suicidal behavior, self-reported insomnia frequency increased. On the OQ administration completed closest to death, insomnia symptoms were a better predictor of suicide than suicidal ideation. Insomnia symptoms may be a valuable indicator of imminent suicide risk in psychiatric patients, even when suicidal ideation is denied.

**Support (If Any):** n/a

**0909**

**ASSOCIATIONS BETWEEN SLEEP-DEPRIVATION DURING ADOLESCENCE AND PRESCRIPTION OPPIOID MISUSE IN YOUNG ADULTHOOD.**

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**Introduction:** Prescription opioid misuse is a serious public health concern affecting young adults, yet antecedent factors remain poorly understood. Insufficient sleep is a potentially important risk factor for opioid misuse, because sleep disturbance is associated with substance use. Yet little is known about the association between insufficient sleep and opioid misuse. Therefore, we examined whether sleep deprived adolescents are at increased risk for misusing prescription opioids by young adulthood.

**Methods:** Nationally representative sample of 14,785 participants captured in the National Longitudinal Study of Adolescent to Adult Health using data from two time points, Wave 1 in adolescence (Mage 16 years) and Wave 3 in young adulthood (Mage 22 years). The primary predictor variable was self-reported insufficient sleep (i.e., not usually obtaining enough sleep) during adolescence. The outcome variable was prescription opioid misuse (i.e., using opioids in a way other than prescribed) by early adulthood. Multivariate models controlled for sociodemographics, chronic pain, mental health symptoms, self-reported physical health status, other substance use/abuse, and history of childhood trauma.

**Results:** Insufficient sleep was reported by 26.4% of adolescents. Prospectively, rates of prescription opioid misuse were slightly higher among sleep deficient adolescents as compared to those reporting getting enough sleep (22% versus 19%, p=0.02). In multivariate analyses insufficient sleep was significantly associated with prescription opioid misuse in early adulthood (adjusted odds ratio (aOR): 1.22; 95% CI 1.04-1.45, p=0.015). Among the cohort of adolescents who reported insufficient sleep, correlates of subsequent opioid misuse included: a history of chronic pain (aOR: 1.33; 95% CI 1.03-1.72, p=0.027), adolescent substance use (aOR: 1.27; 95% CI 1.18-1.37, p<0.001) and childhood trauma (aOR: 1.36; 95% CI 1.20-1.55, p<0.001).

**Conclusion:** We found that young adults with a history of insufficient sleep during adolescence were more likely to misuse opioids as compared to those who reported getting enough sleep, above and beyond known risk factors. Findings highlight the need for further research to understand the complex relationships linking insufficient sleep with later opioid misuse.

**Support (If Any):** National Institutes of Health (grant numbers K23HL138155 PI: CBG & K24HD060068 PI: TMP)
0910
DOES ANTE-NATAL ANXIETY PLACE WOMEN AT GREATER SUICIDE RISK, AND COULD POOR SLEEP PLAY A ROLE?
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Introduction: The reciprocal relationship between poor sleep and clinical depression as risk factors for suicidal ideation (SI) is well-established. While recent recognition has led to increased screening for antenatal depression, the same focus has not been given to anxiety disorders. This study investigated whether sleep could be implicated in a potential relationship between antenatal anxiety and SI.

Methods: Four-hundred and twenty-five pregnant and postpartum women completed an online survey on sleep and various risk factors that included the General Anxiety Disorder-7 (GAD-7) questionnaire, the Pittsburgh Sleep Quality Index (PSQI), and the Edinburgh Postnatal Depression Scale (EPDS), the tenth question of which was used as a single-item SI screen. The relationship between GAD-7 and SI was quantified by Spearman correlations. Multiple regression evaluated the influence of possible coexisting factors that included the General Anxiety Disorder-7 (GAD-7) (r=.325, p<.001), Insomnia Severity Index (ISI, insomnia) and sleep diaries (insomnia symptoms), Time Line Follow Back interview (alcohol consumption in the last 90 days), Short Index of Problems (SIP, psychosocial problems from the drinking), GAD-7 (anxiety symptoms) and TBI screen (traumatic brain injury). Linear regression analyses evaluated the association between ISL total score (outcome) and clinical scales (predictors).

Results: The Veterans had a relatively high mean ISL total score at 19.5(SD=9.3). The ISI total score was 19.4 (SD=3.4), GAD-7 total score was 9.1(SD=5.1), PACS total score was 9.9 (SD=7.0) and SIP total score was 20.0(SD=14.4). They consumed 8.9 (SD=8.2) alcoholic drinks per day. About 64% reported a lifetime history of significant brain injury. Individual predictors of the ISL total score were ISI total score (β=-1.1, p = 0.007), anxiety symptoms (β=-0.9, p<0.001), SIP total score (β=0.3, p=0.002), PACS total score (β=-0.5, p = 0.01), presence of TBI (β=-6.5, p = 0.02). Heavy drinking or sleep diary variables including SOL, WASO, TST and SE were not associated with ISL total score. In an optimal model (adjusted R²=0.37, p=0.0008), the ISL total score was only predicted by GAD-7 total score (β=-0.70, p=0.02), the presence of TBI (β=-6.7, p = 0.02). ISI total score or the sleep diary variables did not optimize the model.

Conclusion: Anxiety symptoms and a lifetime history of TBI may hamper Veterans with AUD and insomnia developing functional social supports.

Support (If Any): VA grant IK2CX000855(S.C.)

0911
WHAT PREDICTS PERCEIVED SOCIAL SUPPORT IN PATIENTS WITH COMORBIT ALCOHOL USE DISORDER (AUD) AND INSOMNIA?
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Introduction: Prior studies have demonstrated interpersonal problems in those suffering from insomnia disorder, AUD, and in those with comorbid insomnia with AUD. Although perceived social support has been shown to play an important role in helping or hampering their recovery, very little knowledge exists on the perceived social support in actively drinking treatment-seeking individuals with AUD and insomnia, a high-risk group of patients.

Methods: A cross-sectional study of baseline data from a treatment study of Veterans with AUD with comorbid insomnia (N=40). The following rating scales assessed the relevant clinical domains: Interpersonal Support Evaluation List-12 items (ISEL), Insomnia Severity Index (ISI, insomnia) and sleep diaries (insomnia symptoms), Time Line Follow Back interview (alcohol consumption in the last 90 days), Short Index of Problems (SIP, psychosocial problems from the drinking), GAD-7 (anxiety symptoms) and TBI screen (traumatic brain injury). Linear regression analyses evaluated the association between ISEL total score (outcome) and clinical scales (predictors).

Results: The Veterans had a relatively high mean ISEL total score at 19.5(SD=9.3). The ISI total score was 19.4 (SD=3.4), GAD-7 total score was 9.1(SD=5.1), PACS total score was 9.9 (SD=7.0) and SIP total score was 20.0(SD=14.4). They consumed 8.9 (SD=8.2) alcoholic drinks per day. About 64% reported a lifetime history of significant brain injury. Individual predictors of the ISEL total score were ISI total score (β=-1.1, p = 0.007), anxiety symptoms (β=-0.9, p<0.001), SIP total score (β=0.3, p=0.002), PACS total score (β=-0.5, p = 0.01), presence of TBI (β=-6.5, p = 0.02). Heavy drinking or sleep diary variables including SOL, WASO, TST and SE were not associated with ISEL total score. In an optimal model (adjusted R²=0.37, p=0.0008), the ISEL total score was only predicted by GAD-7 total score (β=-0.70, p=0.02), the presence of TBI (β=-6.7, p = 0.02). ISI total score or the sleep diary variables did not optimize the model.

Conclusion: Anxiety symptoms and a lifetime history of TBI may hamper Veterans with AUD and insomnia developing functional social supports.

Support (If Any): VA grant IK2CX000855(S.C.)

0912
OBSTRUCTIVE SLEEP APNEA MANAGEMENT ON PANIC DISORDER OUTCOME
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Introduction: Panic disorder is considered as a psychiatric disorder associated with dysfunction in autonomic nervous system. Comorbid obstructive sleep apnea and panic disorder especially when claustrophobic symptom is combined has been considered as difficult continuous positive airway pressure tolerance. For those who have panic symptom and OSA, if CPAP adaptation is successful, panic disorder management can be managed with less medication usage in clinical field.

Methods: 47 comorbid OSA and panic disorder patients were initially collected from 2016 to 2018. OSA diagnosis was confirmed using level I overnight polysomnography. Systematic interview by board certified psychiatrist and psychological tests using HAMA(Hamilton Anxiety Rating Scale), STAI (State-Trait Anxiety Inventory) confirmed diagnosis of panic disorder according to DSM-V. CPAP (Resmed, was offered after CPAP titration study and followed up was made. CPAP tolerance was made according to
0913 EXPLORING THE RELATIONSHIP BETWEEN SLEEP AND DEPERSONALIZATION

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Introduction: Depersonalization is characterized by a state in which an individual’s feelings and thoughts seem unreal and not to belong to themselves. Depersonalization disorder (DPD) is a psychological condition whereby an individual feels dissociated/disconnected from their thoughts, feelings and body. DPD has been previously linked to other psychological conditions including depression and anxiety, both of which have a strong association with sleep. However, there is very little known about the relationship between sleep and depersonalization.

Methods: A cross-sectional study was conducted to assess the potential relationship between subjective episodes of depersonalization and sleep in female university students in the United Arab Emirates. A total of 100 participants were recruited to the study and completed the Pittsburgh Sleep Quality Index (PSQI) as well as the Cambridge Depersonalization Scale (CDS) which determined duration and frequency of depersonalization episodes, as well as a total score. Wrist actigraphy was administered to 37 participants for two days/night to objectively estimate sleep duration and sleep efficiency (%).

Results: The results showed that PSQI global score was positively correlated with both CDS frequency and CDS total score, where r=0.22, p<0.05 and r=0.21, p<0.05, respectively. Subjective sleep duration, obtained from the PSQI, was not significantly correlated with any CDS outcome. CDS total score was positively correlated with both depression (r=0.35, p<0.001) and anxiety (r=0.36, p<0.001), which is in line with previous findings. Actigraphy estimated average sleep efficiency was not, however, significantly associated with DPD, χ²=0.56, p>0.05.

Conclusion: This is the first study to primarily focus on the relationship between sleep and depersonalization and provides initial evidence about the role of sleep in this dissociative disorder. Subjective sleep quality but not sleep duration, is significantly associated with episodes of depersonalization, but this needs to be confirmed in a larger sample and across different populations. Objective estimate sleep also needs to be incorporated into future studies for at least seven days/nights to ensure comprehensive sleep data is obtained in naturalistic settings.

Support (If Any): N/A

0914 THE EXPERIENCE OF CLAUSTROPHOBIA AND CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY

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Introduction: Healthcare is dominated by the biomechanical body disregarding the lived experience. Effective continuous positive airway pressure (CPAP) therapy requires skillful use; claustrophobia may interfere with this. What causes claustrophobia, fear of enclosed spaces, is different for individuals; ability to use CPAP varies. None have examined the lived experience of claustrophobia and CPAP therapy resulting in a critical gap in knowledge. This interpretive phenomenological study explored the lived experience of claustrophobia in adults with sleep apnea prescribed CPAP.

Methods: Participants were recruited from a university-based sleep disorders center in a large Midwest urban area. Four research questions focusing on the meaning of claustrophobia, bodily sensations of claustrophobia, lifetime experiences and coping were addressed in two semi-structured interviews about one month apart. Participants drew a picture of what claustrophobia was like for them.

Questionnaires described the sample and triangulated interview data: demographics, Adverse Childhood Experiences (ACES), Epworth Sleepiness Scale, Beck Anxiety Inventory, Claustrophobia Questionnaire, Patient Health Questionnaire-9, and Likert-type scales for anxiety, depression, claustrophobia.

Results: To date 12/14 subjects aged 40-68 have completed both interviews. Inter-subject variability exists, but participants generally have multiple ACES, mild to severe sleepiness, anxiety, and depression. Participants identified significant claustrophobia triggers beginning in childhood including CPAP mask, crowds, being tied down, MRI, and items around the neck. Participants embody claustrophobia with palpitations, sweating, suffocating/drowning feeling, and lightheartedness. Preliminary themes are emerging: Life altering events (“panic in the MRI” and “babysitter put me in the dark basement for my nap and locked the door.”); Altered bedtime routine (“dread going to bed, put it off as long as possible”; “nothing can touch my neck when I am sleeping”; and, “have to sleep with the TV/light on”); Escape (“need to get away”; “avoid crowds/busy shopping times”; “have to take the mask off for a while”); Coping (“do this for my health”; ‘think about someplace nice”; and, “all about the right mask.”)

Conclusion: Claustrophobia, often caused by a life altering event, modifies daytime/bedtime routines and CPAP use. CPAP coping skills vary based on resources.

Support (If Any): Potter Scholarship Fund

0915 THE EFFECTS OF ESZOPICLONE ON SPINDLES, SLOW OSCILLATIONS AND THEIR COORDINATION IN HEALTH AND SCHIZOPHRENIA

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Introduction: Sleep spindles and slow oscillations (SO) are two slow, rhythmic oscillations observed during non-rapid eye movement (NREM) sleep which are disrupted in schizophrenia. During the initial stages of sleep, sleep spindles are more prominent and SOs are gradually more pronounced. These events are generated by synchronized thalamocortical activity and are critical for memory consolidation, learning and cognitive performance.

Methods: In an open-label study, 15 schizophrenia patients were treated with eszopiclone (an α1-receptor agonist) for 10 days. Sleep spindles and SOs were quantified using depth EEG recordings and the percentage of spindle and SO synchronicity was determined.

Results: The results showed a decrease in the percentage of spindle synchronicity and an increase in the percentage of SO synchronicity. These changes were correlated with improvements in cognitive performance and a decrease in hallucinations.

Conclusion: The findings suggest that eszopiclone may have a beneficial effect on sleep spindles and SOs, potentially improving cognitive performance and reducing hallucinations in schizophrenia.

Support (If Any): N/A
**Introduction:** Patients with schizophrenia have sleep spindle deficits that correlate with impaired sleep-dependent memory consolidation. In a previous study of schizophrenia, eszopiclone, a non-benzodiazepine sedative hypnotic, despite increasing spindles, failed to improve memory. Here, we investigated whether this failure reflected that eszopiclone disrupts slow oscillations (SOs) and their coordination with spindles, both of which are critical for memory consolidation.

**Methods:** Twenty-six chronic, medicated patients with schizophrenia (32.4±8.9yrs, 21 male) and 29 demographically matched healthy controls participated in a double-blind, placebo-controlled, cross-over study. Placebo and eszopiclone visits both involved polysomnography on two consecutive nights. On the second night of each visit, participants trained on the finger tapping motor sequence task (MST) and were tested the following morning. We evaluated eszopiclone effects on SOs (0.5-4Hz), spindles (12-15Hz), SO phase at spindle peak (timing) and the variability of this timing (consistency) during stage 2 non-rapid eye movement sleep and how they related to overnight improvement of MST performance.

**Results:** Regardless of group and condition (eszopiclone, placebo), SO-spindle coordination, both timing and consistency, were stable across nights. While timing did not differ between groups, patients unexpectedly were more consistent (p corrected=.01). Epszopiclone affected both groups similarly: it increased spindle density (p corrected<.001) and reduced SO amplitude (p corrected<.001). Eszopiclone significantly predicted increased anxiety, over and above the effect of sleep disturbance, γ = -.24, SE = .11, p < .05. Model 2 also demonstrated good fit to the data (χ²(31) = 38.98, p = .15; CFI = .95; TLI = .93; RMSEA = .04); however, eveningness was unrelated to negative affect, γ = -.10, SE = .09, p = .26.

**Conclusion:** Epszopiclone changed the morphology of SOs, made their timing in relation to spindles less consistent and not only did not improve memory, but disrupted the correlation between overnight improvement's and spindle density. This suggests that interventions to improve memory need not only to increase spindle density but also to preserve or enhance both SOs and their coordination with spindles.

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**0916**

**DIFFERENTIAL ASSOCIATIONS BETWEEN CHRONOTYPE, ANXIETY, AND NEGATIVE AFFECT: A STRUCTURAL EQUATION MODELING APPROACH**

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**Introduction:** Increasing evidence implicates circadian rhythms, including chronotype, in anxiety symptoms and disorders (Taylor & Hasler, 2018). However, it remains unclear whether the relationship between chronotype and anxiety pathology is explained by sleep disturbance. Likewise, given overlap between anxiety and mood symptoms, a unique link between chronotype and anxiety remains to be established. The present study addressed these questions using a multimethod approach to determine whether there is a unique relationship between chronotype and anxiety symptoms, controlling for sleep disturbance.

**Methods:** Indicators of chronotype (Morningness-Eveningness Questionnaire, average mid-sleep, and modal time of peak sleepiness), sleep disturbance (objective and subjective sleep onset latency, Insomnia Severity Index, and Pittsburgh Sleep Quality Index), anxiety (diagnostic status, Anxiety Sensitivity Index, average daily anxiety, and stressor-induced anxiety), and negative affect (Depression, Anxiety, and Stress Scale, Distress Tolerance Scale, and stressor-induced irritability) were collected in a sample of adults (N=151) and modeled using structural equation modeling. Models 1 and 2 tested the association between chronotype and anxiety and negative affect, respectively, controlling for sleep disturbance.

**Results:** Model 1 demonstrated good fit to the data (χ²(40) = 47.52, p = .19; CFI = .96; TLI = .95; RMSEA = .04) and indicated that eveningness significantly predicted increased anxiety, over and above the effect of sleep disturbance, γ = -.24, SE = .11, p < .05. Model 2 also demonstrated good fit to the data (χ²(31) = 38.98, p = .15; CFI = .95; TLI = .93; RMSEA = .04); however, eveningness was unrelated to negative affect, γ = -.10, SE = .09, p = .26.

**Conclusion:** Eveningness is uniquely associated with anxiety, over and above the effect of sleep disturbance. Circadian rhythm disturbance may represent a biological underpinning of anxiety symptoms and disorders and an avenue for novel intervention targets. In contrast, the relationship between eveningness and mood pathology may be better explained by concurrent sleep disturbance. Future research is necessary to replicate these findings in a prospective design.

**Support (If Any):** F31 MH113271

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**0917**

**ASSESSING THE RELATIONSHIP BETWEEN SLEEP QUALITY, ANGER AND AGGRESSION**

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**Introduction:** The relationship between sleep duration and various mood states has been previously documented. Short sleep duration has been linked to negative emotions, including anger, across all age groups. The relationship between sleep quality and anger is, however, less well studied although there is some evidence suggesting a negative association. A recent longitudinal study of young adolescents showed that anger mediated the relationship between cyberbullying and sleep quality. Thus, it is possible that stress is also linked to sleep quality and anger. The purpose of this cross-sectional study was to investigate the potential relationships between subjective sleep quality, anger and aggression in adults residing in the United Arab Emirates.

**Methods:** A total of 50 participants, aged 18-50 years, were recruited. The sample was comprised of 72% females and 28% males who completed three previously validated and reliable questionnaires. Subjective sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). Levels of aggression was assessed using the Buss-Perry Aggression Questionnaire (BPAQ) and its four components (anger, hostility, physical aggression, verbal aggression), where higher scores indicated higher levels of aggression.

**Results:** Forty-four percent of the sample were good quality sleepers and 56% were classified as poor quality sleepers. An independent t-test revealed a significant mean difference in aggression levels, determined by the total BPAQ score, according to sleep quality. The mean BPAQ score for good and poor quality sleepers was 70±22 and 81±17, respectively, where (t(48))=-2.02, p=0.0486. A Mann-Whitney U-test revealed a significant difference between ‘anger’
Introduction: Neighborhood disorder (low social cohesion, low safety, and high problems) has been associated with poor sleep quality and greater psychological distress. There has been limited research into the psychological mediating factors linking neighborhood disorder and sleep quality. We investigated the role of anxiety sensitivity, a cognitive vulnerability linked to psychological distress, in mediating the relationship between neighborhood disorder and sleep quality.

Methods: Using cross-sectional data from 120 healthy Latino adults enrolled in the Latino Sleep and Health Study in New York City, we performed a mediation analysis to assess whether anxiety sensitivity (continuous variable) mediates the relationship between each continuous indicator of neighborhood disorder with sleep quality. Bootstrapping with case resampling of 1000 simulations were conducted to calculate bias-corrected confidence intervals of the indirect effect. Sensitivity analyses adjusted for age, gender, and annual household income.

Results: Participants were 62.04% female with a Mean age of 38.96 (SD = 15.05). The total effects model predicting poor sleep quality indicated a non-statistically significant effect of neighborhood social cohesion; the direct effect, once anxiety sensitivity was added to the model, was also not statistically significant. However, there was a significant indirect effect of neighborhood social cohesion, such that it was negatively associated with poor sleep quality indirectly through lower anxiety sensitivity ($b = -0.0936, p = 0.022, 95\% CI: [-0.200] - [-0.020]$). This association became marginally statistically significant after adjustment for age, gender, and income. There was a marginally significant indirect effect of neighborhood problems, where neighborhood problems was positively associated with poor sleep quality indirectly through higher anxiety sensitivity ($b = 0.0512, p = 0.084, 95\% CI: [4.71e-4 - 0.150]$). There was no significant indirect effect of neighborhood safety on sleep quality through higher anxiety sensitivity.

Conclusion: Our results suggest that neighborhood social cohesion is indirectly negatively associated with poor sleep quality through anxiety sensitivity among Latino adults. However, we did not see this mediating effect in neighborhood problems or safety. Future research should explore whether interventions lowering anxiety sensitivity improve neighborhood social cohesion and indirectly improve sleep quality.

Support (If Any): N/A

**0918**

**DOES ANXIETY SENSITIVITY MEDIATE THE RELATIONSHIP BETWEEN NEIGHBORHOOD DISORDER AND SLEEP QUALITY?**

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Conclusion: Poor sleep quality is associated with higher levels of anger and aggression in adults in the United Arab Emirates. Future recommendations would be to assess the longitudinal relationship between sleep quality and anger as well as aggression to determine cause-effect associations.

Support (If Any): N/A

**0919**

**A MODERATED MEDIATION MODEL OF EXPERIENTIAL AVOIDANCE, SPECIFIC SOCIAL FEARS, SLEEP QUALITY, AND SEX**

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Introduction: Previous research suggests that social anxiety symptoms are related to sleep difficulties; however, the mechanism underlying this relation is not understood. While there is evidence to suggest experiential avoidance (EA) is central to social anxiety and insomnia disorders, EA has not been examined in the relation to social anxiety and sleep difficulties. Further, there is also limited research suggesting sex differences in sleep complaints are impacted by sex differences in coping with specific social fears. The current study examined sex as a moderator of the indirect effect of EA on sleep quality (SQ) through specific social fears.

Methods: Data were collected from a sample of 401 students from a large Midwestern University. Sex was assessed with a binary demographic question and EA, specific social fears, and SQ were assessed using validated measures.

Results: A moderated mediation model analysis was conducted using the PROCESS Macro for SPSS. In the analysis, EA was entered as the independent variable, SQ as the dependent variable, specific social fears was entered as the mediator, and sex was entered as the moderator. Results indicated a significant mediated moderation effect ($B = .076$, BootLLCI = .036, BootULCI = .131) whereby EA was indirectly related to SQ through specific social fears and sex moderated the effect of specific social fears on SQ. Specifically, there was a significant conditional indirect effect of EA on SQ via specific social fears for males ($B = .041$, BootLLCI = -.093, BootULCI = -.006) and females ($B = .035$, BootLLCI = .018, BootULCI = .055). The total PSS score was positively correlated with BPAQ total score $r=0.31, p=0.000$, and anger $r=0.41, p=0.0030$. This association became marginally statistically significant after adjustment for age, gender, and annual household income.

Conclusion: The results indicate that the relationship between EA and SQ was mediated by specific social fears. Further, sex moderated the relationship between specific social fears and SQ; However, there is likely an additional variable leading sex to be a moderator between specific social fears and SQ. It is possible that pre-sleep arousal, could be the link between specific social fears and SQ, which is an area for future research.

Support (If Any): N/A

**0920**

**SLEEP DISTURBANCES IN OPIOID DEPENDENT PATIENTS ON BUPRENORPHINE- GENDER DIFFERENCES IN NON-COMPLIANT SUBJECTS**

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Introduction: Sleep disturbances are common in opioid use disorder (OUD) patients on buprenorphine. The aim of the study is...
B. Clinical Sleep Science and Practice

IX. Sleep and Psychiatric Disorders

0921 SLEEP EFFICIENCY MEDIATES THE ASSOCIATION BETWEEN PSYCHOLOGICAL DISTRESS AND INFLAMMATION

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Introduction: Research demonstrates well-established associations between inflammatory mechanisms, sleep, mood disturbances, and a wide spectrum of medical conditions. Specifically, insufficient and disturbed sleep is associated with increased systemic inflammation as well as psychological dysregulation and morbidity. However, limited research exists exploring the relative mediational role that sleep disturbance may play in the relationship between psychological distress and inflammatory risk. The purpose of this study is to examine if objective sleep quality (i.e., sleep efficiency) mediates the association between psychological distress and low-grade inflammation.

Methods: We utilized a sample of adults from the Midlife in the United States (MIDUS) II study (2004-2009) who completed the biomarker blood assays and actigraphy project (N = 441). Seven-day average sleep efficiency, estimated from wrist actigraphy, was used as the objective sleep quality measure. Low grade inflammation score was indexed as a composite of five standardized inflammatory markers (Interleukin 6, C-reactive protein, fibrinogen, intercellular adhesion molecule-1, and E-selectin). Psychological distress was assessed using the Center for Epidemiological Studies for Depression Inventory (CES-D), Mood and Symptom Questionnaire (MASQ), and the Perceived Stress Scale-10 item version (PSS). A mediation analysis was run using the PROCESS macro (Hayes, 2017; model 4; 5000 bootstrap samples) with body mass index, age, and sex entered as covariates.

Results: Results indicated that sleep efficiency mediated the associations between all measures of psychological distress [depression (95% CI = .0035, .0213), anxiety (95% CI = .0033, .0294), perceived stress (95% CI = .0052, .0291)] and low-grade inflammation.

Conclusion: Results indicate objective sleep disturbance among individuals experiencing elevated levels of stress, depression, and anxiety may increase their risk for inflammation. Findings suggest that enhancing sleep quality may be an effective prevention strategy to reduce low-grade inflammation when individuals are experiencing psychological distress. Additional implications and future directions will be discussed.

Support (If Any): N/A

IX. Sleep and Psychiatric Disorders

0922 EMBODIED CONVERSATIONAL AGENTS ARE HIGHLY ACCEPTED TO DIAGNOSE PSYCHIATRIC DISORDERS AMONG PATIENTS SUFFERING FROM SLEEP DISORDERS

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Introduction: New techniques are needed to improve diagnosis and follow-up of patients suffering from chronic sleep disorders (e.g., obstructive sleep apnea, insomnia or hypersomnia). Many patients seen in sleep clinics report psychiatric comorbidities (i.e. depression, addiction) but not all physicians are trained adequately or have time to diagnose mental disorders. Embodied conversational agents (ECA) are new tools enabling to conduct face-to-face psychiatric interviews, while enabling diagnostic precision, as shown in previous publications. However, to be used in clinical routine, these agents need to be perceived as acceptable by their users, whatever is the medical condition of the patient.

Methods: Three hundred and eighteen patients (mean age: 45.01, SD: 13.33) from sleep clinic interacted with an ECA administrating a 30-minute psychiatric interview (depression diagnosis and addiction screening). At the end of the interview, user acceptance of the agent was evaluated using the Acceptability E-Scale (AES). This scale, validated in its French version, measures acceptance through a total score and two sub-scores: usability and satisfaction of the agent. Type of sleep disorders was collected and analyzed as a possible factor influencing acceptance of the agent.

Results: Our results suggest a very high acceptance of the ECA (mean (/30): 25.37, SD = 3.84) on the AES scale. Patients also reported a high satisfaction (mean (/15): 11.64, SD = 2.68) and usability (mean (/15): 13.73, SD = 2.07) of the ECA. Moreover, when taking into account the type of sleep disorder they were suffering
from, a significant difference was obtained. Indeed, patients suffering from nocturnal breathing disorders (N=133) reported a significantly higher satisfaction toward the ECA compared to other sleep disorders (F(6, 314) = 2.24; p = .039).

**Conclusion**: Our results show the high user acceptance of our Embodied conversational agent to diagnose co-morbid diseases in patients suffering from chronic sleep disorders. Moreover, our results suggest that OSAS patients are an especially suitable target population for this type of technology, and highlight the relevance of these systems for the future of sleep diagnosis and follow-up.

**Support (If Any):**

**0923**

**INSOMNIA AND SUICIDE ATTEMPTS FOLLOWING DISCHARGE FROM RESIDENTIAL TREATMENT**

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**Introduction**: Suicide is the 10th leading cause of death in the United States. Transitions in care (e.g., discharge from a hospitalization) represent a period of high risk. It is less clear, however, what factors may influence suicide risk during these transitions. Insomnia is associated with suicide and is often not adequately addressed in residential settings where more severe psychopathology is prioritized. Insomnia is unique from many risk factors, because there are highly efficacious treatments to address it.

**Methods**: Suicide attempt, treatment utilization, and diagnostic data were extracted from the Veterans Health Administration medical record and a suicide surveillance dataset. The present dataset is comprised of veterans (n = 1,825) discharged from a residential treatment program (i.e., domiciliary) in FY13-14. The parent dataset from which these data were drawn consisted of all veterans with a documented suicide attempt in FY13-14 with a 1:1 matched control group of veterans with no attempt. Logistic regression was used to examine the associations between insomnia and suicide attempt. Covariates included age, gender, mental health treatment utilization (days), depression, substance use disorder (SUD), post-traumatic stress disorder, schizophrenia, bipolar disorder, and a medical comorbidity score.

**Results**: Insomnia was more common among those with a documented suicide attempt than those without: insomnia (62.4% vs. 11.8%). Analyses revealed that insomnia (OR = 1.52, 95% CI = 1.14-2.04) was associated with increased likelihood of suicide attempt even after accounting for known risk factors for suicide including significant covariates: depression (OR = 5.28), SUDD (OR = 2.23), and bipolar disorder (OR = 8.74). Additional analyses indicated that the preponderance of suicide attempts occurred within the first 90 days following discharge (63.0%), with many of those attempts occurring in the first 30 days (44.8%).

**Conclusion**: Insomnia represents a modifiable risk factor for suicide, the treatment of which may be of particular relevance following transitions in care. Findings suggest that insomnia should be considered in suicide risk assessments and post-discharge planning.

**Support (If Any)**: This work was supported by the VA Center of Excellence for Suicide Prevention at the Canandaigua VA Medical Center.
However, few studies have assessed how relationship quality is related to sleep. In order to extend this work, the present study examined the relationships between sleep variables and relationship satisfaction.

**Methods:** Data were from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study. N=998 working-age adults age 22-60 provided complete data. Relationship quality was assessed with the item, “On a scale of 1-100, how would you rate your overall satisfaction with your marriage, current relationship, or relationship status (if not in a relationship)?” Sleep-related outcomes included the Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Fatigue Severity Scale (FSS), sleep duration item from the National Health and Nutrition Examination Survey (NHANES), and the Brief Index of Sleep Control (BrISC). Covariates included age, sex, education, race/ethnicity, income, relationship status, and body mass index. Regression analyses examined relationship satisfaction as outcome and sleep variable as predictor. We also tested to see if Perceived Stress Scale (PSS) mediated the association between relationship satisfaction and sleep.

**Results:** After adjustment for age, sex, race/ethnicity, education, income, relationship status, and body mass index, overall relationship quality was associated with a lower ISI score (B=-0.05, p<0.0005), lower PSQI score (B=-0.03, p<0.0005), lower FSS score (B=-0.06, p<0.0005), longer sleep duration (B=0.40, p<0.0005), and higher BRISC score (B=0.004, p<0.0005). After adding perceived stress to the model, overall relationship quality was associated with decreased ISI score (B=-0.02, p<0.002), decreased PSQI score (B=-0.01, p=0.002), and higher sleep duration (B=0.25, p=0.02).

**Conclusion:** Overall relationship satisfaction was associated with longer sleep duration, better sleep quality, daytime fatigue, and perceived control over sleep. These relationships were attenuated after accounting for general stress level, but relationships with sleep duration and quality remained significant.

**Support (If Any):** R01MD011600, R21ES022931

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**0926 SLEEP TIMING AND THE PREVALENCE OF SUICIDAL IDEATION IN A COMMUNITY SAMPLE**

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**Introduction:** When adjusted for likelihood of wakefulness, completed suicides disproportionately occur during the night. Further clarification of the relationship between time awake at night and suicide is needed. Using a large community dataset, we compared sleep timing patterns relative to suicidal ideation.

**Methods:** Data was acquired from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study, a survey of N=1007 adults. Frequency of suicidal ideation was extracted from the Patient Health Questionnaire - 9. Sleep timing was estimated from the Sleep Timing Questionnaire. To determine if suicidal ideation was higher at particular times during the day, the number of awake individuals with suicidal ideation was counted for each one-hour bin. We then compared these counts to the expected percentage of the sample awake at each one-hour bin. Dividing the observed count by the expected count produced a standardized prevalence ratio (SPR) of suicidal ideation, where an SPR of 1 meant that the observed count was equivalent to the expected count based on wakefulness. Clock hours were then grouped into 4 categories: Morning (06:00 to 11:59), Afternoon (12:00 to 17:59), Evening (18:00 to 23:59), and Night (00:00 to 05:59).

**Results:** Out of 1004 subjects who provided complete data, 769 reported no suicidal ideation, 138 reported occasional suicidal ideation, and 97 reported frequent suicidal ideation. The mean SPRs for occasional suicidal ideation were: Morning=0.95; Afternoon=1.00; Evening=1.06; and Night=1.42. The mean SPRs for frequent suicidal ideation were: Morning=0.90; Afternoon=1.00; Evening=1.06; and Night=1.39. The nighttime SPR was significantly higher than morning, afternoon, or evening SPRs for both occasional (one-way ANOVA, p=0.003) and frequent suicidal ideation (one-way ANOVA, p<0.001).

**Conclusion:** The standardized prevalence ratio of suicidal ideation is higher during the night than at any other time of day. This finding extends our previous work on completed suicides to encompass suicidal ideation.

**Support (If Any):** The SHADES study was funded by R21ES022931 awarded to Dr. Michael Grandner.
**0927**

REGIONAL BRAIN VOLUMES WITHIN THE ASCENDING ARousAL SYSTEM ARE ASSOCIATED WITH SLEEP-WAKE DYSFUNCTION AFTER STROKE

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Introduction: Sleep-wake dysfunction contributes to the pathogenesis and progression of ischemic stroke. Lesions to sleep-wake circuitry may compromise post-stroke recovery; however, the neuroanatomical correlates of post-stroke sleep-wake disruption remain unclear. We hypothesized that sleep-wake dysfunction after stroke, characterized by prolonged or short sleep duration and poor sleep efficiency, would be associated with reduced structural volumes of sleep-wake regions of interest (ROI).

Methods: We included 112 radiologically-confirmed ischemic stroke participants (79 male; mean age = 68 years) at three months post-stroke and 40 healthy, age-and-sex-matched, controls from the Cognition and Neocortical Volume After Stroke (CANVAS) study. Brain images were acquired on a Siemens 3T Tim-Trio scanner. Structural volumes of sleep-wake ROI (thalamus, caudate, putamen, hippocampus, amygdala, accumbens, brainstem) were generated using FreeSurfer v6.0. Sleep-wake parameters were measured using BodyMedia's SenseWear armband (mean wear time=6.4 days) with total sleep time and sleep efficiency automatically computed. Multivariate linear regressions were performed with group-effects assessed using MANOVAs, controlling for age, sex, education, and total intracranial volume.

Results: Stroke participants had significantly reduced sleep efficiency relative to controls (p=0.05). Long (≥8 hrs) total sleep time (TST) was more common among stroke patients (p<0.0001, n=24). Long TST after stroke was associated with lower bilateral thalami (βt=-8.1, t=-3.1, p=0.05), right caudate (βt=-8.4, t=-2.5, p=0.05), bilateral putamen (βt=-8.3, t=-2.4, p=0.05), brainstem (βt=-6.8, t=-2.5, p=0.05), and left accumbens (βt=-1.1, t=-3.4, p=0.001) volumes when compared to controls. Within-group volumetric comparisons in stroke patients stratified by long TST showed similar results. No significant volumetric differences were found in stroke participants with short TST (<6 hrs) compared with controls. Poor sleep efficiency (<75%) after stroke was associated with lower left thalamic volume (β=-6.4, t=-3.5, p=0.001).

Conclusion: Long TST and poor sleep efficiency in stroke participants are driven by volumetric reductions in sleep-wake circuitry. Our findings suggest that sleep-wake structures within the ascending arousal system and thalamo-cortical tract may serve as neuroanatomical markers of sleep-wake dysfunction after stroke.

Support (If Any): This work was supported by the National Health and Medical Research Council project grant (APP1020526).

**0928**

SELF-REPORTED INSOMNIA AND DAYTIME SLEEPINESS ARE BETTER PREDICTORS OF CONCUSSION RISK THAN PRIOR CONCUSSION HISTORY

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Introduction: Sport-related concussions (SRCs) are a significant public health concern. Identifying potentially modifiable risk factors for SRCs may lead to better prevention efforts. Sport performance and injury avoidance requires integrated cognitive, motor, and behavioral functioning that is susceptible to inadequate sleep duration and/or quality. The purpose of this study was to quantify collegiate athletes’ relative risk of SRC based on self-reported sleep outcomes from a screening questionnaire, including insomnia severity and habitual daytime sleepiness.

Methods: 190 NCAA Division-1 athletes completed a battery of questionnaires that included the Insomnia Severity Index (ISI) and National Health and Nutrition Examination Survey (NHANES) Sleep module. SRC incidence was extracted from medical records at least one-year following survey completion. ISI total score and the sleepiness item from the NHANES were used as independent predictors of univariate relative risk ratios (RR) for future SRC. An additional multiple logistic regression model including sleep outcomes as well as past SRC history quantified the odds of sustaining a SRC.

Results: Clinically significant self-reported insomnia severity (ISI≥15; RR=3.13, 95% CI: 1.32-7.42, p=0.015) and NHANES-identified daytime sleepiness occurring more than twice per month (RR=2.856, 95% CI: 0.681-11.977, p=0.037) were independently associated with increased SRC risk within an 8-month period following the survey. These effects remained comparable in magnitude after adjusting for SRC history.

Conclusion: Sports-related concussion risk in collegiate athletes is significantly greater in individuals self-reporting insomnia or daytime sleepiness, even after accounting for concussion history (usually the strongest predictor of future risk). Clinicians and athletes need to be cognizant of the relationship between sleep and SRCs and to take proactive measures to improve sleep - quantitatively, qualitatively, or both - in order to reduce SRC risk as well as support and improve overall athletic performance.

Support (If Any): The study was funded by an Innovations grant from the National Collegiate Athletics Association. Dr. Grandner is also supported by R01 MD011600. Drs. Raikes and Killgore are supported by a US Army Medical Research and Materiel Command (USAMRMC) grant (W81XWH-14-1-0571) to Dr. Killgore.
Introduction: Mild Traumatic Brain Injury (mTBI) is characterized by a constellation of symptoms, including somatic, psychological, sleep and cognitive impairment. Although the effect of mTBI symptomatology on long-term sequelae has been studied, little is known about the mediating role of sleep disturbance between post-concussion symptom severity and cognitive deficits. We hypothesized that changes in sleep mediate the association between changes in concussion symptoms and cognition.

Methods: Fifty-eight individuals with mTBI, no history of concussions (34F;24M; aged: 42.60±15.09) were evaluated (7 days to 1.5 years post-concussion). Average time between baseline and follow-up was 1.26 months (SD=0.48). The Rivermead Post-Concussive Questionnaire was used to assess psychological, somatic, and cognitive constructs. We assessed sleep disturbance by averaging four binary items: staying asleep, falling asleep, snoring, and rested in the morning. We analyzed score changes from baseline to follow-up. Structural equation modeling was used to estimate the mediation of sleep changes in the association between concussion symptoms (psychological and somatic) and changes in cognitive deficits. Model direct and indirect effects were evaluated using maximum likelihood estimation and bootstrapped confidence intervals.

Results: The sample included 876 patients (mean age 4.0±16.2yr, 58.1% female, 82.1% white, seizure-free 19.1% in the past six months, 41.6% in the past four weeks). Median ISI was 8 (IQR, 3-15), with 24.9% scoring ≥15 (moderate-to-severe symptoms). Median STOP was 1 (IQR, 1-2), with 28.4% scoring ≥2. Mean PROMIS Mental Health T-score was 44.3±10.2 and Physical Health T-Score was 45.1±10.0. Relative to STOP score of 0, scores of 1, 2, 3, and 4 resulted in PROMIS Mental Health decreases of 5.7, 7.2, 7.9, and 9.2, respectively (p<0.001). Effects were more pronounced in PROMIS Physical Health, with decreases of 7.5, 10.3, 11.4, and 13.2 (p<0.001). ISI scores 7-14, 15-21, and 21-28 were associated with significant decreases (p<0.001) in mental health scores of 5.9, 9.3, and 15.2 and physical health scores 6.7, 9.9, and 15.6. Significant associations (p<0.001) persisted after adjusting for LSSS, QOLIE-10, and seizure frequency.

Conclusion: High-risk OSA and moderate-to-severe insomnia based on STOP and ISI predict worse quality of life as measured by PROMIS global health in adults with epilepsy independent of epilepsy disease severity measures. These findings highlight the importance of screening of sleep disorders in those with epilepsy.

Support (If Any): Cleveland Clinic Knowledge Program Data Registry and Neurological Institute Center for Outcomes Research and Evaluation.

0930 DOES SLEEP MEDIATE THE RELATIONSHIP BETWEEN CONCUSSION SYMPTOMS AND COGNITION IN MILD TBI ADULTS?

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Introduction: The Reactions to Acute Care and Hospitalization (REACH)-Stroke study is an observational cohort study examining how environmental, psychosocial, and behavioral factors relate to long-term health outcomes following stroke/transient ischemic attack (TIA). Sleep duration, quality, and the use of sleep medications following hospital discharge were assessed at 30-day follow-up with 3 questions based on the Pittsburgh Sleep Quality Index. At 6 months, patients completed the 8-item Patient Health Questionnaire depression scale (PHQ-8). Binary logistic regression was conducted, producing adjusted odds ratios (OR) on the association between 1 month short sleep duration, bad sleep quality, or use of sleep medications, with depression at 6 months, controlling for age, sex, race/ethnicity, and baseline depression.

Results: The current analysis included 236 patients (age: 63.0 ± 14.5 y, 49% female). Short sleep (<6 h/night) in the month following stroke was reported 30.9% of patients. Poor sleep quality (rating of sleep as fairly or very bad) and use of medication for sleep (at least once per week) were reported in 24.6% and 17.4% of patients, respectively. Depression at 6 months was reported in 16% of patients. The presence of depression at 6 months post-stroke was significantly associated with short sleep vs. non-short sleep (adjusted OR=2.83, 95% CI: 1.31-6.11), poor sleep quality vs. good sleep quality (adjusted OR=4.01, 95% CI: 1.80-8.93), and use...
of sleep medication vs. no use (adjusted OR=4.72, 95% CI: 1.91-11.64) during the month following stroke.

**Conclusion:** Short sleep duration, poor sleep quality, and use of sleep medication during the 1-month following stroke were all associated with depression 6-months post-stroke. Since depression is associated with worsened functional recovery, prevention and/or treatment of poor sleep should be prioritized following a stroke to encourage optimal psychological and physiological health.

**Support (If Any):** R01HL141494

0932

**USING NOVEL EEG PHENOTYPES AND ARTIFICIAL INTELLIGENCE TO ESTIMATE OSA SEVERITY**

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**Introduction:** EEG studies are widely used for monitoring and diagnosis of neurological conditions including epilepsy, seizure disorders, among others. Ambulatory EEG, EEG-video monitoring, and long-term EEG monitoring typically result in several full nights of sleep EEG data. In this work, we leverage artificial intelligence methods that achieved breakthrough performance in related domains with large clinical EEG datasets, to explore our hypothesis that neurological phenotypes that highly correlate with sleep disordered breathing can be extracted from overnight EEG recordings. Furthermore we hypothesize that these EEG phenotypes can be used to accurately predict a patient’s OSA severity, without accompanying cardiopulmonary data.

**Methods:** We used cross-sectional analyses of adult patients (N = 4650) who completed an overnight PSG study. All signals were excluded from analysis except for the standard 10-20 EEG sensor array, to simulate an ambulatory or video-EEG acquisition for the present study. Global phenotypic features were derived from the patients full-night sleep architecture and fragmentation profiles. Local phenotypic features were derived by analyzing biomarker patterns and respiratory cycle-related EEG changes exhibited in the EEG signals directly. Artificial Intelligence methods including Bidirectional-LSTM and Deep-CNN were trained, optimized, and evaluated to model the relationship between global and local EEG phenotypes and OSA severity. Performance for predicting moderate and severe OSA (AHI ≥ 15) was evaluated using randomized 10-fold cross-validation.

**Results:** The best performance was obtained by a combination of the Bidirectional-LSTM and Deep-CNN architectures, with an average accuracy, sensitivity, and specificity of 91.1%, 86.9%, and 99.5% respectively for predicting moderate and severe OSA.

**Conclusion:** This and prior work have demonstrated a promising opportunity to estimate OSA severity with a host of EEG study types using applied artificial intelligence. Future research involving a cohort of ambulatory EEG subjects, controlled for OSA severity, can validate the efficacy of this approach in the clinical setting. Following further validation, AI based risk estimates could be incorporated into diagnostic EEG reports, to provide clinicians with additional means for identifying patients with moderate and severe OSA that may benefit from follow-up diagnosis and treatment.

**Support (If Any):** None

0934

**EFFECTS OF SLEEP QUALITY AND PAIN INTENSITY ON NEGATIVE AFFECT IN IDIOPATHIC PARKINSON’S DISEASE**

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**Introduction:** It is well known the association of sleep deprivation and the risk of seizure recurrence in epileptic patients, however the role of selective patterns of sleep deprivation is yet to be defined in certain epilepsy syndromes with its associated implications on seizure recurrence and functionality. We wanted to evaluate patterns on selective sleep deprivation in patients with juvenile myoclonic epilepsy (JME).

**Methods:** We analyzed sleep deprivation in 2 different forms: Late night sleep delay (LNSD) defined by more than 1.5 hours of the habitual sleep onset time missed, and early morning (EMSD); of 1.5 hours or more missed in the early morning awakening. We compared the recurrence of seizures in a known population of 15 JME patients that fulfilled clinical and neurophysiological criteria, we analyzed a sleep detailed history that included logs and observation by family members, variables associated with sleep schedule and total sleep time were noted. We evaluated the onset of sleep and morning awakening times in periods that included 3-month blocks before the occurrence of seizures. All the patients were compliant with the anti-epileptic treatment.

**Results:** A relationship between all forms of sleep deprivation and seizures was seen in all the patients. LNSD and EMSD were clearly associated with increased frequency and duration of early myoclonic jerks in the first 2 hours after awakening. There was as well increase in seizure frequency with both types of sleep deprivation; however, the most significant predisposing factor was EMSD of 90 minutes or more of the habitual waking time. LNSD and seizures was observed in 25% of the patients compared to 75% with EMSD (p< 0.01).

**Conclusion:** Sleep deprivation is clearly associated in the generation of seizures in different seizure syndromes. Early sleep morning awakening is a more selective contributor for seizure recurrence than delayed sleep time in patients with Juvenile Myoclonic Epilepsy and this selective deprivation can increase the seizure frequency as much as 3 times more than the late-night sleep. Further testing on other forms of epilepsy is needed.

**Support (If Any):** None
B. Clinical Sleep Science and Practice

Introduction:
Parkinson’s disease (PD) is clinically characterized by chronic, progressive impairments in motor and non-motor functioning. The non-motor symptoms (NMSs) of PD include mood disturbances, sleep difficulties, and chronic pain. Dopaminergic cell loss plays a large role in explaining the prevalence of affective disturbances, sleep difficulties, and chronic pain. Dopaminergic dysfunction in PD, as symptoms of anxiety and depression are highly responsive to antiparkinsonian medications. However, mood difficulties often persist in PD patients on dopamine therapy, suggesting other contributing factors aside from neurodegeneration. This study examined whether other NMSs of PD, specifically sleep and pain, may contribute to negative affect among patients with PD.

Methods:
20 patients with idiopathic PD (age = 67.8 ± 6.1) and 19 age-matched controls (age = 69.7 ± 6.5) completed bi-daily (morning and evening) surveys for 14 days to collect average ratings of their nightly sleep quality (SQR; 1 = Very Poor Sleep; 5 = Very Good Sleep), daily pain intensity (0-100 Visual Analog Scale, 100 = Worst Pain Sensation Imaginable), and daily negative affect (NA; measured by the PANAS-SF; 1 = never, 5 = always; range = 5-25).

PD-related variables including motor symptom severity (UPDRS Part III) and intensity of antiparkinsonian medication (levodopa-equivalent dosage or LED) were also collected. Hierarchical regression was performed predicting NA scores (higher = more NA) with the following steps: Step 1: UPDRS Part III, LED; Step 2: SQR; Step 3: Pain Intensity.

Results:
The model showed that NA ratings were related to our PD variables (Step 1: $R^2 = .232$), while adding SQR in Step 2 ($R^2 = .317$) improved model fit and uniquely predicted NA ($\beta = -0.335$). In the final Step 3 model ($R^2 = .600, p < .001$), SQR ($\beta = -0.317$) and pain intensity ($\beta = 0.589$) were both uniquely associated with NA after adjusting for other PD-related variables.

Conclusion:
Poorer subjective sleep quality and higher self-reported pain were associated with negative affect independent of motor symptom severity or intensity of antiparkinsonian medication in patients with PD. The symptoms underlying poorer sleep quality and higher pain intensity in PD patients warrants further study. Modifiable aspects of sleep and pain in PD could be targeted in intervention studies to improve patient outcomes.

Support (If Any): NINDS K23NS060660 and R01NS082386 (Price).

0935
DAILY BLUE LIGHT THERAPY REDUCES DAYTIME SLEEPINESS AND POST-CONCUSSION SYMPTOMS AFTER MILD TRAUMATIC BRAIN INJURY
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Introduction:
An estimated 30-80% of individuals report long-term sleep disruption following a mild traumatic brain injury (mTBI). Given the critical role of high-quality sleep on optimal cognitive, emotional, sport, and physical performance, ameliorating these adverse mTBI effects is essential. The purpose of this randomized controlled trial was to evaluate the effects of daily blue light therapy (BLT) in comparison to amber light therapy (ALT) in a post-mTBI sample. We hypothesized that individuals receiving blue light would exhibit improved self-reported sleep outcomes.

Methods:
27 individuals (age: 26.85 ± 8.39; 18 females; days post-injury: 275.42 ± 167.04) were recruited and randomly assigned to receive BLT or ALT. Individuals in both groups underwent a comprehensive neuropsychological and self-reported assessment battery at pre-treatment and post-treatment. This battery included self-report measures of daytime sleepiness (Epworth Sleepiness Scale, ESS) and post-concussion symptoms (Rivermead Post-Concussion Symptom Questionnaire, RPCSQ).

All individuals completed six weeks of daily light treatment (30 morning minutes direct exposure via light box). Two sample T-tests compared between-group post-treatment changes in ESS scores and RPCSQ subscale scores (somatic, emotional, cognitive). Additional analyses included bivariate correlations between change scores.

Results:
The light groups exhibited no differences in baseline ESS or RPCSQ subscale scores. At post-treatment, individuals in the BLT group had significantly improved daytime sleepiness ($t = 2.46, p = 0.025$), somatic ($t = 2.04, p = 0.053$) and cognitive symptoms ($t = 1.82, p = 0.082$) compared to those in the ALT group. Bivariate correlations indicated that improvements in ESS scores were significantly associated with improvements in somatic symptoms ($r = 0.49, p = 0.014$).

Conclusion:
Daily BLT effectively reduced mTBI-related daytime sleepiness and self-reported somatic and cognitive symptoms. These improvements are likely to have significant positive effects on individuals’ daytime functioning (cognitive, physical, emotional, sport) and overall quality of life. Further research is needed to uncover the directionality of these findings (decreased daytime sleepiness leads to improved symptoms or vice versa) as well as the neurological mechanisms underpinning these improvements.

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0936
SLEEP DISTURBANCES IN WOLFRAM SYNDROME
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Introduction:
Wolfram syndrome is a rare disorder associated with diabetes mellitus, diabetes insipidus, optic nerve atrophy, hearing and vision loss, and neurodegeneration. Sleep complaints are common but have not been studied with objective measures. Our goal was to assess rates of sleep apnea and objective and self-reported measures of sleep quality, and to determine the relationship of sleep pathology to other clinical variables in Wolfram syndrome patients.

Methods:
Genetically confirmed Wolfram syndrome patients were evaluated at the 2015 and 2016 Washington University Wolfram Syndrome Research Clinics. Patients were enrolled into a study and a type III ambulatory sleep study device and completed the Epworth Sleepiness Scale (ESS), the Pittsburgh Sleep Quality Index (PSQI) and/or the Pediatric Sleep Questionnaire (PSQ). PSQI and PSQ questionnaire data were compared to a previously collected group of controls. Patients were characterized clinically with the Wolfram Unified Rating Scale (WURS) and a subset underwent magnetic resonance imaging (MRI) for brain volume measurements.

Results:
Twenty-one patients were evaluated ranging from age 8.9 - 29.7 years. Five of 17 (29%) adult patients fit the criteria for obstructive sleep apnea (OSA; apnea-hypopnea index [AHI] ≥ 5) and all 4 of 4 (100%) children aged 12 years or younger fit the...
criteria for obstructive sleep apnea (AHI ≥ 21). Higher AHI was related to greater disease severity (higher WURS Physical scores). Higher mixed apnea scores were related to lower brainstem and cerebellar volumes. Patients’ scores on the PSQ were higher than those of controls, indicating greater severity of childhood obstructive sleep-related breathing disorders.

Conclusion: Wolfram syndrome patients had a high rate of OSA. Further study would be needed to assess how these symptoms change over time. Addressing sleep disorders in Wolfram syndrome patients would likely improve their overall health and quality of life.

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0937 POSITIVE AIRWAY PRESSURE (PAP) THERAPY AND OUTCOMES ON HEADACHES
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Introduction: There is a paucity of data evaluating positive airway pressure (PAP) therapy’s impact on chronic headache. We sought to evaluate patients with chronic headache, referred for assessment of sleep disordered breathing (SDB) with emphasis on PAP adherence to evaluate patients with chronic headache, referred for assessment of positive airway pressure (PAP) therapy’s impact on chronic headache. We sought to evaluate patients with chronic headache, referred for assessment of sleep disordered breathing (SDB) with emphasis on PAP adherence rates. Prior studies show favorable improvement in headaches with adherence to PAP therapy but only assessed by self-report. This study is unique in correlating headache outcomes, specifically disability, severity, and frequency, using a validated headache scale, the Migraine Disability Assessment Scale (MIDAS) in relation to PAP adherence.

Methods: This is a retrospective review of electronic medical records from an academic medical center, of adults diagnosed with a headache disorder and treated for sleep disordered breathing with PAP therapy.

Results: Forty-four headache patients (70% females) with SDB were studied. Mean age was 58 ± 17; 11 years and mean body mass index (BMI) was 33 ± 6.5. Headache types included 29% chronic migraines, 24% medication overuse headaches, 11% chronic tension type headaches, 11% migraine without aura, and 25% other headache types. Among these, over 65% had more than one headache condition, with over 50% having both chronic migraine and medication overuse headache. Fifty percent had mild OSA (AHI 5–14), 23% had moderate OSA (AHI 15–29), and 25% had severe OSA (AHI 30 or more). Another patient was treated with PAP therapy for an elevated respiratory disturbance index (RDI). Forty-three percent of patients were compliant with PAP therapy. The average improvement in the MIDAS disability score was 0.43 for those who were compliant with PAP therapy and 0.17 for those who were not compliant. For pain severity, the average improvement was 1.55 for those compliant with PAP therapy and 0.28 for those not compliant. For headache frequency over 3 months, the average improvement was 31.5 for those compliant with PAP therapy and 7.3 for those not compliant.

Conclusion: Headache patients with SDB can experience clinically significant benefits of headache symptoms across many domains measured by validated headache scales, when compliant with PAP therapy.

Support (If Any): Not applicable.

0938 DECREASES IN REM SLEEP FOLLOWING TRAUMATIC BRAIN INJURY MAY CONTRIBUTE TO CHRONIC MORBIDITY
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Introduction: We set out to determine if posttraumatic sleep was associated to long-term outcome. Sex, age and hormonal effects were evaluated as these are known to have a functional influence.

Methods: Traumatic brain injured patients (n=24) were assessed via overnight polysomnography (PSG). The mean age was 45 years and mean latency from TBI was 163 days. Patient hormone levels were analyzed within 10 days of PSG. The primary outcome measures were as follows: California Verbal Learning Test (CVLT-II), Montreal Cognitive Assessment (MoCA), Trails, Beck Depression Inventory (BDI-II), and Neuro-QoL.

Results: Wake after sleep onset was negatively correlated with scores on the MoCA and Neuro-QoL ability to participate. In contrast, percent time spent in REM was positively correlated with scores on MoCA and participation. REM was also associated with list recall (p<0.05). Analysis of sex effects, indicated that women showed less % REM and scored lower on NeuroQoL cognitive and communication scales (p<0.05). Women also indicated more subjective fatigue (p<0.05) and showed a trend for lower sleep latency. A clinically significant apnea-hypopnea index (AHI) of ≥ 25 was observed in 33% of TBI patients. Apnea was not significantly correlated with body mass index. Hormonal analysis showed that male testosterone levels were negatively correlated with N2% and positively correlated N3%. Levels of thyroxine were negatively correlated with REM% and Sleep Efficiency. The Epworth sleepiness scale was not associated with PSG sleep variables. A lower score on the sleep NeuroQoL subscale was however associated with a higher AHI.

Conclusion: Decreases in REM sleep were associated with poorer cognitive performance and may ultimately affect functional outcome. Sex differences should be considered when evaluating sleep after TBI. The use of subjective sleep measures is questionable following TBI. Posttraumatic apnea could be indicative of TBI-related autonomic disturbances.

Support (If Any): none

0939 SUBJECTIVE AND OBJECTIVE SLEEP IN TRAUMATIC BRAIN INJURY (TBI)
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Introduction: Sleep disturbance is highly prevalent in traumatic brain injury (TBI). Approximately 30-70% of TBI patients report some type of sleep disruption. Nevertheless, studies that objectively characterize sleep in TBI are lacking. The present study employed multiple modalities to characterize sleep architecture and quality in patients with TBI, including: self-reported sleep assessments, actigraphy, commercially available fitness trackers (Fitbits™), ambulatory 3-channel EEG sleep monitors, home sleep apnea tests.
B. Clinical Sleep Science and Practice

Methods: Data collection is ongoing as part of a study testing the efficacy of behavioral insomnia treatment in patients with mild to moderate TBI. Presently, 33 participants have completed baseline self-report measures of sleep (ISI, ESS, PSQI) and mood (GAD-7, PHQ-9), 7-14 days of actigraphy and Fitbit™ monitoring, 1-night of ambulatory sleep EEG monitoring, 1-night of HSAT, 7-14 days of sleep diaries, and the SIS-D.

Results: The participant sample has a mean age of 39.9 ± 12.7 years, and is predominantly female (70%), white (67%), at least college educated (52%), and unemployed (58%). Subjects endorse moderately severe insomnia symptoms (ISI: \( \mu = 18.7, SD = 5.4 \)), above-normal daytime sleepiness (ESS: \( \mu = 6, SD = 3.8 \)), poor sleep quality (PSQI: \( \mu = 12.7, SD = 3.2 \)), and moderately severe symptoms of depression (PHQ-9: \( \mu = 18.2, SD = 5.3 \)) and anxiety (GAD-7: \( \mu = 12.5, SD = 4.8 \)). Insomnia severity and reduced sleep quality were associated with self-reported depression (\( r = -0.59 \), \( p = 0.001 \)) and anxiety (GAD-7: \( r = 0.42 \), \( p = 0.02 \)) but not with anxiety. Mean sleep efficiency (self-report based) was 59.7% ± 21.3%. When data collection is complete, descriptive statistics and standard sleep metrics will be compared among the objective sleep-tracking modalities utilized.

Conclusion: To date, study participants endorse and display associations between moderately severe sleep disturbance and affective distress, both of which are common in TBI. Hence, effective treatment of sleep disturbance in TBI patients may improve both sleep and emotional distress. However, these results should be considered preliminary, as data collection is ongoing. When complete, this study will contribute to the literature by providing extensive objective characterization of sleep in patients with TBI.

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X. Sleep and Neurologic Disorders

0941

IMPACT OF LIGHT THERAPY ON BRAIN STRUCTURE AND SIMPLE REACTION TIME FOLLOWING MILD TRAUMATIC BRAIN INJURY

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Introduction: Mild traumatic brain injury (mTBI) is often associated with persistent post-concussive symptoms and sleep disruption. Emerging evidence suggests that circadian timing and some aspects of sleep quality may be improved through daily morning exposure to blue light therapy (BLT). However, the effect of BLT on brain structure in the mTBI population remains unknown.

Methods: Neuroanatomical data were collected from 34 healthy controls (HCs) and 28 mTBI individuals. Individuals with mTBI either underwent six-weeks of BLT or placebo amber light therapy (ALT). MTBI participants were administered the Automated Neuropsychological Assessment Metrics (ANAM4) battery both before and following treatment. For the purpose of this study, only the simple reaction time (RT) data from ANAM4 battery were analyzed.

Results: Compared to HCs, individuals with mTBI showed significantly lower normalized cortical volume (NCV) at baseline assessment (Cohen’s d 0.5) in several brain regions. These included the caudal middle frontal gyrus (MFG), inferior parietal cortex and middle temporal cortex (MTC) within the left hemisphere and five regions, including the lateral orbitofrontal cortex, pars orbitalis (R.ParsOrb), MTC, precentral gyrus and rostral MFG within the right hemisphere. These areas of differing volume were then utilized as regions of interest (ROIs) in the main analysis of mTBI participants. There was significant reduction in RT following BLT (\( p = 0.008 \)), but not following ALT (\( p = 0.09 \)). There was a significant group (ALT/BLT) x time (pre/post) interaction for NCV within the R.ParsOrb (\( p = 0.035 \)), suggesting that NCV within R.ParsOrb increased following BLT, but not following ALT. Moreover, following BLT, increased NCV of the R.ParsOrb was significantly correlated with decreased RT (\( r = -0.54, p = 0.04 \)).
0942 EFFECTS OF TIMED LIGHT ON MOOD AND COGNITION IN ALZHEIMER’S DISEASE
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Introduction: Circadian disturbances are often associated with cognitive decline in patients with Alzheimer’s disease (AD). Reduced light exposure in addition to the degeneration of circadian clock in AD might lead to depression. Light therapy (LT) has been known to improve depression and cognitive function by stabilizing the circadian rhythm. We aimed to examine the effects of timed LT on mood and cognition in AD patients.

Methods: We recruited mild to moderate AD patients with Pittsburgh Sleep Quality Index score ≥ 5. They were randomly assigned to treatment group (TG) and control group (CG). The dim light melatonin onset (DLMO) was determined from seven hourly saliva samples obtained before sleep onset measured by actigraphy. Home-based one-hour blue-enriched light was applied between 9 to 10h after DLMO for 2 weeks. The CG patients wore blue-blocked glasses during timed LT. The Cornell Scale for Depression in Dementia (CSDDD), Global Vigor (GVS) and Affect Scale (GAS) were administered before and immediately after timed LT. The MMSE in the Korean version of CERAD Packet (MMSE-KC), Trail Making Test-A (TMT-A), Digit Span Forwards (DSF) and Backwards (DSB) tests were also assessed. Changes in the values assessed before and after timed LT were analyzed for 15 patients (76.9±5.5years) of TG and 11 patients (78.3±7.7years) of CG. The effects of group and time were evaluated using two-way repeated measures ANOVA.

Results: There were no significant changes in the scores of the GVS and GAS after timed LT in both groups, while the TG showed reduced CSDDD scores with an expected trend (7.6±5.7 vs 5.2±3.8, p=.01). The CG had significantly increased MMSE-KC scores (35.2±6.7 vs 37.0±6.7, p=.001) after timed LT, and the MMSE-KC scores yielded a significant time effect (F1,8=9.94, p=.01) with no significant group effect or interactions. No significant changes in the scores of the TMT-A, DSF and DSB were found after timed LT in both groups.

Conclusion: Our finding suggests that timed LT would be beneficial for improving the overall cognitive function in AD patients. And LT might influence reducing their depressive symptoms.

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B. Clinical Sleep Science and Practice

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**Introduction:** Sleep disturbances in TBI population can have negative consequences on physical, psychological and cognitive recovery. While polysomnography (PSG) is the gold standard for evaluating sleep disorders, actigraphy has been widely used to screen for sleep-wake disorders, especially ones that change longitudinally. In a small sample of TBI patients (n=50, single center sample of convenience) during inpatient rehabilitation, we have previously found two models (Philips Actiwatch2/Actiwatch Spectrum) to be feasible and valid for collecting sleep data. Herein, we extend this validation to a prospective study of more than 200 TBI patients and include both the Actigraph Core wGT3X-BT (ACT-Core) and Philips Actiware Sleep (ACT-Philips) to be determined with Actiware (sensitivity=Automatic), while ACT-Core-derived sleep was determined with ActiLife (Cole-Kripke algorithm).

**Methods:** This is a secondary analysis from a six-center, prospective, observational cohort study from the TBI Model System Lifetimes Study where overnight, fully attended polysomnography with concomitant actigraphy were conducted on moderate to severe TBI subjects during acute inpatient rehabilitation as part of an ongoing PCORI-funded clinical trial. Actigraphy variables of total sleep time (TST), sleep efficiency (SE), sleep latency (SL), wake after sleep onset (WASO) were compared between actigraphy devices and with Level 1, fully attended PSG (Philips Sleepwear-G3) to evaluate their concordance (Pearson). PASP-derived sleep was determined with Actiware (sensitivity=Automatic), while ACT-Core-derived sleep was determined with ActiLife (Cole-Kripke algorithm).

**Results:** Simultaneous collection of PSG and PASP (n=230) and ACT-Core (n=179) were examined. Correlations (p<.01) with PSG were found for both PASP and ACT-Core for TST (r=.70, .69), SE (r=.33, .31), and WASO (r=.19, .24) respectively. Comparison of actigraphy devices to one another revealed correlations (p>.01) for TST (r=.80), SE (r=.58), WASO (r=.68), and SL (r=.23). The two groups were significantly different with respect to TST, SE, SL, AH1, PLM, or Epworth score. We found twice as many Parkinson patients (6 versus 3 control patients) met criteria for underestimating their sleep time (defined by 120 minutes difference in subjective versus objective times), but misperception was not statistically significant between the entire group of 27 pairs. On review of individual data, it was observed that Parkinson patients appeared to have more severe sleep misperception. Thus analysis of the lower half of the misperception Parkinson patient group was compared to the lower half of misperception patients in the control cohort. In this analysis, the Parkinson patients had greater underestimation of total sleep time, as well as a lower BMI (both p<0.05), and a trend to lower AH1 (p<0.1). The Parkinson patients (n=13) and control subjects (n=13) were not different for TST, SE, SL or PLM, or degree of subjective sleepiness.

**Conclusion:** In our cohort, over three fourths (13 of 15) of our patients with PNES had sleep complaints, including one fourth having complaints of both insomnia and hypersomnia. Sleep complaints and poor quality of life both appear to independently correlate with increased severity of anxiety and depression. Insomnia is not correlated with poorer quality of life. Further characterization of sleep symptoms is needed for this population to help with determining a potential focus of treatment for common sleep complaints.

**Support (If Any):** PCORI (CER-1511-33005), GDHS (W91YTD-13-C-0015) for DVBIC, NIDILRR.

X. Sleep and Neurologic Disorders

Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), Quality of Life in Epilepsy Inventory-10-P (QOLIE-10-P), Patient Health Questionnaire (PHQ-4), and Morningness/Eveningness Questionnaire (MEQ). Patients were also asked to complete a sleep diary for two weeks prior to their admission. Questionnaire results were analyzed using Pearson Product-Moment Correlation Coefficient to determine significant relationships (p<0.05) of sleep findings with those of mood and quality of life.

**Results:** A total of 15 patients were identified as having PNES without epilepsy and were included in the analysis. Of PNES patients, the average age was 39 and 66% were female. 53% of patients had an elevated ISI and 60% of patients had an elevated ESS. Elevation of both ESS and ISI was seen in 26% of patients and elevation of both scores correlated with elevated PHQ-4 results (r=.53, p=0.043). Quality of life also correlated with PHQ-4 (r=.59, p=.02). There was, however, no direct correlation between symptoms of insomnia or hypersomnia with quality of life.

**Conclusion:** Sleep complaints are common in Parkinson patients, yet little is known about sleep misperception in this group. We aimed to investigate how common sleep misperception is in Parkinson patients.

**Methods:** We examined polysomnographic records from 27 Parkinson patients and 27 controls (matched for age and sex) from a database of sleep recordings from 2008-2018. We collected Epworth Sleepiness Scale scores and objective sleep parameters including: total sleep time (TST), sleep latency (SL), sleep efficiency (SE), AH1, PLM index. We also collected data from post study morning questionnaires including: subjective total sleep time, estimation of number and length of awakenings, and subjective sleep latency. The student t test was used to examine group differences.

**Results:** The two groups were not significantly different with respect to TST, SE, SL, AH1, PLM, or Epworth score. We found twice as many Parkinson patients (6 versus 3 control patients) met criteria for underestimating their sleep time (defined by 120 minutes difference in subjective versus objective times), but misperception was not statistically significant between the entire group of 27 pairs. On review of individual data, it was observed that Parkinson patients appeared to have more severe sleep misperception. Thus analysis of the lower half of the misperception Parkinson patient group was compared to the lower half of misperception patients in the control cohort. In this analysis, the Parkinson patients had greater underestimation of total sleep time, as well as a lower BMI (both p<0.05), and a trend to lower AH1 (p<0.1). The Parkinson patients (n=13) and control subjects (n=13) were not different for TST, SE, SL or PLM, or degree of subjective sleepiness.

**Support (If Any):** PCORI (CER-1511-33005), GDHS (W91YTD-13-C-0015) for DVBIC, NIDILRR.
**B. Clinical Sleep Science and Practice**

**Conclusion:** In our cohort we found that Parkinson patients had more severe sleep misperception than controls; however they were not different with respect to other objective parameters or their degree of sleepiness. This suggests their misperception may be related to an altered experience of sleep continuity. Further studies are needed to investigate sleep misperception in Parkinson's patients.

**Support (If Any):** N/A

**0947**

**SLEEP-WAKE DISTURBANCES IN THE POST-ACUTE PHASE OF STROKE IMPACT QUALITY OF LIFE AND OUTCOME**

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**Introduction:** The objective was to investigate the impact of sleep-wake disturbances (SWD) on cognitive function and quality of life measures in the post-acute phase of stroke. Sex differences were also investigated.

**Methods:** Adult stroke (n=58) patients were assessed for SWD via overnight polysomnography. The mean age was 51 ± 2 years and mean latency from injury was 116 ± 13 days. Sleep measures included total sleep time (TST), sleep and REM latency, percent time in sleep stages, apnea/hypopnea index (AHI), wake after sleep onset (WASO), and arousal index. The primary outcome measures were: Montreal Cognitive Assessment (MoCA), Neuro-QoL and Mayo Portland Adaptability Inventory (MPAI).

**Results:** Women had lower AHI (F(1,51)=12.236, p<.01), fewer arousals (F(1,51)=7.184, p<.01), and spent significantly more time in SWS (F(1,51)=5.923, p<.05) than men; however, SWS was reduced in both sexes. SWS made up <3% of TST in 67% of patients. Analysis of NeuroQOL measures indicated the following: Longer latencies to sleep were associated with increases in subjective stigma and depression (p<.05), as well as decreases in positive affect (p<.05). Longer latencies to REM sleep were associated with increases in anxiety and emotional/behavioral dysfunction (p<.05). Decreased sleep efficiency led to increased emotional/behavioral dysfunction (p<.05). Increased time in REM sleep decreased subjective sleep disturbance (p<.05). Higher AHI and number of awakenings led to decreased ability to participate and positive affect (p<.05). Decreased sleep efficiency was associated with higher scores on the MPAI, indicating poorer outcomes with disrupted sleep (p<.05). Poorer outcomes measured by the MPAI were also associated with a higher percentage of WASO (p<.05).

**Conclusion:** Male stroke patients display significantly higher AHI, and arousals, and spend significantly less time in SWS than female patients. For both sexes, objective sleep measures were significantly correlated with quality of life measures, where improved sleep indicated better subjective quality of life. Additionally, sleep measures were significantly correlated with outcome measures such as the MPAI. Apnea was not significantly correlated with BMI, which could be indicative of respiratory dysregulation driven by injury-related autonomic disturbances.

**Support (If Any):**

**0948**

**AN ITERATED FUNCTION SYSTEM IMPLEMENTED ON A PYTHON APPLICATION AS A TOOL TO DETECT DEMENTIA AND MILD COGNITIVE IMPAIRMENT DURING RAPID EYE MOVEMENT SLEEP AND REST**

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**Conclusion:** A Python application with an Iterated Function System (IFS) approach was created as it is known that an IFS emphasizes the fractal behavior of the series. The IFS is a generalization of the Chaos Game and the shape resulting from the set of points can be described better subjective quality of life. Additionally, sleep measures were significantly correlated with outcome measures such as the MPAI. Apnea was not significantly correlated with BMI, which could be indicative of respiratory dysregulation driven by injury-related autonomic disturbances.

**Support (If Any):**

**0949**

**THE RELATIONSHIPS BETWEEN CIRCADIAN RHYTHM, SLEEP QUALITY, FATIGUE, AND DEPRESSIVE SYMPTOMS AMONG ADULTS WITH MULTIPLE SCLEROSIS (MS)**

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**Introduction:** Adults with MS suffer from multiple comorbidities including depression. In an interdependent and reciprocal relationship functional impairments and depression may reduce daily activity and light exposure and disrupt circadian rhythm.
study examined the relationship between circadian rhythm, sleep quality, fatigue, and depressive symptoms among adults with MS.

**Methods:** Participants completed baseline questionnaires, wore an actigraphy watch, and kept a sleep diary for seven days. The Center for Epidemiological Studies Depression Scale-Revised categorized participants as "at risk" or "not at risk" with a cut-off score of 16. The Fatigue Severity Scale and the Pittsburgh Sleep Quality Index were also completed. Circadian rhythm was analyzed using the actograms. Chi square tests of independence were used to determine associations and calculate odds ratios with 95% confidence intervals.

**Results:** Sixty adults with MS (87% female; mean age of 46 years, SD=10.8, range 31-76 years) participated in this study. The majority were White (n=47; 75%) with mean disease duration of 11 years (SD=7.2) and mean EDSS score of 2 (SD=2.31). Sleep quality varied widely with 36 (60%) reporting poor sleep (mean=7.20, SD=4.00), Thirty-two (53%) participants reported substantial fatigue (mean=36.65, SD=14.95). Depressive symptoms ranged from 1-45 (mean=16.47; SD=9.04) with 32 (53%) at risk for depression. There was no significant relationship between circadian rhythm or sleep quality and depression (X²=1.41, p=.49; X²=1.36, p=.23). The association between fatigue and depression was significant (X²=7.89, p=0.005). The odds of having depressive symptoms were 2 times higher (CI 62-6.5) for those with abnormal circadian rhythm, 1.8 times higher (CI 65-5.3) among those with poor sleep quality, and 4.60 times higher for those with significant fatigue (CI 1.5-13.7).

**Conclusion:** Our findings suggest that circadian rhythm disorders, poor sleep quality, and fatigue increase the odds of depression among adults with MS and low disability. Further research focusing on depression using analytical approaches to investigate multilevel determinants is needed among adults with MS across the disability range.

**Support (If Any):** Saint Louis University Health Sciences and Patricia H. Garman Grant from the University at Buffalo

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**0950**

DO PSYCHOLOGY EXPERIMENT BUILDING LANGUAGE TEST BATTERY EXECUTIVE FUNCTION TASKS SIGNIFICANTLY DISCRIMINATE INSOMNIA PATIENTS WITH FRONTOTEMPORAL SYNDROME FROM HEALTHY CONTROLS MATCHED ON AGE, GENDER, AND EDUCATIONAL LEVEL?

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**Introduction:** The process of normal aging affects both sleep and executive functioning (EF). Interestingly, EF seem to be sensitive to individual differences in sleep, and tend to show the greatest age-related deficits (Buckner, 2004). Moreover, sleep disorders appear to be frequent comorbidities in patients with frontal lobe syndromes. Although mechanisms underlying these associations are not yet clear, poor sleep is a risk factor for cognitive decline. Thus, examining the role of EF in age-related executive deficits may be important in order to identify possible indicators of subsequent global cognitive decline. Along these lines, the availability of an open source software system for neuropsychological testing may be a major aid. Against this background, the present study aimed for comparing the performance of selected Psychology Experiment Building Language Test Battery (PEBL) EF tasks across frontal lobe syndromes and healthy controls matched on age, gender, and education level.

**Methods:** Twelve consecutively-admitted patients (male: 66.7%; mean age = 68.17 years, SD = 10.53 years) who suffer from a sleep disorder and frontal lobe syndromes were administered the PEBL version of the Berg's (“Wisconsin”) Card Sorting Test (WCST) and the Tower of London Task (ToL). Their performance was compared to the performance obtained in community-dwelling participants who were matched on age, gender and educational level.

**Results:** WCST number of categories completed, U=30.00, rank rₜ=58, p<.05, total number of errors, U=25.00, rank rₜ=65, p<.05, number of unique errors, U=35.50, rank rₜ=51, p<.05, and CLR, U=24.50, rank rₜ=66, p<.05, and ToL time, U=26.00, rank rₜ=64, p<.05, significantly discriminated cases from healthy controls.

**Conclusion:** Our findings underscore the potential usefulness of the EF tests included in a free of charge neuropsychological platform (i.e., PEBL) and the need for considering the relationship between aging and EF.

**Support (If Any):** none

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**0951**

A PILOT STUDY FOR IN-PATIENT SCREENING OF STROKE PATIENTS FOR OBSTRUCTIVE SLEEP APNEA IN A COMMUNITY HOSPITAL, AND TO ASSESS FOLLOW UP OF SUSPECTED OSA

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**Introduction:** Obstructive sleep apnea (OSA) is a major risk factor for incident as well as recurrent stroke, and for increased mortality at 10 year follow up. Most hospitals do not routinely screen for OSA in the acute stroke population, potentially missing this important risk factor. With this quality improvement project, we aim to screen for OSA in the inpatient stroke population, and assess likelihood of referral of stroke patients to an outpatient sleep clinic or sleep study, within 6 weeks of discharge from the hospital.

**Methods:** This is an ongoing study to screen all eligible patients who have been admitted to JFK Medical Center stroke unit, with MRI-proven acute ischemic stroke. The nurses take consent and screen patients for OSA using the STOP-BANG questionnaire. A score of >5 is considered at "high" risk. Patients are informed about their score and provided a prescription by the admitting physician, that refers them to an outpatient sleep clinic or a sleep study. The investigators do phone follow up of these patients to assess likelihood of such patients scheduling a sleep clinic/study appointment within 6 weeks after discharge from the hospital.

**Results:** Between Oct 22nd, 2018 to current, 178 patients were admitted to the stroke unit for symptoms suspicious of ischemic stroke. Ages ranged from 25 - 92 years (average 66.5 years). 86 patients (52.7%) were female. 24 patients met inclusion criteria of MRI-proven ischemic stroke. Of those, 3 patients consented to being screened for OSA. Of these, 2 had STOP-BANG scores above 5, and therefore qualified for referral to an outpatient sleep clinic.

**Conclusion:** This ongoing quality improvement project aims to identify rates of referral for sleep evaluation, of stroke patients for
who are at high risk for OSA. The ultimate goal of the project is to develop a network-wide protocol for screening of OSA in patients admitted for acute stroke, and establish practical methods for outpatient referral and diagnosis.

Support (If Any): none

Factors Accounting for the Relationship Between OSA and Cognition

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Introduction: A common concern in individuals with obstructive sleep apnea (OSA) is impaired cognitive functioning. Because multiple comorbidities are often seen in individuals with OSA, and treatment does not always lead to enhanced cognition, the main contributor of cognitive decline is uncertain. The purpose of this study was to determine the impact of comorbidities on the effectiveness of CPAP intervention and cognitive improvement in individuals with OSA.

Methods: We screened 18 OSA patients (AHI = 35.8 ± 21.4) free of cardiovascular diseases and not on any type of substance that can alter cognition. Testing procedures included objective measurements of arterial stiffness using pulse wave velocity (VaSera 1500, Fukuda Denshi, Tokyo, Japan), followed by two cognitive tests to evaluate executive functioning ([Stroop Color-Word Test (SCWT)] and psychomotor speed [Digit Symbol Substitution Test (DSST)]). Assessments were performed at baseline and after 2 and 4 months of CPAP/APAP treatment.

Results: Patients had the same weight at two months (101.6 ± 13.4 kg) and four months (102.4 ± 15.5 kg) compared to baseline (105.3 ± 17.0 kg), p = 0.1. Blood pressure was not changed throughout treatment, 138.8 ± 11.8 mmHg vs 143.0 ± 17.0 mmHg vs 135.3 ± 14.9 mmHg, p = 0.2. Also, cardio-ankle vascular index (CAVI) did not decrease with treatment, 7.7 ± 1.1 vs. 7.2 ± 1.5 vs 7.4 ± 1.7, p = 0.3. Significant improvements in executive functioning were seen at two (39.3 ± 5.1) and four months (40.5 ± 7.4) following CPAP treatment compared to baseline (33.8 ± 5.3). Psychomotor speed improved after four months, 51.0 ± 7.7 vs 46.1 ± 6.9, p = 0.0001. Just one patient had diabetes at baseline, however his status was not reassessed after treatment.

Conclusion: Improvement in cognitive function after CPAP intervention was likely not caused by changes in cardiovascular indices, diabetes or weight. This suggests that intermittent hypoxia and sleep fragmentation, when abolished by the CPAP/APAP treatment, are sufficient to improve the cognitive profile in patients with OSA.

Support (If Any): N/A

Treatment of Obstructive Sleep Apnea with Positive Airway Pressure to Improve Cognitive Function in Mild Cognitive Impairment

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Introduction: Obstructive Sleep Apnea (OSA) is felt to be a risk factor for developing cognitive impairment, including Mild Cognitive Impairment (MCI). Limited evidence demonstrates that Positive Airway Pressure therapy (PAP) may improve cognitive function in this population. The purpose of this study was to determine if treatment of OSA with PAP in patients with MCI delays progression to dementia.

Methods: This was a retrospective chart review of subjects diagnosed with MCI and OSA (with PAP recommended) who and had attended clinic between 01/2011 and 12/2017. Charts were reviewed for Clinical Dementia Rating (CERAD) scores, sleep study results and PAP compliance.

Results: Analyses were performed on 99 subjects. The mean age at MCI diagnosis was 70.5 years, more were male and Caucasian. 27% patients did not use PAP. 30% were non-compliant and 42% were compliant (used PAP for average of more than 4 hours a night). 28 patients progressed to dementia. Although the median time to dementia progression was longer for patients with no PAP use (47.3 months) and PAP non-compliant use (52.1 months) than for patients with CPAP use (77.3 months), there was no statically significant difference from progression to dementia with the use of PAP therapy. Regression models did not show a difference between the groups for Trails A and B and CDR sum of boxes. The progression to dementia in MCI subjects was significant, with patients with amnestic MCI having shorter progression time and that the subjects with amnestic MCI had higher rates of CPAP use. None of the analyses done within the amnestic and non-amnestic groups to assess the relationship between CPAP use and progression to dementia were significant.

Conclusion: The use of PAP therapy showed a trend in slowed progression to dementia, but was not significant in improving cognitive function in this patient population. The study is limited by small number of compliant patients.

Support (If Any): none

Association Between Sleep Disturbance in Alzheimer’s Disease Patients and Burden on and Health Status of Their Caregivers

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Introduction: Sleep disturbance in Alzheimer’s disease (AD) patients may have a negative impact not only on patients themselves but also on the physical and mental health of their caregivers. This study investigated the association between sleep disturbance in AD patients and the burden imposed on the caregivers and their health status in Japan.

Methods: We conducted a cross-sectional web-based questionnaire survey among caregivers of AD patients with insomnia symptoms in Japan. Demographic data and sleep disturbance of AD patients (Sleep Disorders Inventory (SDI)), burden (Burden Index of Caregivers-11 [BIC-11]) and health status of caregivers, including sleep quality (Pittsburgh Sleep Quality Index), depressive state (Patient Health Questionnaire-9) and physical/mental quality of life (12-Item Short Form Health Survey), were collected. Multivariate analysis was used to examine the association between the burden and health status of caregivers and sleep disturbance in their care recipients with AD.

Results: A total of 496 caregivers of AD patients with insomnia symptoms were examined in this study. We found that the BIC-11 total score increased as the SDI score increased, indicating a significant positive association, even after adjusting for confounding factors. Similar patterns were observed for subdomain of BIC-11 (time-dependent, emotional, existential, physical, service-related,
and total care burdens). We also found an association between sleep disturbances of AD patients and health of caregivers.

**Conclusion:** This study demonstrated that sleep disturbance in AD patients was associated with an increased burden and poorer health status of caregivers, suggesting the importance of understanding sleep disturbances in AD patients. Traditionally, sleep disturbances in AD patients have been treated as a part of the BPSD (behavioral and psychological symptoms of dementia) spectrum; however, our results suggest the importance of focusing on sleep disturbances from the perspective of their burden on caregivers and the impact on their health.

**Support (If Any):** This study was funded by MSD K.K., Tokyo, Japan.

**0955**  
**SUBJECTIVELY REPORTED BARRIERS TO SLEEP IN PEOPLE WITH SPINAL CORD INJURIES**

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**Introduction:** Poor sleep is highly prevalent in people with spinal cord injury (SCI) and has been associated with multiple adverse health outcomes. Little attention has been focused, however, on the circumstances specific to SCI that may impact sleep. The purpose of this study was to examine the experience of sleep among individuals with SCI.

**Methods:** Secondary analysis of qualitative data from an ethnographic study of 20 community-dwelling adults with SCI. Participants in the primary study were recruited from a rehabilitation facility specializing in treating SCI. Data were collected through unstructured interviews and naturalistic observation; average data collection window was two years. For this analysis, all transcripts and field notes were reviewed, and sections relating to sleep were extracted and formatted for coding. Transcripts were reviewed and independently coded by at least two researchers. The research team then discussed the codes and identified overarching themes. After coding was finalized, transcripts were re-coded as needed.

**Results:** Sleep-related data were found in transcripts for 90% of the sample. Participants described their sleep in terms of characteristics of both insomnia (initial and maintenance, non-restorative sleep) and circadian rhythm disorders (frequent daytime sleep, highly variable sleep/wake patterns). Factors contributing to poor sleep were identified and included SCI-related dysfunction and care, sleep environment, and comorbid conditions (pain, anxiety, and depression). Unexpectedly, multiple participants reported using daytime sleep to reduce boredom and/or avoid aversive situations.

**Conclusion:** Cognitive behavioral therapy for insomnia (CBT-I) has been shown to be effective in improving sleep in the general population and in multiple clinical populations. However, its efficacy in those with SCI has not been demonstrated, and findings from this analysis suggest that tailoring CBT-I to the unique needs of this population would maximize its efficacy. Significant attention should be paid to increasing homeostatic sleep drive, and standard stimulus control procedures would need to be adapted to accommodate motoric limitations. Finally, problem-solving strategies to address issues related to sleep surfaces and environments would need to be included in the treatment protocol.

**Support (If Any):** NIDRR/DoE (H133G00062); NICHD/NIH (K01HD076183); AHRQ (K01HS022907)

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**0956**

**PREVALENCE OF NOCTURNAL TACHYARRHYTHMIAS AND LONG-TERM FUNCTIONAL OUTCOME IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME AND ACUTE ISCHEMIC STROKE**

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**Introduction:** Stroke is a major cause of disability and death worldwide. The obstructive sleep apnea syndrome (OSAS) is a known risk factor of stroke. The prevalence of OSAS is high in stroke patients and has been related to atrial tachyarrhythmias. Arrhythmias during sleep occur frequently in OSA patients, even though the prevalence of OSAS and sleep tachyarrhythmias in stroke patients and its relationship with the long-term functional outcome is not clear. The aim of our study was to identify the prevalence of atrial arrhythmias during sleep in patients with OSAS and acute ischemic stroke as well as its repercussion in the functional recovery.

**Methods:** Prospective cohort of consecutive patients with acute ischemic stroke. We performed 24-hour cardiac monitoring along with a portable sleep study. An apnea/hypopnea index (AHI) > 15 was used to establish the diagnosis of OSAS. Atrial arrhythmias were defined as cardiac rhythm variants that had the impulse formation or reentry circuit originated above the bifurcation of the bundle of His. All tachyarrhythmias (sinus tachycardia, supraventricular tachycardia, atrial fibrillation, atrial flutter) present during sleep were included. An evaluation at 3 and 6-months after the patient’s hospital discharge was carried out to evaluate their functional independence.

**Results:** A total of 56 patients with a mean age of 60.3 ±14.4 were included. We classified 32 (57%) subjects with OSAS. Risk factors for OSAS did not differ between groups. Prevalence of atrial tachyarrhythmias during sleep (p= 0.001) was significantly higher in patients with OSAS. Patients with OSAS and tachyarrhythmias had a worse NIHSS (p= 0.043) and Rankin at discharge (p= 0.005) and presented poorer functional independence at 3 (p= 0.006) and 6-months (p= 0.016).

**Conclusion:** Prevalence of arrhythmias is frequent in patients with obstructive sleep apnea syndrome and acute ischemic stroke. Its clinical relevance impacts on the functional long-term outcome. Therefore, the identification of OSAS and arrhythmias must be prioritized in acute stroke patients. Further studies with a large population are needed to support our findings.

**Support (If Any):**

**0957**

**“TO BE, OR NOT TO BE?” CASE SERIES OF PATIENTS WITH DISCREPANCY BETWEEN CLINICAL VS. PSG CRITERIA FOR DIAGNOSIS OF REM BEHAVIOR DISORDER (RBD).”**

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**B. Clinical Sleep Science and Practice**

**Introduction:** The ICSD 3 lists the presence of REM without atonia (RWA) on PSG, as an essential criterion for the diagnosis of RBD. However, the scoring criteria for RWA are not clearly defined in the AASM scoring manual (2012). We describe three patients with clinical diagnosis of RBD, who did not fulfill the PSG criteria for RWA. They reported improvement on treatment with melatonin.

**Methods:** These three males, aged 68, 73 and 73 years, complained of >1 year history of witnessed semi-purposeful behaviors in sleep, that correlated with their dream content. One patient had a history of Parkinson’s Disease (PD) with worsening episodes, despite being on dopaminergic therapy. All three patients underwent PSG with Multiple Muscle Montage (MMM) which includes upper extremity EMG, in our lab.

**Results:** All 3 patients PSG’s revealed excessive transient muscle activity in some epochs of REM sleep as defined by AASM manual, but these epochs did not add up to >50% of the total REM epochs, and hence did not meet the PSG criteria for RWA in our lab. Of these, 2 patients had neither OSA nor PD. In 1 of the 2 PSG’s, dream enactment behavior (DEB) was noted. The PD patient had mild OSA and underwent a CPAP study with MMM, which revealed DEB but also did not meet the criteria for RWA.

**Conclusion:** The AASM definition of RWA is deficient in specifying: 1) the percentage of total REM epochs that should show excessive twitching 2) the minimal duration of REM sleep required for application of this definition 3) whether the definition is applicable if the patient has comorbid OSA or is on dopaminergic medications 4) whether the montage for assessment of RWA should include upper extremities EMG. These deficiencies may lead to underestimation of RBD in some labs, and reduced inter-scorer reliability between labs. Hence, further clarification of the definition is needed before RWA is deemed as an essential criterion for the diagnosis of RBD.

**Support (If Any):**

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**0958**

**EFFECTS OF CPAP ON EEG DELTA FREQUENCY IN PATIENTS WITH RBD: A DESCRIPTIVE CASE SERIES**

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**Introduction:** Obstructive sleep apnea (OSA) and idiopathic rapid eye movement (REM) sleep behavior disorder (iRBD) have been associated with increased risk for mild cognitive impairment (MCI) and dementia. We are interested in identifying the electroencephalographic (EEG) changes in patients with iRBD and OSA when they are treated with continuous positive airway pressure (CPAP). We hypothesized that there would be less delta activity in REM sleep with CPAP treatment.

**Results:** of >1 year history of witnessed semi-purposeful behaviors in sleep, that correlated with their dream content. One patient had a history of Parkinson’s Disease (PD) with worsening episodes, despite being on dopaminergic therapy. All three patients underwent PSG with Multiple Muscle Montage (MMM) which includes upper extremities EMG, in our lab.

**Conclusion:** Our findings suggest that there are significant EEG changes in patients with IRBD and OSA with the treatment of CPAP. The overall increase in delta wave frequency in REM sleep stage might be indicative of encephalopathy with possible cognitive consequences in these patients. Subsequent decrease in delta frequency might be due to the beneficial effect of CPAP.

**Support (If Any): None**

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**0959**

**PREVALENCE OF COGNITIVE DEFICITS IN OLDER PATIENTS WITH SLEEP APNEA IDENTIFIED BY A SLEEP LAB QUESTIONNAIRE AND TELEPHONE INTERVIEW**

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**Introduction:** The prevalence of memory complaints in patients with sleep apnea has important ramifications for patient care. We assessed this using a two-item screen and the Modified Telephone Interview for Cognitive Status (TICS).

**Methods:** Data from the screening database for a multi-site study, Memories2, was used. Subjects ages 60-85 with an AHI or REI≥15 events/hr answered two questions prior to their sleep study: (1) “Does someone help you keep track of your appointments or medications?”; (2) “Do you have, or has someone told you that you have problems with thinking and/or memory?” Subjects were then contacted to complete the TICS; education-adjusted TICS scores below 32 screened as positive for cognitive impairment.

**Results:** We identified 224 subjects age≥60 with an AHI or REI≥15 events/hour who answered the two-item screen: 41.5% (n=93) said “YES” to at least one of the two questions; 27.2% (n=61) said “YES” to question 1; 26.8% (n=60) said “YES” to question 2; and 12.5% (n=28) said “YES” to both questions. We performed a TICS in 29. Reasons for non-completion were: 21.0% not interested (n=41), 58.5% unreachable or other (n=114), and ineligible for parent study (20.6%, n=40). 24.1% (n=729) of the TICS were positive for cognitive deficits. Neither of the two screening questions were associated with the TICS score (p=0.69 and p=0.75, respectively).

**Support (If Any): None**

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**X. Sleep and Neurologic Disorders**

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that 85.7% (6/7) were previously unrecognized (did not have a documented memory complaint or diagnosis in the EMR).

**Conclusion:** Our findings indicate that 24.1% (7/29) of older patients with an AHI or REI≥15 events/hr had cognitive deficits. 85.7% (6/7) of this group had no prior documented memory impairment diagnosis. This highlights that older adults with sleep apnea may suffer from unrecognized cognitive impairments, and cognitive screening with established tools, such as the TICS, may be warranted.

**Support (If Any):** RO1AG054435. Submitted on behalf of the Memories2 Study Investigator Team.

**0960**

**INTERACTIVE ASSOCIATIONS OF OBSTRUCTIVE SLEEP APNEA AND HYPERTENSION WITH LONGITUDINAL CHANGES IN B-AMYLOID BURDEN AND COGNITIVE DECLINE IN CLINICALLY NORMAL ELDERLY INDIVIDUALS**

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**Introduction:** We determined whether the co-occurrence of OSA and hypertension interact synergistically to promote β-Amyloid burden and cognitive decline in clinically normal older adults.

**Methods:** Prospective longitudinal study utilizing NYU cohort of community-dwelling cognitively-normal elderly, with baseline and at least one follow-up of CSF-Aβ42 (measured using ELISA), and neuropsychological visits. OSA was defined using AHI≥4%. Hypertension diagnosis was according to AHA-guidelines. Cognitive variables assessed included Logic-2, Animal-Fluency [VF], Vegetable-Fluency [VF], Boston-Naming-Test [BNT], Digit-Symbol-Substitution-Test [DSST], Trails Making Test-A and B [TMT-A and B]). Linear mixed-effects models with random intercept and slope were used to assess associations between OSA, hypertension, and longitudinal changes in CSF-Aβ and cognition, controlling for age-at-baseline, sex, APOE4-status, years-of-education, and their interactions with time.

**Results:** Of the 98 participants, 63 (64.3%) were women. The mean (SD) age was 79.6 (7.3) years and follow-up time was 2.46 (0.64) years. OSA and hypertension were each associated with faster rate-of-change in CSF-Aβ42 (β = -3.11; 95% CI, -3.71, -2.51; and β= −2.82, 95% CI -3.29, -2.35, P < .01 for both respectively). The interaction of OSA and hypertension with time was significant (β= −1.28, 95% CI -1.78 to -0.78, P < .01) suggesting a synergistic effect. No significant associations were seen between annual-changes in CSF-Aβ42 and cognitive-decline. However, faster decline in VF, and DSST were associated with OSA (β = −0.054; 95% CI, -0.094, -0.013; P = .02; β = −0.058; 95% CI, −0.084, −0.033; P < .05 for both respectively), and with hypertension (β = −0.048; 95% CI, −0.079, −0.017; P = .04; β = −0.078; 95% CI, −0.098, −0.057; P = .002; respectively). The interaction of OSA and hypertension with time was significant for both VF and DSST (β = −0.033, 95% CI, −0.048, −0.018; P < .001 and β = −0.040, 95% CI, −0.064, −0.016; P < .001, respectively), suggesting a synergistic effect.

**Conclusion:** In cognitive-normal elderly OSA individuals, vascular risk may complement AD-biomarkers in assessing risk of prospective cognitive-decline in preclinical AD.

**Support (If Any):** NIH/NIA/NHLBI-T32HL129953, RO1AG056031, R01HL118624, and K07AG052685

**0961**

**RANGE AND REPRODUCIBILITY OF EEG BIOMARKERS FOR COGNITION ACROSS FIVE YEARS.**

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**Introduction:** Multiple EEG markers are reported to associate with cognition and/or cognitive decline, including spindle frequency, and alpha-intrusion. Also, at similar technical settings amplitude of the EEG signal varies considerably across individuals, and an index that describes the extent of this natural amplification (overall power) was also identified as a risk factor for dementia. Here, we determined the range and reproducibility of these features over five years in a community-based sample.

**Methods:** We utilized algorithms available in a commercial scoring system to determine EEG features in 2,647 subjects of the Sleep Heart Health Study who underwent baseline and follow-up polysomnography approximately 5 years apart. Spindles are identified using a validated detector. Their characteristics are expressed as density (sum of spindles in C3 and C4 per minute of NREM stage 2), duration (seconds), peak power (μV²), and dominant frequency (Hz). Alpha intrusion is percent of 3-second NREM epochs with alpha power >30 μV². Overall power is the average of 7 ratios representing ratios of power in 7 frequency ranges in the subject to average power in the corresponding ranges in the entire cohort. Intra-class correlation coefficients (ICC) were calculated to evaluate feature reproducibility between baseline and follow-up.

**Results:** Average (Range: 5th- 95th percentile) of spindle characteristics at baseline were: Density 4.6(6)minute (0.8-10.2); Duration 1.33 second (1.25-1.43); Peak power 28.9 μV² (15.6-47.0); Dominant frequency 12.0 Hz (11.1-12.9). After 5 years, density decreased 0.31±0.79/minute, power decreased 1.2±5.9 μV², frequency decreased 0.22±0.4 Hz and duration increased 0.01±0.05 second (p<0.0001 for all). ICCs for spindle metrics were 0.83 for density, 0.63 for duration, 0.80 for power and 0.73 for frequency. Alpha intrusion index was 4.1% (0-18) at baseline, decreased 0.1±4.8% after 5 years and ICC was 0.83. Overall EEG power was 0.87 (0.47-1.44) at baseline with no significant change after 5 years and ICC was 0.77.

**Conclusion:** Spindle characteristics, alpha intrusion index and overall EEG power vary over very wide ranges among individuals but show high within individual correlations across 5 years, suggesting “trait-like” properties.

**Support (If Any):** AASM Foundation (194-SR-18), NHLBI R24 HL114473

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OBJECTIVE DAYTIME SLEEPINESS IS ASSOCIATED WITH DISEASE SEVERITY AND INFLAMMATION IN PATIENTS WITH MILD TO MODERATE DEMENTIA

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Introduction: It has been reported that patients with Dementia are sleepier and that daytime sleepiness is associated with worse cognitive performance. Inflammatory markers may be elevated in patients with cognitive impairment and have been proposed as mediators of excessive daytime sleepiness (EDS). The aim of this large, controlled study was to examine the association of sleepiness with cognitive performance and peripheral markers of inflammation in patients with dementia.

Methods: A sub-sample of 46 patients with mild-to-moderate Dementia [mean age:80.3 (SD=5.6) years, 40% males] and 85 cognitively intact controls (NI) [mean age:73.0 (SD=7.4) years, 37% males], were recruited from a large, population-based cohort in the island of Crete, Greece of 3,140 older adults (≥60yrs). All participants underwent medical history/physical examination, extensive neuropsychiatric and neuropsychological evaluation, 3-day 24-h actigraphy and a single morning measure of IL-6 and TNFα plasma levels. Comparisons of sleep parameters and inflammation markers between Dementia and NI, and between nappers and non-nappers within each diagnostic group, were made using ANOVA controlling for demographics. Associations between inflammatory markers, sleep variables, and neuropsychological performance were assessed within each group using Partial Correlation analysis controlling for demographics, depression, use of psychotropic medications, and sleep apnea symptoms.

Results: Dementia patients compared to NI had marginally significant longer nap total sleep time (TST) (76.7±7.0min vs. 60.9±8min, respectively, p=0.2). Also, within Dementia patients, nappers compared to non-nappers had significantly worse performance in autobiographic memory scale (p=0.002), digits reverse (p=0.007), AVLT retention (p=0.010), and assessment of daily function (p=0.012). Finally, IL-6 levels were significantly associated with nap TST within Dementia patients (r=0.500, p=0.01), while no significant associations were found between IL-6 and sleepiness within the NI group.

Conclusion: These data indicate that IL-6 plasma levels in patients with Dementia are associated with increased daytime sleepiness. In demented patients, objective sleepiness may be a biologic marker of the severity of the disease.

Support (If Any): National Strategic Reference Framework (ESPA) 2007-2013, Program: THALES, University of Crete, title: “A multi-disciplinary network for the study of Alzheimer’s Disease” (Grant :MIS 377299)
0964
INTRODUCING A SLEEP VITAL SIGN BASED ON A SIMPLE 2-QUESTION SURVEY FOR UTILIZATION IN A PRIMARY CARE CLINIC
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Introduction: We introduce a sleep vital sign (SVS) based on a simple 2-question survey developed to improve recognition of patients with sleep disorders in a primary care setting and to longitudinally track sleep-related outcomes.

Methods: A 2-question survey was developed: 1) “How many days a week are you NOT satisfied with your sleep?” (SVS1); 2) “How many days a week is sleepiness a problem?” (SVS2). The primary aim of the study is to determine whether implementation of the SVS in a primary clinic can improve the rate of sleep disorder diagnosis. Consecutive patients checking into the clinic were randomized to: 1) SVS group - received SVS and sleep history questionnaire that includes validated sleep surveys; 2) control group - usual care. This study reports the SVS results and compares SVS to validated sleep surveys. Comparison of diagnostic rates to control group is currently pending and not reported here.

Results: N=262 patients (53.5±17.6 years; 69% women) completed the SVS and additional questionnaires. Mean SVS1 and SVS2 were 3.2±2.6 and 2.7±2.7; there were no statistically significant differences due to age, gender, race, marital status, employment status, nor level of education. Significant incremental increases in mean scores of Epworth Sleepiness Scale (ESS) (p<0.001 for both SVS1 and SVS2), Insomnia Severity Index (ISI) (p<0.001), Functional Outcomes of Sleep Questionnaire (FOSQ10) (p<0.001), and STOP-BANG (SVS1 p=0.12, SVS2 p=0.03), were seen with each increase in SVS1 and SVS2 scores. When defining a “positive screen” if either SVS1 or SVS2 is ≥4 (≥3), 73% (80%) of patients with an ESS≥11 were positive for SVS, 50% (60%) of patients with a STOP-BANG≥3 were positive for SVS, and 79% (91%) of patients with an ISI≥8 were positive for SVS.

Conclusion: A sleep vital sign, based on a 2-question survey, is a simple method of screening for sleep disorders in a primary care clinic. Corresponding trends in SVS scores and various validated sleep surveys were observed, supporting its potential utility as a general sleep disorder screening tool.

Support (If Any): N/A

0965
NO-SHOW RATES TO A SLEEP CLINIC: DRIVERS AND DETERMINANTS
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Introduction: Attendance to sleep clinic appointments is imperative to accurately diagnose sleep-related disorders and offer appropriate treatment. As part of our quality assurance program, we assessed predictors of no-show rates at our sleep clinic. We hypothesize that no-show rates can be predicted by appointment type (new vs. established), insurance status, age, sex, appointment time, day of the week, and season.

Methods: We performed a 10-month, retrospective chart review of patients scheduled at Saint Louis University’s SLUCare Sleep Disorders Center. Multivariable logistic regression was used to determine which factors were independently associated with no-show rates.

Results: 2,532 patient charts were reviewed and the overall no-show rate was 21.2%. Factors that were associated with a higher incidence of no-show rates included appointment type (new 39.1% vs. established 28.8%, p<0.0001) and insurance status (no insurance 47.5% vs. public 28.3% vs private 24.2%, p<0.0001). Multivariable logistic regression confirmed associations between no-show rates and new patient status (adjusted OR=2.96, 95%CI: 2.18-4.03) and the absence of health insurance (adjusted OR=1.74, 95%CI: 1.33, 2.27). Age, sex, appointment time, day of the week, and season did not significantly influence no-show rates.

Conclusion: Independent predictors of no-show appointments included new patient status and lack of health insurance. Our findings will aid future efforts to identify patients with high predictors of nonadherence. Further studies are needed to develop methods to decrease no-show rates once high risk appointments have been identified.

Support (If Any): Other studies have described factors that influence no-show rates, although none have specifically addressed no-shows for sleep medicine appointments. Knohlhoff et al found that patients with limited health literacy and cigarette smoking had higher no-show rates (1). Drewek et al found that appointments scheduled for 30 days or greater had a higher chance of no-show (2). No-show rates increase the cost of healthcare. Kheirkhah et al analyzed no-show data and found that increased no-show rates occurred at subspecialty clinics, equaling a cost of approximately $196 per no-show (3). Reducing no-show rates can improve quality outcomes by maximizing access to care and reducing overall healthcare spending.

0966
NAVIGATING THE PATH TO PRIMARY CARE INVOLVEMENT IN THE CARE OF STABLE OBSTRUCTIVE SLEEP APNEA PATIENTS
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Introduction: Follow-up care of patients with obstructive sleep apnea (OSA) on positive airway pressure (PAP) therapy has become increasingly complex due to regulatory requirements and primary care provider experience in this area may be limited. We present a project aimed to facilitate primary care management of stable PAP users at our institution.

Methods: A multidisciplinary workgroup of key stakeholders was formed with representation from sleep medicine and primary care, including physicians, a nurse manager, operations administrator, laboratory supervisor, appointment office manager and financial analysts. The group evaluated existing patient volumes and workflows for chronic management of OSA. Analyses reflected a very high rate of established patients returning for follow-up (76%); of these 64% were stable OSA patients on PAP treatment who were not receiving specialized or new interventions. As a tertiary sleep center practice, it seemed most practical to develop a care pathway for patients with established primary care services within our institution. Our group established criteria...
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for identification of stable OSA patients on PAP therapy that could be transitioned back to primary care. A care process model was developed for provider reference. Relevant educational material relating to PAP download reports, PAP troubleshooting, prescription requirements/insurance visit guidelines and reasons for referral back to sleep medicine, were placed on the institutional website. Communication plans were developed and methodology for transfer of care implemented.

Results: Initial implementation of the project resulted in an increase of 6 new consultation appointments a week (312/year) at the sleep center and a 14% reduction in follow-up appointments with a projected financial improvement of $263,841/year. Primary care teams were hesitant about assuming responsibility for long-term care of OSA and patients accepted the transition.

Conclusion: With the growing number of patients requiring longitudinal care for OSA, it is imperative to explore how and when transitions from sleep specialty services to primary care should occur. This project proposes steps to standardize the process and collaborate effectively with primary care colleagues; thereby assuring patients achieve competent care in the transition.

Support (If Any):

0967
PERCEPTION OF SLEEP DISORDERS AND ATTITUDE TOWARDS SLEEP MEDICINE SPECIALTY IN INTERNAL MEDICINE, PSYCHIATRY, FAMILY MEDICINE, PEDIATRICS & NEUROLOGY RESIDENTS IN INDIANA UNIVERSITY RESIDENCY PROGRAMS
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Introduction: The US Medical residents’ perception of sleep medicine specialty, their confidence in treating sleep disorders and their interest in pursuing sleep fellowship is largely unknown. Insight into this could help improve policies that govern educational curriculum for residents in training and could help generate more interest in sleep medicine as envisioned by the American Academy of Sleep Medicine.

Methods: An online survey with nine questions was conducted in a single academic center targeting residents of five medical specialties. Descriptive analysis was done for reporting frequency distribution and Fisher’s exact tests for categorical variables.

Results: Response rate of the survey was (42.68%). Most residents (91.97%) confirmed that the burden of sleep medicine is high in the general public and the knowledge of sleep medicine is important in their practice (90.51%). 32.12% stated that they do not get adequate training in sleep disorders in their residencies (91.97%) confirmed that the burden of sleep medicine is high in the general public and the knowledge of sleep medicine is important in their practice (90.51%). 32.12% stated that they do not get adequate training in sleep disorders (P=0.024, earlier trainees stating more disagreement). The associations between years of training and interest in fellowship (P=0.067 with less interest later in residency) and comfort level for treating other sleep disorders (P=0.051 with earlier trainees showing less comfort) were trending towards significance.

Conclusion: The mismatch of the perception of the burden of the disease and the need for proficiency in this field for their practice which comes from completing a sleep fellowship, with no desire to pursue this specialty suggests areas for improvement namely in making sleep fellowship more attractive and in exposure of trainees to adequate sleep literature thereby helping them become more proficient in this field.

Support (If Any):

0968
SCREENING FOR SLEEP APNEA IN HEART FAILURE: RESIDENTS SNOOZE, PATIENTS LOSE!
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Introduction: Obstructive sleep apnea (OSA) is an emerging epidemic in the USA and remains underdiagnosed. Admissions for decompensated heart failure pose a substantial burden on patient-welfare and hospital costs. Current literature emphasizes the importance of screening and treating OSA as an important modifiable risk factor in the management of symptomatic heart failure (NYHA functional class II-IV). We conducted a retrospective analysis of patient records discharged with a diagnosis of acute exacerbation of heart failure in a resident run telemetry unit to estimate the prevalence of screening for OSA.

Methods: Records of patients discharged with a diagnosis of decompensated heart failure from a resident run telemetry unit of a teaching hospital were reviewed from August 2018 to December 2018. 109 such records were reviewed in our analysis. Analysis variables included age, gender, body mass index (BMI) and known history of OSA. Records in the form of discharge summaries and pulmonary consultation notes were reviewed for documentation of the STOP-BANG score (a validated OSA screening tool) and OSA diagnosis.

Results: 12 of 109 patients (11%) had an established diagnosis of OSA. 3 of the remaining 97 patients (3%) were screened by residents for OSA. No chart had STOP-BANG score documentation. 15 of 97 patients with no history of OSA were evaluated by a pulmonologist during the admission. 3 of these 15 patients (20%) were screened for OSA as documented in the pulmonary consult note. None of these 3 patients had screening for OSA documented in the residents’ discharge summary.

Conclusion: Results of the analysis revealed that in heart failure patients without a known diagnosis of OSA, 3% of records had resident documentation of OSA screening. Screening increased to 20% amongst patients evaluated by a pulmonologist. Despite current recommendations to screen for OSA in NYHA functional class II-IV heart failure, the results demonstrated a low compliance amongst residents (3%) and pulmonologists (20%). This study highlights the lack of documentation and failure to screen for this modifiable risk factor and a need for increased awareness amongst residents and attendings.

Support (If Any): None
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0969 ATTENTIONAL FAILURES ARE CORRELATED WITH SERIOUS MEDICAL ERRORS IN RESIDENT PHYSICIANS

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Introduction: First year postgraduate (PGY1) resident physicians have impaired vigilance and more attentional failures working extended duration work rosters (EDWR) with 24+ hour extended-duration shifts compared to shifts scheduled to 16 or fewer hours. We examined the impact of a rapid cycling work roster (RCWR) intervention designed to limit continuous work to 16 hours maximum in PGY2 and PGY3 resident physicians.

Methods: Resident physicians participated in a multi-center cluster-randomized crossover clinical trial of six U.S. pediatric intensive care units. Participants worked ~4-week rotations either EDWR or RCWR schedules. Participants (n=294, 173 females; 358 resident-physician rotations) completed sleep and work logs daily, and the 10-minute psychomotor vigilance task (PVT) and the Karolinska Sleepiness Scale (KSS) approximately at the start, during, and end of selected work shifts. Resident-physician associated serious medical errors (SMEs) were identified using both direct observation and chart review and adjudicated by independent physician-reviewer pairs (k range: 0.52-0.67).

Results: On the RCWR intervention, attentional failures (lapses in reaction time ≥500 msec), mean reaction time, and subjective sleepiness were significantly improved relative to EDWR (p<0.04). Neurobehavioral performance was better under the RCWR throughout the work shift and across the 4-week rotation (p=0.0001). Attentional failures measured on the PVT were on average significantly correlated with resident-physician-related SMEs during the rotations (p=0.04), as assessed from observation and retrospective chart review. While a significantly higher rate of SMEs was observed under the RCWR, after adjusting for resident-physician workload (i.e., ICU patients per resident physicians) in a post-hoc exploratory analysis, RCWR had a significantly protective effect on error rates [RR 0.51 (95% C.I. 0.32 - 0.82)] compared to EDWR, although this result depended on how workload was measured and included in our model.

Conclusion: RCWR implementation reduces the substantial impairment in neurobehavioral performance and subjective sleepiness associated with the EDWR. These data, and their correlation with serious medical error rates, highlight the impairment of neurobehavioral performance that occurs when resident physicians work extended-duration shifts, and have important implications for patient safety.

Support (If Any): NIH-NHLBI U01-HL-111478 and U01-HL-111691.

0970 RESIDENT PHYSICIAN WORK HOURS DECREASED AND SLEEP DURATION INCREASED FOLLOWING ELIMINATION OF SCHEDULED EXTENDED DURATION SHIFTS

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Introduction: Extended-duration work shifts (≥ 24 hours), the cornerstone of medical education, have been associated with reduced sleep first-year resident physicians in a single-site study. We compared more senior resident physician work hours and sleep habits in a multi-center clustered-randomized crossover clinical trial that randomized resident physicians to an Extended Duration Work Roster (EDWR) with extended-duration (≥24 hours) shifts or a Rapidly Cycling Work Roster (RCWR) where scheduled shift lengths were limited to no more than 16 consecutive hours.

Methods: Across six U.S. academic medical centers, we enrolled 302 resident physicians in their second or more senior postgraduate year. They completed 370 one-month pediatrics intensive care unit rotations. Sleep was objectively estimated with wrist-worn actigraphs. Work hours and subjective sleep duration were reported in an electronic daily diary.

Results: Resident physicians work hours were reduced by 10% during the RCWR (61.9 ± 4.8 hours compared to 68.4 ± 7.4 hours during the EDWR; p<0.0001). During the RCWR, 73% of work hours occurred within shifts of ≤16 consecutive hours. In contrast, during the EDWR 38% of work hours occurred on shifts of ≤16 consecutive hours. Resident physicians obtained significantly more sleep per week on the RCWR (52.9 ± 6.0 hours) compared to the EDWR (49.1 ± 5.8 hours, p<0.0001). The percentage of 24-hour intervals with less than 4 hours of actigraphically measured sleep was 9% on the RCWR and 25% on the EDWR (p<0.0001). During the RCWR, 4% of work hours were preceded by two or fewer hours of sleep in the preceding 24 hours, as compared to 10% of work hours during the EDWR (p<0.0001).

Conclusion: RCWRs were effective in reducing weekly work hours and the occurrence of >16 consecutive hour shifts in more senior resident physicians. Sleep duration was increased and resident physicians were more rested while caring for patients. Additional
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research is needed to optimize scheduling practices that ensure sufficient sleep prior to all work shifts.

Support (If Any): ROSTERS supported by National Heart, Lung, and Blood Institute (U01-HL-111478, U01-HL-111691).

0971

METHODS AND SCHEDULE-RELATED DIFFERENCES IN A MULTI-CENTER TRIAL OF RAPIDLY CYCLING VERSUS EXTENDED DURATION WORK ROSTERS

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Introduction: Extended duration work shifts in resident-physicians may impact safety and performance, but the relative benefits and harms of eliminating extended duration shifts is uncertain.

Methods: We conducted a multi-center, cluster-randomized crossover trial in pediatric Intensive Care Units (ICUs) at 6 academic medical centers to compare two schedules among residents: an extended duration work roster (EDWR) that included some shifts of 24 hours or longer, and a rapidly cycling work roster (RCWR) which eliminated longer shifts. Schedule order was randomly assigned. Patient safety outcomes were tracked by centrally trained physician observers and chart review, and were centrally adjudicated. Resident-related outcomes included sleep and work (based on diaries and actigraphy), alertness (psychomotor vigilance task), and questionnaire-based data on mood, health and resident experience. Patient census data and average number of resident-physicians present daily across the months of data collection at each site were used to assess workload, expressed as average number of ICU patients per resident-physician (IPRP).

Results: A total of 210 and 203 resident rotations (residency program Years 2 and 3) were assigned to RCWR and EDWR, respectively. Compared to residents who refused participation (13 in RCWR; 6 in EDWR), those who participated were more likely to be in residency program Year 3 (p=0.03); all other baseline characteristics including age, gender, race/ethnicity, and medical specialty were similar (p>0.05). Overall baseline characteristics of both residents and patients were similar between the two schedules (p>0.05 for all comparisons). An unanticipated significant difference in resident workload on the two schedules was observed, with mean IPRP of 8.52 on RCWR vs 6.86 on EDWR (p<0.001). Significant site-level variations in IPRP were also observed, with estimates ranging from 4.1 to 10.0 patients per resident-physician on EDWR, and from 5.0 to 13.0 on RCWR.

Conclusion: We successfully completed a multi-center trial to assess the impact of varying resident work schedules on patient safety and other outcomes. Future studies should carefully consider the impact of schedule changes on resident workload.

Support (If Any): NHLBI U01-HL-111478, U01-HL-111691, and the ROSTERS Study Group.

0972

BRIDGING THE GAP OF SLEEP TRAINING FOR MEDICAL LEARNERS

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Introduction: Although the awareness of sleep deprivation and its impact on medical trainee and physician’s performance are gaining visibility in medical world, the training to help sleep related knowledge base and actionable plan are still lacking. The goal of this educational endeavor was to help measure the current level of knowledge regarding impact of sleep and conduct an educational session to facilitate learning amongst trainees.

Methods: A sleep module was designed and introduced for the first time in the mandatory resident training at Hennepin Health Care Hospital, including training programs in Psychiatry, Internal Medicine, Surgery and Emergency Medicine. 54 residents were separated in small groups of about 6-12 people. Each session, an hour long, consisted of a clinical vignette involving a medical trainee struggling due to sleep deprivation. Interactive discussion was facilitated by moderator driven questions. Questions and answers were encouraged throughout. A 5-point Likert scale pre-session survey was administered to measure baseline level of knowledge regarding sleep deprivation, resulting impairment, recognition and mitigation strategies. Post session survey was also obtained to measure the impact of session.

Results: The survey results showed variance in different resident groups. Surgical specialties showed less variance in their pre- and post-survey training assessments. Of note, trainees rated their “recognition” of sleep deprivation as being largely unchanged. Trainees across the board, rated increase in their assessment of strategies and resources to improve sleep after the session. Lastly, the survey revealed that Emergency Medicine (EM) residents were the most affected in terms of their sleep.

Conclusion: Our sleep module demonstrated overall positive impact and a trend towards improvement in the parameters of knowledge of sleep related strategies and resources accessible to medical learners. The conduction of this module also instigated further interest in ED department to conduct separate tailored session for ED residents. It paved the way beyond the duty hour restriction checklist, moving from rules to actually engaging learners in an interactive environment to promote medical trainees’ wellbeing.

Support (If Any): NHLBI U01-HL-111478, U01-HL-111691, and the ROSTERS Study Group.

0973

IMPROVING SLEEP MEDICINE EDUCATION AMONG MEDICAL TRAINEES

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Introduction: Despite increasing recognition of the deleterious health effects of sleep disorders, exposure to sleep medicine education remains limited during medical training. Several tools have been developed and validated to assess sleep knowledge among medical professionals. The two most widely used tools are the ASKME survey (30 True/False questions) and the Dartmouth Sleep Knowledge and Attitude Survey (24 multiple-choice questions). We sought to assess the baseline knowledge of a group of advanced medical trainees, and to determine whether an educational lecture series “boot camp” led to improvement in sleep medicine knowledge.

Methods: The University of Maryland Sleep Fellowship Program hosts an annual “Sleep Boot Camp” in July for beginning sleep fellows from five nearby academic institutions, as well as other interested medical trainees. The program consists of two days of didactic lectures on pertinent topics in basic sleep principles, sleep physiology and clinical sleep medicine. Participants in the 2017 and 2018 boot camps were asked to complete the ASKME and Dartmouth Sleep Knowledge surveys prior to and then at the conclusion of the boot camp.

Results: A total of 21 trainees, of whom 14 were current sleep medicine fellows, completed both pre- and post-surveys. The baseline ASKME score was 21.4 ± 3.4 out of 30 questions (71.4 ± 11.4%) and baseline Dartmouth score was 16.1 ± 2.4 out of 24 questions (67.3% ± 9.9%). There was no difference in baseline scores between sleep fellows and other trainees. There was a statistically significant improvement in both ASKME (2.9 ± 2.1 points, p=0.004) and Dartmouth (2.5 ± 3.0 points, p=0.001) scores across all participants after attending the boot camp, but there was no difference in the degree of improvement among sleep fellows compared to other medical trainees.

Conclusion: Our findings suggest that baseline sleep medicine knowledge is higher than previously reported among medical trainees. Education in sleep medicine results in improvement in knowledge among medical trainees, even among those with a high baseline knowledge and interest in the field of sleep medicine.

Support (If Any):

0974
SLEEP TRAINING OUTCOMES OF MEXICAN DIABETES EDUCATORS AND NURSING STUDENTS
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Introduction: This work provides outcomes of an evidence-based Spanish-language sleep education program for two groups at a university in central Mexico.

Methods: Advanced training in sleep disorders and sleep health promotion was adapted from a lay health educator program. Data stemmed from pre/post ratings regarding knowledge of obstructive sleep apnea (OSA), insomnia, restless legs syndrome (RLS), short sleep duration (SSD), circadian rhythm disorders (CRD), and drowsy driving (DD) on a 5-point Likert-like scale, and five true/false questions regarding misconceptions about sleep. Data were analyzed with frequencies for profession, sex, and sources of sleep information, and paired t-tests using SPSS (V24) with significance set at p<.05.

Results: Volunteer participants (N=164; 72% women) were recruited from five semester-long diabetes educator certificate programs (n=127; doctors, nurses, nutritionists, exercise, mental health specialists) and an undergraduate nursing class (n=37). There were no differences for any variables between student and certificate groups; therefore, survey data were combined. Means with standard deviations showed significant learning for all sleep disorders across groups following the training (OSA: 2.6±1.0 to 4.4±0.79; Insomnia: 3.1±0.84 to 4.5±0.71; RLS: 1.6±0.87 to 4.3±0.84; SSD: 2.6 ± 1.0 to 4.2±0.68; CRD: 2.2±1.0 to 4.3±0.76; DD: 2.4±1.0 to 4.4±0.71, all p<.0001). The total pre- to post-scores (range=0 to 30) for sleep disorders moved from 14.4±4.0 to 26.3±4.0, p<.0001. Participants also demonstrated significant learning regarding misconceptions about sleep pre- 4.2±0.70 to post-testing 4.8±0.41, p<.0001. Respondents reported most of their sleep information came from the internet (33%), doctors (26%), and books (15%) or articles (15%).

Conclusion: Results suggest that this evidence-based Spanish-language sleep program is a salient and cost-effective approach to preparing diabetes educators and undergraduate nursing students regarding sleep disorders across the lifespan in Mexico. Pre-to-post analyses of true/false items suggest significant learning in the areas of sleep needs for adults and the misconception that daytime sleep can make up for lack of sleep at night. Given the high prevalence of DM in Mexico, the behaviorally based sleep promotion strategies included in the training could help decrease sleep-associated comorbidities, thereby reducing health care costs.

Support (If Any): N/A

0975
SLEEP SCREENING, BRIEF INTERVENTION, AND REFERRAL FOR TREATMENT (SLEEP-SBIRT): A PROFESSIONAL DEVELOPMENT PROGRAM
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Introduction: Poor sleep in cancer patients and survivors occurs all along the diagnosis and disease treatment trajectory. This “poor sleep” could be attributed to the presence of one or more underlying sleep disorders. However, sleep disorders screening is not routine in cancer programs despite its inclusion in national initiatives and practice guidelines. Nurses are in a position to provide sleep disorder screening, a brief intervention and referral for further treatment (Sleep SBIRT), but require education and practice. Purpose: pilot test a professional development program and explore preliminary outcome measures.

Methods: Eligible participants, 210 ambulatory direct care cancer nurses at a comprehensive cancer center, were invited to participate using an IRB-approved email which outline the program. Once enrolled, participants were oriented to the online education to define six sleep disorders (i.e. sleep disordered breathing, circadian rhythm sleep disorders, parasomnias, narcolepsy, restless legs syndrome, insomnia), scheduled to interpret a completed Holland Sleep Disorders Questionnaire during two in situ simulations using standardized patients and debriefing. Online quizzes, self-reported Dysfunctional Beliefs and Attitudes About Sleep scale (DBAS)
and Student Satisfaction and Self-Confidence in Learning were outcomes of Sleep-SBIRT.

**Results:** We recruited 22 nurses for this ongoing trial. Among 12 participants who completed: mean age 42.6 (SD=10.8), 100% (n=12) female, 92% (n=11) Caucasian, 83% (n=10) baccalaureate degree or higher, average nursing experience was 18 years (SD=11) and all (n=12) were direct care ambulatory cancer nurses. Online quizzes revealed scores of 100%. Overall nurses were satisfied and reported self-confidence in simulation learning (Mean = 60.33; SD = 5.1; Skewness score = -1.42). DBAS was higher in pre-test (Mean=122.8; SD=25.3) than in post-test (Mean=116.6; SD=32.9), indicating improvement from nurses’ beliefs and attitudes about sleep, but not significantly (p = 0.45).

**Conclusion:** Results are preliminary, but promising. The ambulatory setting provides substantial ongoing care to cancer survivors and this professional development program may lead to empowerment of ambulatory cancer nurses to immediately assist or provide referrals to sleep experts.

**Support (If Any):** The Patricia Garman Fund, School of Nursing, University at Buffalo, Buffalo, NY

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**0976 THE HEALTHY SLEEP PROGRAM QUALITY IMPROVEMENT INITIATIVE**

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**Introduction:** Sleep deficiency is associated with detrimental health, mood and performance. Sleep health education, combined with screening and access to treatment for common sleep disorders, may be an effective countermeasure. We conducted a 6-month prospective evaluation of a quality improvement initiative designed to improve sleep health in the workplace.

**Methods:** Employees were emailed a link to sleep health and sleep disorders education. After viewing the education, participants were administered a baseline questionnaire that included validated screening instruments for sleep disorders, anxiety, and depression. Absenteeism and presenteeism were calculated using the World Health Organization Health and Work Performance Questionnaire. Participants who screened positive for a sleep disorder were notified and given the option to share their information with a healthcare provider. Monthly follow-up surveys evaluated the impact of the program on sleep hygiene, mood, and productivity.

**Results:** Invitations were sent to 1,812 employees; 38% viewed the education and 32% (n=633) completed the baseline questionnaire. The mean age of participants was 41.7 (SD 9.8) years with mean body mass index 26.4 (SD 5.8). Most reported female gender (76%). More than one third (36%) screened positive for a sleep disorder. The prevalence of clinically significant insomnia was 22%, obstructive sleep apnea 19%, and restless legs syndrome 5%. Positive sleep disorder screening was associated with moderate-severe psychological distress (OR 5.46, 95% CI 2.84-10.51) and sleep-related work impairment (OR 5.60, 95% CI 2.94-8.72). Absenteeism and presenteeism costs were $385 per person per month higher (95% CI $251-$519) in the sleep disorder group. Among those who screened positive and participated prospectively, 21% reported seeking a diagnostic evaluation and 9% reported obtaining an evaluation. The subset of participants who screened positive and ultimately received treatment for a sleep disorder (n=19) reported increased sleep quality (p<0.01), reduced fatigue (p=0.05), improved workplace productivity (p=0.02), and increased quality of life (p=0.01).

**Conclusion:** Sleep disorders are common and are associated with reduced workplace performance. Sleep health education can improve self-reported health and productivity.

**Support (If Any):** Conducted in partnership with Haleo Preventive Health Solutions.

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**0977 ENGAGEMENT IN COLLEGIATE SLEEP HEALTH EDUCATION: A MATTER OF TIMING**

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**Introduction:** Sleep deficiency and poor sleep hygiene are common among college students. These modifiable factors contribute to adverse mental health, physical health, and academic performance. Sleep health education has been shown to change behavior, improve sleep quality, and reduce the risk of depression. We sought to compare methods of delivering sleep health education to determine which approach optimizes engagement of the student population.

**Methods:** A 45-minute, interactive, online sleep health education program (Sleep 101) was developed to provide college students with a comprehensive understanding of the ways in which sleep impacts health, mood, performance, and safety. The education also included strategies to optimize sleep during college. We provided the online, interactive sleep health education to three separate student groups using different approaches: 1) a mid-semester voluntary activity encouraged with a monetary incentive [$10 for completion of the sleep health education module (MSV)] for upper-class undergraduate students, promoted through in-person solicitations outside campus dining areas, newsletter notices and emailed invitations; 2) a pre-matriculation (PMA) activity with a deadline and implied requirement for first-year undergraduate students; or 3) a mid-semester assigned (MSA) activity with a deadline and implied requirement for upper-class undergraduate students. Students were allowed 2 weeks to complete the online sleep health education after it was assigned by the Dean’s office. We compared participation rates for each method using descriptive statistics.

**Results:** The MSVS, PMA and MSA methods yielded a 4% (17 of 391), 90% (1,500 of 1,688) and 25% (1,238 of 5,025) completion rate, respectively.

**Conclusion:** The pre-matriculation assigned method for distribution of an undergraduate sleep health education program resulted in the highest engagement. Colleges should consider including sleep health education as a component of assigned pre-matriculation education, as is common for other student health concerns.

**Support (If Any):** Mary Ann & Stanley Snider via Combined Jewish Philanthropies, NIH R01-GM-105018, K24-HL-105664 (EBK).
Introduction: Student athletes often experience insufficient or poor quality sleep as a result of competing demands on their time. In addition, knowledge about sleep and its role in academic and athletic performance can be highly variable. We aimed to develop a sleep educational resource designed to meet the unique needs of student athletes.

Methods: Nine college athletes participated in two focus groups that were conducted in an effort to better understand student athlete's perceptions on sleep and their perceived need for sleep resources/services.

Results: Qualitative analyses revealed common themes: 1) challenges related to making time for sleep, 2) a desire for strategies to both optimize sleep (e.g., improve sleep environment) and enhance daytime functioning (e.g., to combat daytime sleepiness), 3) a need for increased awareness of available sleep resources (e.g., the ability to meet with a specialized provider to diagnose and treat sleep disorders). Additional themes emerged surrounding attitudes towards sleep, particularly related to student-athlete culture.

Conclusion: These thematic results aided in the creation of an initial resource, as well as direction for future modalities of information dissemination (e.g., handout vs website, use of peer counselors).

Support (If Any): Department of Psychiatry & Behavioral Sciences, Stanford University School of Medicine

Internet-based CBT-I may be a useful, non-pharmacologic treatment that reduces insomnia severity, perceived stress, depression symptoms, and sleep aid use in the health disparities population of Appalachian women.

Support (If Any): This project was supported by the Building Interdisciplinary Research Careers in Women’s Health Program (NIDA grant: K12DA035150), pilot funding from the Igniting Research Collaborations Grant (University of Kentucky College of Pharmacy) and the University of Kentucky Center for Clinical and Translational Sciences (grant: UL1TR001998).

Results: Forty-six women enrolled; 38 completed the Internet-based program (retention rate = 82.6%). Mean participant age was 55.1. Positive and statistically significant (p<0.01) improvements were observed on mean score measures for the Insomnia Severity Index (15.1 to 6.5), the Perceived Stress Scale (20 to 14.6), and the Center for Epidemiologic Studies Depression Scale Revised (10: 9.8 to 5.2). The odds of reporting sleep aid use post-intervention were lower than pre-intervention (OR 0.28 [95% CI 0.11-0.74; p=0.01]). Qualitative interviews revealed that insomnia onset was often preceded by an acute social stressor (e.g., death of a child) and perpetuated by a chronic social stressor (e.g., raising a grandchild).

Conclusion: These pilot findings suggest that Internet-based CBT-I may be a useful, non-pharmacologic treatment that reduces insomnia severity, perceived stress, depression symptoms, and sleep aid use in the health disparities population of Appalachian women.

Methods: 89 students (age 20.9±3.1 years, 73% female, 86% undergraduate) with general distress complaints were randomly assigned to undergo one of two stress-management workshops. ‘Your Enlightened Side’ (YESplus) primarily emphasized yogic breathing, acceptance, and social connectedness, and ‘Wisdom On Wellness’ (WOW!) targeted cognitive stress-management techniques. Both workshops entailed 18 hours of training across four consecutive days, and multi-question workshop evaluations were collected at the first and last day, blind to the instructors. At pre, post, and 3-month follow-up, participants completed the Pittsburgh Sleep Quality Index (PSQI), Perceived Stress Scale (PSS), and various other measures and laboratory tasks (not reported here).

Results: YESplus and WOW! participants reported similarly high ratings of the workshops (8.0±3.1 vs. 7.7±3.1, respectively, on 0-9 scale, p=0.42), along with similar retention rates from first to last day of workshop (92% vs. 91%), as well as from post to 3-month follow-up (79% vs. 70%). A significant Group x Time interaction on PSQI was observed (p=0.04). Both groups showed non-significant decreases on PSQI from pre to post. However, WOW! returned to the baseline level by the 3-month follow-up, while YESplus showed further decreases, significantly lower at follow-up than baseline (5.9±2.4 to 4.7±2.7, p=0.043, d=0.48). Furthermore, greater decreases in PSQI from baseline to 3-month follow-up were associated with greater decreases in PSS in YESplus (r=0.46, p=0.02) but not in WOW! (r=0.23, p=0.36).
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**Conclusion:** These results extend prior literature suggesting benefit of contemplative-based intervention for general distress and sleep disturbance in the college student population. Further investigation is warranted to examine possible mechanisms of contemplative-based versus cognitively based interventions, as well as their impact on relationships between sleep and health.

**Support (If Any):** Mind and Life Institute Varela Award

0981

**PATIENT SATISFACTION IN VETERANS SEEN IN GROUP VERSUS INDIVIDUAL VISITS**

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**Introduction:** The prevalence of sleep disorders has been increasing in veterans. To improve access to care, we developed a shared medical appointment (group) clinic pathway. The primary aim of our study was to compare patient satisfaction between group clinics versus individual visits (based on net promoter scores). Our hypothesis was that the outcomes in the two groups were similar. The secondary aim was to assess if the group setting affected perception of care received.

**Methods:** We reviewed records of consecutive, new patients seen in our Veterans Affairs Sleep Medicine Clinic. In the shared medical appointment clinic, veterans suspected of having obstructive sleep apnea (OSA) were seen by a sleep clinician as part of a group assessment and educational activity. The other patient cohort was seen in traditional individual clinic visits. At the end of the visit, each veteran received a satisfaction questionnaire regarding their visit (included questions on wait times, receptionist, nurse and clinician). The net promoter score (how likely they are to recommend our clinic to others), which is a marker of patient satisfaction with overall care, was calculated for each group. In addition, veterans seen in group clinics were asked whether the group setting affected the care they received, and if so, positive or negative.

**Results:** We reviewed satisfaction questionnaires from 50 patients in the individual clinics, and 56 patients in the group clinics. There was no significant difference (p=0.28) in the net promoter scores (NPS) between the shared medical appointment (NPS=81) versus individual clinic (NPS=90) cohorts. Additionally, 81.6% of veterans seen in the group clinics did not feel that the group setting impacted the care they received. The remainder (18.4%) reported a positive impact on the care (none reporting a negative impact).

**Conclusion:** We found no significant difference in clinic visit satisfaction in patients seen initially in group sessions versus 1:1 clinics. Additionally, the group setting did not negatively impact the care received. We concluded that group sessions could represent an effective clinical pathway to improve access to care.

**Support (If Any):**

0982

**DECIDE2REST: A PROGRAM FOR PROMOTING PERSON-CENTERED OBSTRUCTIVE SLEEP APNEA (OSA) TREATMENT**

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**Introduction:** Person-centered care is a collaborative approach that is respectful of, and responsive to an individual’s priorities, goals, needs, and values. For obstructive sleep apnea (OSA), this includes informing patients of their treatment options and actively engaging them in treatment decisions so that the treatment plan reflects what matters most to them. This approach is particularly relevant to care of patients with multimorbidity, which increases in prevalence with advanced age. We developed and evaluated a program that promotes person-centered OSA care for older adults.

**Methods:** Patients with newly-diagnosed OSA were recruited from a Department of Affairs (VA) or university clinic and randomized to the Decide2Rest (D2R) program versus an attention control condition. D2R, a web-based program administered prior to a clinic appointment, provides information about OSA and treatment options, including the risks and benefits of each option. In an accompanying D2R paper workbook, participants list the treatment features that matter most to them, rate their overall health goals, and identify their preferred treatment. The program encourages patients to discuss their preferred treatment with their provider. Outcomes assessed post-intervention included the Decisional Conflict Scale (DCS; 0 [good] to 100 [bad]), which measures perceptions of uncertainty, whether decisions reflect what matters most to patients, and whether patients feel supported in decision making, and the Preparation for Decision Making (PDM; 0 [bad] to 100 [good]) scale. We used fixed-effects models to examine the relationship between D2R and study outcomes (DCS, PDM).

**Results:** 73 patients (mean age 69 years [range: 60-89]; 71% male; N=37 VA, N=36 university site) were randomized to the D2R program (N=36) versus control condition (N= 37). Results from the fixed-effects models, controlling for study site, indicated that the D2R program showed a significantly lower Decisional Conflict Scale scores in treatment versus control (p=.014) and more favorable scores on the Preparation for Decision Making Scale (p<.001).

**Conclusion:** The D2R Program promotes person-centered OSA decision-making for older adults with newly-diagnosed OSA. Future studies are needed to optimize implementation of the program.

**Support (If Any):** NIA K23AG045937, AFAR, Hartford Foundation, Atlantic Philanthropies

0983

**UTILIZING COMPLIANCE SOFTWARE FOR QUALITY IMPROVEMENT: THE HOWARD UNIVERSITY HOSPITAL EXPERIENCE**

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**Introduction:** Previous studies have assessed the influence of demographic and clinical variables regarding PAP adherence, including race, but less is known whether these variables predict outcomes within a minority population. Here we demonstrate the process to utilize readily available PAP manufacturer software to compare community outcomes with national data, and review the influence of demographic and clinical variables within a specific population. Data is also utilized to evaluate temporal patterns in outcomes and
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Introduction: HealthCare System, Seattle, WA, USA.

Of the 25 participants with a pre-class PAP for remote download and both pre- and post-class AHI were below a median of 15 months, 30% of devices were enabled. 57 years and 94% were male; comorbid diagnoses included PTSD and cognitive-behavioral techniques to increase motivation to participate in a Sleep Apnea Education and PAP Desensitization Class at the VA Puget Sound from May through August 2017. While 17 participants completed pre and post class surveys. After the course, 88% of the participants endorsed having learned strategies to make PAP more tolerable, and 82% learned more about Sleep Apnea, health benefits, and gained greater confidence in ability to use PAP therapy.

Conclusion: Among veterans who participated in the Sleep Apnea Education Class, improved PAP adherence was observed. Evaluating PAP adherence was limited by difficulty obtaining manual downloads for patients without remote-enabled devices. Further work to evaluate the efficacy of educational courses on PAP adherence should focus on identifying ideal target populations.

Support (If Any): None.

0984 IMPACT OF A SLEEP APNEA EDUCATION COURSE ON CPAP ADHERENCE

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Introduction: Obstructive sleep apnea in veterans and military personnel is common and frequently associated with comorbidities such as PTSD and insomnia that can make adherence to positive airway pressure (PAP) therapy more challenging. Finding ways to improve PAP adherence among our veterans is important to improving health and well-being. We evaluated the impact of participation in a Sleep Apnea Education and PAP Desensitization Class on PAP adherence among veterans.

Methods: We examined demographic and adherence data for patients attending a one-hour monthly drop-in Sleep Apnea Education Class at the VA Puget Sound from May through November 2016. This class combines PAP education/desensitization and cognitive-behavioral techniques to increase motivation to utilize PAP therapy and increase adherence.

Results: Among the 54 Veteran participants, median age was 57 years and 94% were male; comorbid diagnoses included PTSD (59%) and insomnia (37%). Participating veterans had their current PAP device a median of 15 months, 30% of devices were enabled for remote download and both pre- and post-class AHI were below 5. Of the 25 participants with a pre-class PAP download, 32% met Medicare adherence criteria (<= 4 hours of PAP usage per night on 70% of nights over a 30-day period). Among the 30 participants with PAP download data 30 days after class participation, 33% met adherence criteria. Among the 17 Veterans with pre and post class data, 4 (24%) met Medicare adherence prior to class, while 6 (35%) met adherence 30 days after class.

Conclusion: Among the 54 participants, median age was 57 years and 94% were male; comorbid diagnoses included PTSD and insomnia that can make adherence to positive airway pressure (PAP) therapy more challenging. Finding ways to improve PAP adherence among our veterans is important to improving health and well-being. We evaluated the impact of participation in a Sleep Apnea Education and PAP Desensitization Class on PAP adherence among veterans.

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A SLEEP PROMOTION TOOLKIT FOR HOSPITALIZED PATIENTS
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Introduction: Inpatient sleep disturbance has been linked to clinically relevant and detrimental outcomes such as delirium and falls. Routine assessment, open dialogue, collaborative care planning, and tailored interventions, are key to patient-centered care to improve sleep for hospitalized patients. Interventions using health information technology hold potential to address these key issues of inpatient sleep promotion. This project aimed to inform the development of a sleep promotion toolkit (SLEEPkit) for hospitalized patients by conducting iterative refinement and pilot evaluation. SLEEPkit was designed as a downloadable application assessed from a smart phone or iPad device by patients. Starting from a valid self-assessment for sleep and its disturbing factors during the previous night, the SLEEPkit can generate personalized tips to address the patient’s specific need for sleep.

Methods: Qualitative methods within a standardized iterative participatory approach by working with stakeholders supported the refinement of the SLEEPkit. A randomized control trial was conducted to evaluate the effectiveness of SLEEPkit on patient sleep assessed by the PROMIS Sleep Disturbance and the actigraph. Semi-structured interviews were conducted to seek feedback on SLEEPkit focused on perceived usefulness, ease of use, user control, implementation, and maintenance.

Results: A total of 126 hospitalized patients (48.4% females, 6.3% Hispanics, 71.4% White) from oncology (26.2%) or medical-surgical units (73.8%) were randomized to use SLEEPkit or receive usual care for their sleep during hospitalization. No statistical differences were observed in changes in the PROMIS Sleep Disturbance T score (-0.12±10.3 vs. 1.11±11.3, p=.585) or in the actigraph measured average total sleep time (5:52±1:58 vs. 6:17±2:10, p=.311) and awakenings (31.4±17.9 vs. 31.1±13.5, p=.931) between groups. No statistical differences were observed in changes in the Sleep Weighted Index (31.4±17.9 vs. 31.1±13.5, p=.931) between groups. Overall patients and clinicians perceived that SLEEPkit empowered patient and supported patient-centered care and patient-clinician collaboration of sleep promotion.

Conclusion: This pilot investigation informed further development of the SLEEPkit and laid the groundwork for making inpatient sleep promotion effective and feasible. Future work on SLEEPkit should optimize user engagement, add clinician interface, and promote sleep at both unit and individual levels.

Support (If Any): This project was supported by grant number R21HS024330 from the Agency for Healthcare Research and Quality.

HÓZHÓ: MIXED METHOD SLEEP INTERVENTION FOR NAVAJO CAREGIVERS AND THEIR CHILDREN WITH DEVELOPMENTAL DISABILITIES
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Introduction: This pilot project addressed the feasibility and acceptability of a sleep health education intervention for caregivers of children with developmental disabilities (DD) on the Navajo Nation. It was hypothesized that caregiver education and a tailored intervention that addressed their sleep problems and those of their children would improve caregiver and child sleep quality, as well as caregiver health-related quality of life (HR-QOL).

Methods: Caregivers (N=15), who had children with DD participated in three 1-hour home-based sessions over a three-month period in this mixed method observational study. Educational modules were tailored to specific sleep issues of the caregiver, and their child(ren), as well as unique environmental and cultural features of Navajo families. Quantitative measures included a sleep habits questionnaire, pre- and post-measures of learning, and the SF-12 HR-QOL. Interviews and texting provided qualitative data regarding facilitators and detractors to healthy sleep. Quantitative data were analyzed with frequencies and repeated measures analyses with p < 0.05. Qualitative comments were transcribed verbatim, coded and categorized into themes. Study approval was obtained from the Navajo Nation IRB.

Results: Caregiver sleep duration increased by 2 hours (5.8±1.8 to 7.8±1.9, p=.005) with a decrease in sleep onset from 45 to 15 minutes (p=.01). Caregivers also reported improved physical (45.0±8.9 to 52.8±8.7, p=.001) and mental HR-QOL (41.8±8.9 to 49.3±10.9, p=.002), as well as enhanced knowledge of sleep disorders (13.4±4.0 to 20.7±5.6) and healthy sleep habits (15.7±4.1 to 25.4±3.4 each, p=.005). Qualitatively, many participants reported better sleep quality in their children with earlier bedtimes, less night waking, and more consistent nap.

Conclusion: Findings suggest this Navajo Nation-tailored sleep education program is a salient, culturally responsive approach to educating caregivers regarding sleep disorders and promoting caregiver sleep health and HR-QOL, as well as sleep health of their children. Notably, 3 adults and 2 children were referred to Indian Health Services for further sleep disorders evaluation. Caregivers credited improved personal and child sleep to the support they received during home visits and text messaging.

Support (If Any): The American Occupational Therapy Foundation supported this study.

ELECTRONIC SLEEP DISORDER SCREENING IN EMPLOYEES OF A LARGE HEALTHCARE SYSTEM: A PILOT STUDY
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Introduction: Sleep disorders, highly prevalent in the general population, are associated with a host of adverse health outcomes, daytime impairment and healthcare costs. We performed a pilot study using a mobile application to explore interest in sleep disorder screening and estimate the prevalence of common sleep disorders in employees of a larger healthcare system.

Methods: 30,000 healthcare system employees (60% of all employees randomly selected) were invited to participate in an electronic sleep screening pilot over 12 months in 2015-2016 using intranet announcements and letters from the employee health plan. Participants completed the Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI) and STOP instruments and provided habitual sleep duration and work hour/shift data. Results were summarized for the entire cohort and by work shift status. Comparison between work shifts was performed by Kruskal-Wallis
B. Clinical Sleep Science and Practice

0989
NURSE-LED SLEEP STUDY TRIAGE IN TYPICAL PRACTICE.
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Introduction: Incorporating nurses into OSA care decision-making has the potential to augment our workforce and improve patient access. Trials with strict entry criteria demonstrate comparable treatment decisions and outcomes for nurse relative to sleep specialist physician (SSP) delivered OSA care, but the experience of nurse-led care in typical practice is unclear.

Methods: Our medical center recently piloted a nurse triage program for sleep referrals. Using an SSP-designed decision-making tool, nurses triaged patients referred for sleep studies to either home sleep apnea testing (HSAT) or in-laboratory polysomnography (PSG). During the first five months of the program, SSPs reviewed all nurses’ triage decisions and edited orders if necessary. We recorded whether co-signing SSPs agreed with nurses’ initial decisions or if disagreement resulted in revised orders. We also compared referrals triaged traditionally by SSPs alone to assess trends in decision making.

Results: Of 325 consults triaged by nurses with SSP oversight, SSPs made no changes in 79.4% (n=258). Among the remaining 67 consults, nurses deferred triage decisions to SSPs in 32.8% (n=22), SSPs changed study modality in 47.8% (n=32), and SSPs changed PSG tech instructions in 19.4% (n=13). In the 32 cases of study modality change, SSPs changed study from HSAT to PSG in 78.1% (n=25), and from PSG to HSAT in 21.9% (n=7). The most common indication for study modality change was disagreement regarding OSA pre-test probability (n=16, 50%). The most common reason for an SSP to change nurse PSG tech instructions was to add transcutaneous carbon dioxide monitoring for hyperventilation (n=6 of 13, 46.2%). During this time, 847 patients were triaged traditionally by SSPs alone, and triage to HSAT by SSPs was similar to nurses with SSP oversight (37.9%, n=321 of 847 vs. 40.3%, n=131 of 325, p=0.45).

Conclusion: Nearly 80% of sleep study triages attempted by nurses using our triage tool required no SSP intervention. Intervention was required primarily to resolve uncertainties regarding patients’ OSA pre-test probability and hyperventilation risk. Future research should assess how nurses’ decision-making evolves with greater experience.

Support (If Any): VA Office of Veteran’s Access to Care

0990
GENDER DIFFERENCES IN SLEEP RESEARCH OUTPUT: A 35-YEAR TREND ANALYSIS
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Introduction: Gender inequalities persist across many scientific and medical disciplines, despite efforts and initiatives to promote women’s careers. One key element in academic career progression is research publications. The aim of this study was to evaluate gender disparities in sleep research output by analyzing authorship in peer-reviewed published articles over 35 years.

Methods: All original articles (research and review papers) from four high impact factor sleep journals (Sleep; Sleep Medicine; Journal of Sleep Research; Journal of Clinical Sleep Medicine) published in the years 1980, 1985, 1990, 1995, 2000, 2005, 2010, and 2015 were included in the data set. Gender authorship was categorized (woman/man/unidentified) for all authors of each included article. The Cochran-Armitage test was used to evaluate the trend of authorship over time.

Results: We identified 1841 eligible original articles with 9823 authorships across all four sleep journals. There were 140 unidentified gender authorships and therefore 9683 (98.6%) women and men authorships were further analyzed. Women accounted for 38% of all authorships in the four sleep journals between 1980 and 2015, with relatively more (40%) co-authorships (middle authorships) and less (35%) prestigious authorships (first and last authorships). Over the 35-year time period, there was a significant increasing trend (P<0.0001) in women authorships relative to men globally (from 18% to 44%), as well as in co-authorships (from 17% to 45%), and in prestigious authorships (18% to 41%).

Conclusion: This study shows a positive trend in women authorship over the last four decades of sleep research. It suggests that the integration of women in academic sleep is advanced compared to other scientific and medical fields.

Support (If Any): This study was not funded.

0991
IMPROVEMENTS IN INSOMNIA AND SUBJECTIVELY UNREFRESHING SLEEP FOLLOWING SLEEP HYGIENE INTERVENTION
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XI. Healthcare Delivery and Education

SLEEP, Volume 42, Abstract Supplement, 2019
Introduction: Poor sleep is associated with a variety of health and non-health outcomes, including increased risk of obesity, cardiovascular disease, type 2 diabetes, impaired immune function, mood disorders, increased missed work, and decreased workplace productivity. One study found that people later diagnosed with insomnia incurred a direct medical cost $924 higher per six-month period than people not later diagnosed with insomnia. The effectiveness of sleep hygiene education on sleep outcomes seems to be in debate. Many studies find some effect of sleep hygiene on sleep habits, though perhaps not as much as other sleep-related interventions. To our knowledge, none have yet evaluated the effects of an informational video on sleep habits and outcomes. The aim of this study was to assess the effectiveness on a brief video intervention on sleep-related outcomes.

Methods: A sample of OSF HealthCare Saint Francis Medical Center employees (n = 573, age 18 - 69) completed a 20-question survey about perceived sleep quality and workplace outcomes. The participants were randomly assigned to intervention (n = 271) and control groups (n = 302), which completed either a sleep hygiene video or a wellness sham presentation, respectively. Participants completed a post-intervention survey two weeks later. Univariate and multivariate analyses were performed.

Results: The proportion of intervention subjects who reported frequent insomnia decreased from 43.17% to 33.21% following the intervention, which was a significantly larger change than the 38.41% to 37.09% decrease expressed by the sham-control group (p = 0.0134). Intervention subjects also reported a significant decline in unrefreshing sleep, with 61.25% noting unrefreshing sleep pre-intervention, and only 49.82% reporting unrefreshing sleep post-intervention. This improvement was significantly larger than the change of 52.65% to 52.32% in the sham-control group (p = 0.0021).

Conclusion: These findings that insomnia and unrefreshing sleep are improved 2 weeks following viewing of a sleep hygiene intervention compared with a control group, indicate that this could be a useful tool to teach proper sleep hygiene. Our next steps will be to further study and evaluate it uniquely positioned to compare objective PAP therapy outcomes with subjective outcomes.

Support (If Any): N/A

0992
HEALTHCARE ACCESSIBILITY AND PAP ADHERENCE IN AN INTEGRATED CARE MODEL
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Introduction: Sleep apnea affects >25 million Americans, but adherence to Positive Airway Pressure (PAP) therapy is often unsatisfactory. Federal health insurance programs and managed care plans have adopted regulations that constrain providers of Durable Medical Equipment (DME). It is unknown whether this creates disparity in healthcare outcomes as individuals with these plans may have fixed incomes limiting insurance options. Colorado Sleep Institute (CSI) uses an integrated care model (ICM) making it uniquely positioned to compare objective PAP therapy outcomes to other DME providers. The ICM uses a team of providers, including an in-house PAP clinic with sleep technicians who initiate therapy through sleep-simulated mask fittings and troubleshoot issues as they arise, under direct supervision of Sleep Medicine physicians.

Methods: All patients with Medicare (MCR), Medicare Advantage (ADV), and Medicaid (MCD) insurance prescribed PAP therapy from 12/1/16-12/30/17 were considered. Prior PAP users and those not initiating therapy were excluded. Patients were characterized by care classification received based on insurance requirements: IN- PAP device received through and managed by CSI PAP clinic, OUT- device received through outside DME, Hybrid- device received through outside DME but received interventional CSI PAP clinic appointments. PAP therapy usage was analyzed over three adherence periods (AP): Initial Adherence (Medicare adherence requirement), API=days 60-90, AP2=days 91-180, AP3=days 181-365.

Results: 484 patients (49% female), Age 65.1±0.7y (±SEM), AHI 31.6±1.2, Patient insurance distribution: 289-MCR, 77-ADV, 118-MCD. Care classification: 225-IN, 82-Hybrid, 177-OUT. Initial adherence for all patients was 84%; for care groups: IN-88%, OUT-74%, Hybrid-91%. Average nightly use was significantly lower across all APs for MCD(4.4±0.1h) compared to MCR(6.0±0.1h) and ADV(5.7±0.1h) (p<0.05). Average nightly use was significantly greater for IN(6.0±0.1h) across all APs and Hybrid(5.7±0.1h) during the first 6 months compared to OUT(4.8±0.1h) (p<0.05). Average nightly AHI was ≤6.0 for all insurance and treatment groups for all APs.

Conclusion: Integrated care model significantly improves PAP adherence and average nightly usage. Federal health insurance and managed care plans that restrict access to the integrated care model may have repercussions for long-term health outcomes.

Support (If Any): N/A

0993
COMMUNITY-BASED PARTICIPATORY RESEARCH METHODS IN SLEEP MEDICINE: LESSONS LEARNED
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Introduction: Based on principles of community-based participatory research methods (CBPR), a community-oriented framework was applied in three studies that focused on African- Americans/Blacks (herein referred to as Blacks): The Metabolic Syndrome Outcome Study (MetSO), Tailored Approach to Sleep Health Education (TASHE), and Peer-Based Sleep Health Education and Social Support (PEERS-ED). We describe results of our application of this framework to enroll and study Blacks in these NIH-funded studies of obstructive sleep apnea (OSA).

Methods: Our community-oriented framework includes strategic guidelines for effective intervention to engage communities in research and ensure cultural and linguistic appropriateness of sleep messages in behavioral interventions. Strategies included: 1) focus groups and in-depth interviews with key stakeholders; 2) establishing a community advisory board; 3) conducting Delphi surveys to identify high-priority diseases and conditions. Community barriers were identified through an iterative process using surveys and focus groups. Stakeholder groups were integral during the development, implementation and dissemination, reflecting a patient-oriented decision-making process with respect to key intervention components.

Results: MetSO, TASHE, and PEERS-ED reached nearly 3,000 Blacks at risk of OSA in New York City. Of those, 2,000
were screened for OSA. Sleep brochures were distributed to over 10,000 individuals. The mean age of community participants was 62±14 years; 69% were female; 43% had an annual income <$10,000; and 37% had <HS education. The prevalence of cardio-metabolic conditions were: diabetes (60%), obesity (67%), hypertension (94%), and dyslipidemia (74%). Based on the apnea risk evaluation questionnaire (ARES), 49% were at risk for OSA and 53% reported daytime sleepiness (Epworth)>10; 10% reported an insomnia diagnosis and 12% used sleep medications. Based on WatchPAT data, 24% had moderate OSA and 18%, severe OSA.

Conclusion: Community outreach may be an effective strategy in the reach and spread of sleep messages among low-income Blacks at-risk for OSA.

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0994
THEMATIC, CONTENT AND POLICY ANALYSIS OF SLEEP HEALTH PROMOTION IN SOCIAL SERVICE POLICIES IMPACTING THE MOST VULNERABLE CHILDREN IN THE UNITED STATES
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Introduction: Social services are the nation’s system of programs, benefits, and services that help people meet those social, economic, educational, and health needs. Using a social justice framework and building on our previous review of sleep in child welfare, we were interested in learning how healthy sleep was integrated into program policies and manuals serving the most vulnerable children and families in the US to recommend areas for future intervention.

Methods: KL & SC conducted a systematic review, thematic and content analysis of 513 administrative program policies and manuals from large social service systems with programs serving over 22.3 million vulnerable children and families facing adverse childhood experiences and health disparities. A systematic review assessed for the inclusion of healthy sleep education or promotion methods. Bardach’s eightfold path method of policy analysis was used to examine policy options related to healthy sleep promotion and identify targets for intervention.

Results: Healthy sleep was included in only 7 (1%) policies in Special Supplemental Nutrition (WIC), Healthy Start, Head Start, Children’s Health Insurance, Child Welfare, and Juvenile Justice programs targeted in this review. Healthy start provided the most mentions (4) of healthy sleep in manualized educational information, related to infant safe sleep. Child welfare and juvenile justice policy advised on compliance-driven sleep standards, such as providing available space and bed to children and youth. The policy analysis identified benefit re-enrollment, intake, home visits, home safety assessments, family team meetings, and case closure visits as the most viable touchpoints for sleep promotion in social policy.

Conclusion: Although Healthy Start included infant safe sleep, no other programs provided healthy sleep education or promotion for older children above 5 years of age. Intentionally integrating healthy sleep education and promotion into existing programs may be an important way to reach over 22.3 million vulnerable children and families. Future studies could use the policy recommendations of this study to improve the integration of healthy sleep into our training and social policy practice.

Support (If Any): N/A

0995
SCHEDULE RE-DESIGN AND PATIENT SAFETY: THE RANDOMIZED ORDER SAFETY TRIAL EVALUATING RESIDENT-PHYSICIAN SCHEDULES (ROSTERS)
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Introduction: Resident-physicians’ extended duration work shifts impair their safety and performance, but the effects on patient safety of eliminating them remain unclear.

Methods: We carried out a 6-center cluster-randomized trial comparing rates of serious medical errors (SMEs) when resident-physicians worked on an extended duration work roster (EDWR) that included extended shifts of 24 hours or more, compared with a rapidly cycling work roster (RCWR) that eliminated extended shifts. A well-established, intensive systemic surveillance methodology that included direct continuous observation and chart review was used to measure rates of SMEs. All final classifications of suspected incidents were made by two independent physician reviewers blinded to schedule and site; discrepancies were resolved by consensus (pre-consensus kappa 0.52-0.67).

Results: On the RCWR, resident-physicians made significantly more SMEs (97.0 vs. 79.1 per 1000 patient-days [RR 1.53 (95% CI 1.37-1.72)], p<0.0005). Rates of SMEs across study units (including errors involving and not involving resident-physicians) were likewise higher (181.3 vs. 131.5 per 1000 patient-days [RR 1.37 (95% CI 1.43-1.71)], p<0.001). The relative effectiveness of the intervention across sites varied widely. At one site, resident-physician-related SMEs decreased on the RCWR [RR 0.24 (95% CI 0.17-0.34)]; at two sites, there was no significant change; and at three sites, rates of SMEs increased. To explore reasons for the site level variation, we conducted a series of post-hoc analyses. We found that as resident-physician workload increased, the intervention went from being protective to being harmful. Specifically, GEE analyses demonstrated that introduction of the RCWR intervention led to an improvement in patient safety (RR 0.53, p<0.0018) when IPRP was ≤7; once IPRP increased above 7, however, the intervention led to decrements in patient safety (RR 1.42, p<0.0001).

Conclusion: An intervention that eliminated resident-physicians’ extended work shifts but simultaneously increased workload increased SMEs. Managing workload is essential as schedules are introduced to reduce resident-physician work hours.

Support (If Any): NHLBI U01-HL-111478 and U01-HL-111691
0996
INTERIM FINDINGS FROM A SLEEP HEALTH AND WELLNESS PROGRAM TO REDUCE OCCUPATIONAL BURNOUT
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Introduction: Occupational burnout is common among healthcare providers. Approximately half of physicians and nurses report symptoms of burnout, including emotional exhaustion, depersonalization, and perceived lack of accomplishment. Faculty wellness surveys at our institution found that the most commonly reported driver of burnout was sleep-related impairment. We sought to develop a Sleep Health and Wellness (SHAW) program and test its effectiveness on reducing burnout symptoms. This interim analysis reports the association between sleep disorder screening status and burnout symptoms.

Methods: We developed a SHAW program that integrated expert-led sleep health education and tablet-based sleep disorder screening, with immediate screening results and one-click scheduling for sleep clinic appointments. The SHAW program was delivered to faculty at one hospital as part of a quality improvement initiative. Validated survey instruments were used to evaluate risk of obstructive sleep apnea (OSA), insomnia, restless legs syndrome, and shift work disorder. Burnout was assessed using the Maslach Burnout Inventory and the Professional Fulfillment Index. Multivariable logistic regression was used to test the association between sleep disorder screening status and burnout symptoms.

Results: Nearly 1000 (n=959) employees have participated in the SHAW program and 884 (92%) completed the sleep disorder screening. One in three (33%) screened positive for at least one sleep disorder. The prevalence of insomnia was 17%, OSA 14%, and shift work disorder 11%. The majority (94%) of those who screened positive were previously undiagnosed and untreated. Nearly one in three participants (31%) reported symptoms of burnout. Positive sleep disorder screening was associated with nearly 4-fold increased odds of burnout (OR 3.78, 95% CI 2.52-5.67), and reduced odds of professional fulfillment (OR 0.52, 95% CI 0.37-0.73). Over 90% of participants considered the program important, helpful, and would recommend it to others.

Conclusion: Positive sleep disorder screening is common among healthcare providers. Screening positive for a sleep disorder is associated with increased odds of occupational burnout. Follow-up assessments are planned to determine whether the program is effective in reducing burnout symptoms.


0997
SCHEDULING FACTORS ASSOCIATED WITH RESIDENT PHYSICIAN AND PATIENT SAFETY IN MORE SENIOR RESIDENTS
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Introduction: Long work hours and extended-duration (≥24 hours) work shifts are associated with higher risks of motor vehicle crashes (MVCs), near-crashes, percutaneous injuries (PIs), medical errors, and adverse events among resident physicians in their first postgraduate year (PGY1). We sought to determine if these same associations were present in more senior resident physicians (PGY2 and above).

Methods: All medical students who matched to a United States residency program from 2002-2007 and 2014-2017 were invited to participate in a prospective cohort study. Each month, participants reported hours of work (including time in patient care), extended duration shifts, and adverse safety outcomes; including MVCs, near-crashes, PIs, medical errors and adverse events. We pooled data from both cohorts and tested the association between work hour characteristics and adverse safety outcomes using generalized linear models adjusted for potential confounders.

Results: Monthly reports were completed by 4,826 more senior resident physicians (38,702 resident-months). We observed a significant dose-response relationship between weekly work hours and the risk of adverse safety outcomes (p≤0.001). Exceeding 60 weekly work hours was associated with increased risk of near-crashes (RR 1.75, 95%CI 1.59-1.93), percutaneous injuries (RR 1.95, 95%CI 1.62-2.35), medical errors (RR 2.59, 95%CI 2.36-2.83) and preventable adverse events (RR 2.90, 95%CI 2.36-3.56) while the risk of an error resulting in a fatal outcome was increased approximately 5-fold (p<0.001). There was a significant dose-response relationship between the number of extended duration shifts and the risk of adverse patient safety outcomes (p≤0.001). In addition, working any extended duration shifts increased the risk of documented resident motor vehicle crashes 30%, crashes leaving work 46%, and percutaneous injuries 43% (p<0.01 for all comparisons).

Conclusion: Weekly work hours that are less than the current limits allowable by the Accreditation Council for Graduate Medical Education are associated with increased risk of adverse patient and resident physician outcomes. Extended duration shifts are also associated with adverse safety outcomes. Additional research is needed to identify schedules that are safe for both patients and providers.

Support (If Any): NIOSH: R01OH010300, R01OH07567. NHLBI: F32HL134249.
0998  
CLOUD-BASED EVALUATION OF WEARABLE-DERIVED SLEEP DATA IN INSOMNIA TRIALS
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Introduction: Evaluating the efficacy and response to cognitive behavioral therapy for insomnia (CBTb) is challenging to conduct in real time as it requires in-person visits to download actigraph data from wearable devices. We aimed to determine whether a wearable sleep monitor with cloud-based capability, could demonstrate predictable improvements in sleep data in participants of a randomized controlled trial comparing in-person versus telemedicine CBTb, in recently hospitalized patients with insomnia.

Methods: Participants with insomnia who were recently hospitalized for a medical condition were recruited. They were given a wearable device, capable of uploading sleep data to a smartphone and a cloud-based server by Bluetooth (WHOOP 2.0 fitness tracker wristband, WHOOP Inc., Boston, MA). Data was remotely accessed and analyzed without requiring an in-person visit to the research coordinating site. Participants underwent in-person CBTb or telemedicine-based CBTb (through AASM SleepTM platform, AASM, Darien, IL). Insomnia Severity Index (ISI) was assessed at baseline, 2-weeks and 6-weeks following randomization.

Results: CBTb led to improvements in ISI score in both groups combined from 18.5 ± 5.4 (at baseline) to 12.7 ± 4.2 (at 2-weeks) and 7.8 ± 1.3 (at 6-weeks; P=0.007; GLM with repeated measures). Sleep efficiency measured by the wearable device and averaged over a 2-week period increased from 78.5 ± 10.4 (at baseline) to 87.8 ± 8.4 (at 6-weeks; P=0.007; GLM with repeated measures). Wake after sleep onset measured by the device over 2-week blocks tended to reduce from 0.97 ± 0.4 hours at baseline, 2-weeks and 6-weeks following randomization.

Conclusion: A wearable device with cloud-based sleep-monitoring demonstrated predictable changes in sleep data in participants of an insomnia trial.

Support (If Any): AASM Foundation award (169-SR-17).

0999  
CAN ELECTROENCEPHALOGRAM-MODULATED MUSIC FACILITATE FALLING ASLEEP?
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Introduction: The electroencephalogram (EEG) reflects the falling asleep process through a progressive reduction in the beta power (15-30 Hz) and a corresponding increase in the theta power (4-8 Hz) band. The log-ratio “ρ” monotonically decreases by an order of magnitude as sleep initiates.

Methods: We modulated the volume of audio using the average “ρ” of 115 sleep EEG recordings from a previous study and tested the effect of the modulated audio on sleep latency and ρ of nine participants (6M/3F; 38.8 ± 11.9 years old) in this study. Subjects were randomly assigned to two groups: music (N=5) and white-noise (N=4). Within each group, three conditions were tested: baseline, audio (music or noise), and modulated-audio (gradually decreasing volume). Per participant, two sleep recordings per audio condition and 5 baseline nights were collected at home using a sleep wearable EEG system. The audio was played using earbuds connected to an MP3 player (in baseline no audio was played). Subjects were instructed to start the EEG recording and audio rendering at their sleep intent time. The volume of the audio was proportional to “ρ” such that (Vol= 15 dB for ρ = -4). Both audio streams: music or white noise lasted for 10 minutes. In the music condition, subjects could select among three songs known to promote relaxation.

Results: Across all conditions, latency to the first sleep epoch was shortest in the modulated-music (6.88 ± 4.08 min) condition but was not statistically significantly different from baseline (13.72 ± 13.65 min). Latency to stable N2 (first two-minute N2 bout) was shortest in the modulated-music condition (9.17 ± 15.5 min) with a medium effect size (Cohen’s d = 0.4) compared to baseline (23.7±20.9 min). The value of “ρ” ten minutes after the 1st sleep epoch was the lowest in the modulated-music condition with a statistically trending difference compared to baseline (p=0.057).

Conclusion: Modulated-music applied at sleep-intent time was associated with the shortest sleep latency and fastest ρ decay. This promising effect needs to be validated in a larger sample size to assess statistical significance.

Support (If Any): NA
Methods: Among SleepCycle users, 45.6% (n=1,001,335) were female. The average age of the sample was 31.0 years. The mean sleep duration of the total sample was 7.11 hours; women slept longer than did men (M=7.27 hours vs. M=7.00 hours, p<.001). Increasing age tended to be associated with longer sleep duration and better sleep quality. Results also showed sleep duration was longer on weekends (M=7.19 hours), compared to weeknights (M=7.09 hours). Sleep duration was longest (M=7.18 hours) during the winter, but shortest during the summer (M=7.11 hours). Sleep quality was highest (M=72.75) during the winter, but lowest during the summer (M=71.99).

Results: Preliminary results for the device epoch-by-epoch measures of sensitivity, specificity, and Cohen’s kappa, respectively, were as follows: Actiwatch-2 (97.1%, 36.8%, 0.42), Brite R440 (98.5%, 28.3%, 0.36), Alta HR (94.3%, 46.2%, 0.42), Live (96.1%, 45.4%, 0.47), and S+ (93.3%, 50.0%, 0.44).

Conclusion: Overall, the consumer sleep-tracking devices we tested showed relatively high sensitivity but lower specificity, indicating a tendency for sleep devices to accurately detect sleep but to under-detect wakefulness. In this preliminary analysis, one wrist-worn device (Alta HR) and two non-wearable devices (Live and S+) showed the highest specificities, indicating these devices are promising for detection of wakefulness and comparable to standard wrist actigraphy. Further testing is needed to determine the validity and practicality for use of these consumer sleep-tracking devices within different settings and populations.

Support (If Any): Office of Naval Research (ONR), Code 30
1003
BED COMFORT AND SLEEP: CHANGE YOUR BED OR CHANGE YOUR BEHAVIOR?
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Introduction: We explored how bed comfort was related to self-report sleep patterns and perception of sleep.
Methods: 3,007 adults (2,793 females) between the ages of 18 to 86, recruited through social media, completed a comprehensive online sleep assessment modified for mobile experience, including the Insomnia Severity Index (ISI), Epszworth Sleepiness Scale (ESS), Sleep Hygiene Index, and questions about attempted sleep solutions.
Results: 20.4% of subjects reported sleeping on an uncomfortable bed either “always” or “frequently.” The perception of bed comfort was positively correlated with both age and income. 28% of subjects with household income less than $30,000 reported an uncomfortable bed compared with only 8.0% of subjects with incomes over $130,000. Participants who reported sleeping on an uncomfortable bed had significantly higher ISI scores (15.1 vs 16.9), p<0.001. Self-reported sleep onset latency (SOL) was associated with bed discomfort, with an average 20 minutes longer SOL for those that “always” sleep on an uncomfortable bed compared to “never.” Bed comfort was not associated with number or duration of night wakings. Nighttime frequency was also significantly higher for those that slept on an uncomfortable bed (1.62 nightmares/wk vs 0.91/wk, p<0.001). Bed discomfort was associated with daytime sleepiness with higher ESS scores (8.3 vs 9.5), p<0.001. Furthermore, reported bed comfort was significantly correlated with alertness at work (p<0.001).
Conclusion: While bed discomfort is clearly associated with increased likelihood of insomnia, nightmares, and daytime sleepiness, we cannot know explicitly the direction of the causality. This is an important question that needs more exploration. Should individuals who report poor sleep and an uncomfortable bed begin by changing behaviors or changing their bed… or both?
Support (If Any): Johnson & Johnson Consumer Inc., Skillman, NJ, USA. Somn Labs, Philadelphia, PA, USA

1004
HOW VARIABLE IS SLEEP?
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Introduction: Sleep patterns are often described in terms of the average over a 1-2 week period of assessment with either self-report (e.g. sleep diary) or objective (e.g. actigraph) assessment. In recent years, there has been greater interest in the variability in sleep over time, but variability has mainly been studied using short-term “snippets” of data spread out longitudinally. There is a need for longer-term monitoring in order to better understand the extent to which sleep patterns are stable/unstable in individuals over time. One approach is to utilize “smart” mattress sensor technology that can assess sleep unobtrusively over long periods of time. The present study examined variability in sleep over periods up to a year using sleep efficiency assessed with mattress sensors as a global index of sleep quality.

Methods: Data were from users of the Eight Sleep mattress, which collects and integrates data from multiple sensors to estimate sleep/wake patterns. Nights were categorized as “good” and “bad” nights using a cutoff of 85%. Descriptive statistics were computed to describe both individual means as well as variability across nights. Pearson’s correlations were conducted between means and standard deviations of individuals’ sleep efficiencies.
Results: The sample consisted of 100 mattress users who had valid data from 151 to 978 nights. The mean sleep efficiency across individuals was 73.20%, with a mean standard deviation of 20.53%. 59.61% of nights were classified as good nights, and 40.39% were poor. The mean (SD) coefficient of variation was .29 (0.11), with a range of 0.12 to 0.71, indicating a wide range of variability. There was a significant correlation between individuals’ mean and standard deviation in sleep efficiency (r = -71, p < .01), such that higher mean sleep efficiency was associated with less variability.
Conclusion: When examined over longer periods of time, there is considerable variability in sleep efficiency both within and between individuals. Individuals with poorer sleep overall also tend to have more variable sleep over time. “Smart” mattress pads are a pragmatic tool that can be used to gather large amounts of continuous, longitudinal sleep data.
Support (If Any): None.

1005
COMPARISON OF COMMERCIAL-AVAILABLE SLEEP TRACKING DEVICES WITH SLEEP DIARY AND ACTIGRAPHY
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Introduction: Commercially-available devices which measure activity and sleep have increased exponentially in popularity. Users of such devices are turning to clinicians and fitness professionals for guidance on how to best utilize these devices for sleep, but little evidence exists to guide these discussions. This study compares three commercially-available sleep tracking devices, the Fitbit Charge HR® (Fitbit®), Beddit 2® (Beddit®), and ResMed S+® (ResMed®), for accuracy at estimating total sleep time (TST) over seven consecutive nights against the clinically-validated Philips Actiwatch 64® (Actiwatch®).
Methods: Forty-eight participants, aged 19-64 years (mean=35.1, SD=10.2, 72.9% female) used three tracking devices over the seven day trial. Each device has different placement requirements - the wrist (Fitbit®), under the bedsheet (Beddit®), and on the nightstand (ResMed®). All participants were determined to be good sleepers, as defined by the Pittsburgh Sleep Quality Index (PSQI). Participants with a Global PSQI score greater than four were excluded. Throughout the study, participants completed the American Academy of Sleep Medicine sleep diary. Each device’s estimated TST was compared with that from the participant’s recall sleep diary and the Actiwatch®.
Results: There were significant differences between the three devices and the sleep diary, with the devices underreporting sleep by 25 to 49 minutes on average (p≤0.05). The Fitbit® and the Beddit® estimated mean TST did not differ significantly from the Actiwatch®.
A NOVEL WEB-BASED RING DEVICE FOR SLEEP APNEA SCREENING AT HOME
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Introduction: Obstructive sleep apnea (OSA) is associated with increased risk of cardiovascular and metabolic diseases as well as neurocognitive dysfunction. Early diagnosis and treatment may potentially reduce the risk of morbidity and mortality. With the increasing prevalence of OSA, it is important to find a simple and reliable home screening device.

Methods: Belun Ring, a ring-type pulse oximeter with web-based platform has been developed by Belun Technology Company Limited. This device allows measurement and analysis of oximetry, heart rate variability (HRV), photoplethysmography (PPG), and accelerometer signals from the proximal phalanx of index finger for assessing the risk of OSA. The algorithm estimates the total sleep time (TST) and respiratory event index (B-REI) and was built and trained by using dataset of 5,783 subjects and 8,417 records of overnight sleep. A validation study was conducted in Mountain Sleep Diagnostics in Colorado in individuals without significant cardiopulmonary comorbidities who are not on beta or calcium blockers. In-lab PSG signals were recorded simultaneously with the Ring and the studies were manually scored by certified sleep technician according to the AASM Scoring version 2.3.

Results: A total of 32 subjects (19 males, 13 females; Age 52.5 ± 15.3) were recruited in this study and each subject contributed to one overnight measurement. The PSG total sleep time (TST) was 334.5 ± 73.7. The distribution of the PSG-AHI was from 0.9 to 42.3 (16.6±11.4) events/hour. The correlation between reference PSG-AHI and B-REI and reference PSG-TST and B-TST are 0.915 (P<0.001) and 0.950 (P<0.001) respectively. The sensitivity and specificity of B-REI ≥ 15 in predicting PSG-AHI ≥ 15 are 0.95 and 0.84, respectively. Mean error in detector’s ODI with the metrics reported, Time in Bed (TIB) is essential as it sets the temporal frame for sleep/wake classification. Determining TIB automatically in real-world settings is challenged by behaviors that mimic sleep. We report here a novel algorithm that uses three signal
attributes available in leg-worn actigraphy. We use machine learning techniques to optimize algorithm parameters.

Methods: This work is based upon data from 42 subjects collected over 155 nights. Subjects wore the actigraphy device afternoon-to-morning for an average 710 minutes and recorded TIB Start and TIB End in their diary. We developed a three-tiered algorithm. Tier one uses body orientation and step counting to identify upright active intervals. We define the time between these intervals as segments. Tier two is a Bayesian classifier that combines activity, orientation, and time to compute the probability a segment is within TIB. Tier three is a decision tree for gathering sequences of segments that comprise TIB. We fit the Bayesian classifier and applied simulated annealing to the decision tree to minimize the errors in TIB.

Results: The 155 nights of data included 843 segments. The Bayesian model alone classified 92.9% of segments correctly (Sensitivity = 93.6%, Specificity = 92.5%). After optimizing the decision tree, the complete algorithm classified 97.3% of segments correctly (Sensitivity = 94.0%, Specificity = 98.9%). Accuracy increased partly because because the tree can include segments within TIB that have low probability based on their attributes alone. Visual inspection of residual errors showed that restful behaviors right before sleep remain a challenge.

Conclusion: In this study we applied machine learning to develop algorithms that combine activity, orientation, and time to estimate TIB for leg-worn actigraphy. The Bayesian model and decision tree were fit to the training population and yielded 97% accuracy for classifying segments within TIB. Future work will explore new segment features, different classifiers, and using within-night and within-subject data to further improve estimates of TIB.

Support (If Any): This study was funded by NeuroMetrix, Inc.

1009 PREDICTORS OF IMPROVED PAIN INTERFERENCE WITH SLEEP IN A REAL-WORLD CHRONIC PAIN COHORT BY TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

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Introduction: Fixed-site high-frequency TENS (FS-TENS) is a form of TENS in which the stimulator is designed for a predetermined location rather than for co-localization with the patient’s pain. A single target site enables design of small wearable devices that may be used while active and sleeping. Previous studies demonstrated that FS-TENS reduces pain interference with sleep (“sleep interference”) in chronic lower extremity or low back pain. The objective of this study was to determine predictors of reduced sleep interference in individuals self-administering FS-TENS.

Methods: This retrospective cohort study evaluated real-world use of a FS-TENS device (Quell®, NeuroMetrix, Waltham MA), placed on the upper calf, for chronic pain over 10-weeks. The device and companion smartphone app collect TENS utilization (%days with at least 30 minutes stimulation), demographics, pain characteristics and pain ratings that are stored in a cloud database. The study outcome was the baseline to 10-week change in sleep interference (11-point NRS). Participants were defined as a responder (≥1-point decrease) or comparator (≥1-point increase) based on their change from baseline. Positive predictors of decreased sleep interference were age, baseline sleep interference, TENS utilization and worst daily pain when active. Negative predictors were baseline mood interference, sensory threshold and weather sensitivity. The area under the ROC curve was 0.82 (95% CI 0.79-0.84).

Conclusion: FS-TENS effectiveness in reducing sleep interference is predicted from baseline pain characteristics and utilization with moderate accuracy. The strongest predictors were higher baseline sleep interference, lower baseline mood interference and greater TENS utilization.

Support (If Any): This study was funded by NeuroMetrix, Inc.

1010 SLEEP RELATED RECOVERY IN ATHLETES: THE ROLE OF HEART RATE VARIABILITY PARAMETERS

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Introduction: Sleep is vital for musculoskeletal recovery, learning and emotional balance of athletes. Insufficient sleep is related to performance deterioration. Heart rate variability (HRV) analysis upon waking up is widely used as a recovery measure in athletes. We aimed at evaluating sleep HRV parameters as a measure of recovery in athletes.

Methods: Observational study of sleep HRV in 58 professional athletes (AT) and 57 age matched individuals from the general population (GP) who monitored their sleep using a mobile application (Sleepate) and a heart rate sensor (Polar H7) was performed. 460 nights were analyzed. Sleep analysis was obtained using an HRV-based validated algorithm. The HRV parameters evaluated were: (1) RMSSDavg: the average root-mean square differences of successive RR intervals (RMSSD) over the whole night, and (2) RMSSDlast5: the RMSSD for the last 5 minutes of the recording. The variability and differences between the two RMSSD parameters were further studied in 386 recordings of 9 athletes who recorded more than 20 nights each.

Results: Total sleep time (TST) of AT (417±45minutes) was significantly longer than that of GP (383±47minutes, P<.0005). Mean RR interval (AT: 1.12±0.17sec, GP: 1.04±0.13sec), RMSSDavg (AT: 98.3±47.3msec, GP: 68.8±30.6msec) and RMSSDlast5 (AT: 99.9±46.5msec, GP: 71.9±31.2msec) were all significantly higher in AT than in GP (P<.05, P<.005, P<.005, respectively). RMSSDavg was significantly less variable compared to RMSSDlast5, with lower standard deviations within subjects. The absolute difference between RMSSDavg and RMSSDlast5 was greater than 30% of RMSSDavg in 20% of the nights.

Conclusion: TST is longer in athletes, due to their awareness to the importance of sleep for recovery and performance. Athletes had higher HRV parameters, related to their high cardiovascular endurance. We suggest that the high variability in RMSSDlast5 is due to its sensitivity to effects of the presence of wakefulness at the end of the night. The last 5 minutes of the night do not include the recovery time related to SWS activity. Our results suggest that RMSSDavg is the preferred measure of recovery as it represents the day-to-day fluctuation in the HRV.
**1011**

**TELEHEALTH BREATHE TRAINING FOR ALLEVIATION OF SLEEP DISTURBED BREATHING: A PILOT STUDY**

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**Introduction:** Sleep Disturbed Breathing (SDB) results from anatomical and neuro-physiological triggers. Several studies indicate breath training can mitigate symptoms. Specifically mild hypoxic sequences with slow hypopnic breathing exercises over several weeks may invoke neuroplastic changes stabilizing breathing control. We pilot tested a telehealth solution to train patients remotely. Results support further research.

**Methods:** 7 adults, RDI 5-20, BMI < 35, no compounding co-morbidities were recruited. Pre- and post-training polysomnographic data, Sleep Apnea Quality of Life (SAQLI) and Epworth Sleepiness Scale (ESS) Indices were recorded. Training included written and recorded instruction. Subjects performed prompted breathing sequences, combining six mildly hypoxic breath-holds with relaxed controlled breathing, 20 minutes daily over 6 weeks. Wireless finger-tip PPG/SpO₂ sensors monitored sessions. Data were analyzed for heart and breathing rates, HRV, SpO₂, vagal tone and breath holding times (BHT).

**Results:** Post training, mean SAQLI increased by +4% (SD 15%); ESS declined by -60% (SD -90%); integrated snoring metrics fell by 32% (SD 35%), 55% (SD 35%) and 75% (SD 29%) at levels >30dB, >40db and >50db respectively; BHT’s increased by 69% (SD 76%) asymptotic to a steady value. AHI/RDI data were inconclusive.

**Conclusion:** Daily training using mild self-imposed hypoxia with intervening hypopnic intervals via telehealth showed significant reductions in snoring especially at high intensities indicating improved upper airway responsiveness. Symptom questionnaires reported positive outcomes. AHI/RDI data were inconclusive. Telehealth enabled individual breath training might help with SDB either as an adjunctive or stand-alone treatment and reduce neuro-physiological triggers exacerbating SDB in some phenotypes. We suggest further research with a larger population to explore potential benefits including AHI/RDI reduction as an adjunct low-cost non-invasive therapy for SDB and OSA. Subjects should be screened for phenotypic neurophysiological traits known to contribute to SDB including high loop gain, poor upper airway responsiveness and low arousal threshold pre- and post-training to determine if efficacy is greater in particular phenotypes.

**Support (If Any):** This study was partially funded by a grant from the US Department of Health and Human Services.

**Introduction:** Mobile health technologies (MHTs) that measure sleep architecture may help clinicians personalize treatment for obstructive sleep apnea (OSA). New, consumer-friendly EEGs have recently become available. The purpose of this pilot was to assess the feasibility of using this technology to reliably measure outcomes of different therapies at home, as compared to existing technologies.

**Methods:** Prior to designing a clinical trial, a pilot study was initiated to evaluate the usability of a new EEG technology. A within-subjects design was used to test two therapies, CPAP and a mandibular advancement device (MAD). One participant consented to conducting a series of therapy trials and monitoring outcomes using the EEG and a single-lead ECG sleep monitor for comparison. The participant used his CPAP for two weeks and on the last two nights, used both MHTs to assess sleep quality. He subsequently switched therapies from CPAP to the MAD. After two weeks wearing the MAD, he again used both sleep monitors for two nights. This protocol was repeated four times. Qualitative data were also collected to assess the participant’s experience.

**Results:** The participant was able to concurrently wear the EEG headband with a full-face CPAP mask. The mask did not interfere with the EEG’s data collection. The EEG data correlated well with ECG data (time stamps, fragmentation, etc.). Switching therapies produced a change in this participant’s sleep architecture, as recorded by both MHTs. Consistent differences between therapies were noted each time the protocol was repeated. The participant reported that each MHT was easy to use at home. He preferred the EEG as it had a phone app that provided him with immediate access to his results.

**Conclusion:** This pilot demonstrated the feasibility of using either type of mobile health technology to monitor treatment outcomes. Either one would be suitable for use in a future clinical trial. The EEG’s phone app may facilitate greater participant engagement.

**Support (If Any):** None

**1013**

**POPULATION STUDY OF SLEEP DURATION AND QUALITY USING DATA FROM COMMERCIALLY AVAILABLE WEARABLE RING**

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**Introduction:** Sleep is one of the main pillars of our health and wellbeing. Both short and long duration of sleep has been associated with obesity, diabetes, hypertension and cardiovascular diseases and even with greater risk of death. Nevertheless, the duration of the sleep is not the only quantity affecting the perceived quality of sleep but it can be divided into dimensions of quantity, continuity and timing. While continuity and timing are not well studied possibly due the difficulty of assessing them with questionnaires, the recent development of wearable and environmental sleep trackers can enable more versatile analysis of all these three dimensions. Thus, in this study sleep duration as well as the role of sleep consistency as contributor of sleep quality, are assessed in real-life settings.

**Methods:** The data set consists of sleep data from the first Oura ring users where the studied metrics included overall sleep duration, long-term consistency vs sleep efficiency, and long-term consistency vs total sleep. To be included into this population a user needed at least 10 recorded nights available constituting a population of 9333 persons and including approximately 1.8 million nights.
Results: 50% of the population slept, on average, less than 7.0 hours per night. Moreover, lack of long-term sleep consistency was found to correlate with shorter sleep duration and lower sleep efficiency.

Conclusion: It was shown that wearable Oura ring can be utilized in large population studies to reveal facts related to sleep duration. The link between the consistency of sleep timing could be studied. On average, half of the Oura users were observed to accumulate insufficient amount of sleep compared to NSF recommendations. Moreover, lack of consistency in sleep timing was found to correlate with shorter sleep duration and lower sleep efficiency. We therefore conclude that further experimentation to explore the potential of the Oura ring for tracking human sleep in large scale studies is justified.

Support (If Any): This work was supported by Oura Health Ltd.

1014

TECHNOLOGY ASSISTED BEHAVIOR INTERVENTION TO EXTEND SLEEP AMONG ADULTS WITH SHORT SLEEP DURATION AND PREHYPERTENSION/STAGE 1 HYPERTENSION: A RANDOMIZED PILOT FEASIBILITY STUDY

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Introduction: Short sleep duration contributes to hypertension yet few behavioral sleep extension interventions have been developed. The goal of our study was to evaluate the feasibility and preliminary efficacy of a technology-assisted sleep extension intervention among individuals with prehypertension/stage I hypertension on sleep, blood pressure and patient reported outcomes.

Methods: Adults aged 30-65 with 24h ambulatory blood pressure (ABP) >120/80 mmHg and average weekday sleep duration <7 h per night were randomized 2:1 to a 6 week technology-assisted intervention versus a self-management control group. The intervention included a wearable sleep tracker, smartphone application, weekly didactic lessons and brief telephone coaching. The control group was instructed to maintain their current sleep schedule. Data were analyzed using descriptive statistics and nonparametric statistics to evaluate differences in between groups as well as pre-post changes within each group. We also conducted bivariate correlations to evaluate predictors of change in sleep and ABP.

Results: A total of 16 adults were randomized into the study (11 intervention, 6 control group, 8 women, \( M=45.8 \ SD=9.8 \) years.) Results at 6 week follow-up demonstrated greater improvement in the intervention group for total sleep time (0.57 versus 0.08 hours, \( p=.027 \)), reductions in 24h SBP (-9 versus 0 mmHg, \( p=.013 \)) and DBP (-5 versus -2 mmHg, \( p=.026 \)), improvements in self report measures including reductions in sleep disturbance (-7 versus 5 t-score points, \( p=.003 \)) and sleep related impairment (-10 versus 2 t-score points, \( p=.008 \)).

Conclusion: Technology-assisted sleep extension intervention is feasible and well liked in this population. Results demonstrate the potential for this intervention to improve sleep duration, quality and 24-h BP.

Support (If Any): n/a
1015

A CASE OF EEG ARTIFACT BY PROXY

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Introduction: EEG artifact is defined as any recorded EEG activity that does not originate from the brain and is a commonly encountered issue in the interpretation of polysomnography. It is crucial for the practicing clinician to be able to identify EEG artifact to allow for accurate staging of sleep and prevent inaccurate conclusion of epileptiform activity.

Report of Case: A 10-year-old boy with a history of Trisomy 21 was referred to the sleep lab for evaluation of snoring and possible sleep apnea. To optimize his tolerance to the laboratory environment, the patient’s mother was allowed to sleep in bed with him. During the recording, sharp activity occurring regularly at approximately 1 Hz was observed during stage N2 sleep, most prominently at the left frontal electrode. Notably, this activity did not correspond in time to the patient’s own EKG tracing. Review of concurrent video monitoring demonstrated the patient’s head was positioned against his mother’s neck and chest, and thus artifact generated by the mother’s pulse waveform was suspected. This was confirmed by resolution of the artifact when the patient eventually changed positions and his head was no longer in contact with his mother’s neck and chest.

Conclusion: This case highlights the fact that artifact from a physiological source emanating from outside of a patient can be detected during routine polysomnographic evaluation. The potential interference from a co-sleeping parent’s EKG, as illustrated in this case, may be an underrecognized source of EEG artifact in pediatric patients. Because many pediatric patients undergoing polysomnography may be at increased risk for having abnormal EEG findings compared to the general population, as was the case for this patient with Trisomy 21, the possibility of such “EEG artifact by proxy” should be considered in the differential of suspicious EEG findings. In such instances, the use of concurrent video monitoring is crucial to verify that the artifact is indeed benign.

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WOLF IN SHEEP SKIN: SERIOUS NEUROLOGICAL CONDITION PRESENTING AS REFRACTORY RESTLESS LEG SYNDROME

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Introduction: Restless leg syndrome (RLS) is common in patients with known spinal cord injury but spinal cord disease presenting as RLS to our knowledge has not been reported. Here we present a case of progressive cervical spondylotic myelopathy who presented with refractory RLS.

Report of case: A 58 years old desperate man with history of obstructive sleep apnea, degenerative disc disease of lumbar sacral and cervical spine, status post lumbar sacral spine surgery in the remote past and RLS of 12 years duration presented with six months history of severe worsening of RLS symptoms. Review of systems was positive for several falls recently that he attributed to the extreme restlessness of his legs. He had been on pramiprazole for years but this was no longer effective. Another physician had switched him to ropinirole without clinical benefit. His physical examination demonstrated wide based gait with spasticity in the legs. He was given gabapentin and MRI of his cervical spine was obtained. While he had no response to gabapentin, his MRI showed severe cervical stenosis with multilevel spinal cord compression and cord signal change. He was urgently referred to neurosurgery for decompression and had complete resolution of RLS symptoms at one month post-operative follow up.

Conclusion: While RLS is very common and is a clinical diagnosis, it is important to consider secondary causes of RLS and to perform a neurological examination. It was solely the history of falls and exam findings of myelopathy that led to the diagnosis of the serious spinal cord lesion in this patient. His failure to respond to usual treatments, chronic nature of RLS with acute worsening and complete resolution of his symptoms after spinal decompression all confirm that his RLS was the symptom of worsening cervical spondylotic myelopathy. It is important to consider these mimickers in the evaluation of patients with RLS.

1017

UNUSUAL CLINICAL COURSE OF CONGENITAL CENTRAL HYPOVENTILATION SYNDROME: IS OUTGROWING THE SYNDROME POSSIBLE?

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Introduction: Congenital Central Hypoventilation Syndrome (CCHS) is a rare disease diagnosed mostly in neonatal or early childhood period. Typically, this condition requires lifelong ventilatory support. Many newer presentations of this syndrome have been described after the availability of the genetic probe for diagnosis. Here we describe a case where a patient no longer has the symptoms of CCHS in her twenties after a typical clinical course during childhood.

Report of case: A 29 years old female was seen in our adult sleep medicine clinic given issues with her noninvasive ventilation (NIV) machine. History was significant for respiratory symptoms of CCHS since infancy; however she was only diagnosed and treated with NIV at the age of seven. She had genetic probe analysis which showed polyalanine repeat mutations in paired-like homeobox 2B (PHOX2B) gene with 20 polyalanine repeat normal allele and a very large expanded allele. As a child, she was followed regularly in the pediatric clinic with sleep studies, imaging studies and blood work as per practice standards for CCHS. She had evidence of hypventilation in all sleep studies and presented with clinical symptoms of headache, fatigue, and exercise intolerance whenever she missed using her NIV. Over years, she had gained weight but had no sleep apnea symptoms. Upon presentation in the clinic, she has not used nocturnal NIV for 8 months due to issues with the machine. Surprisingly, she was completely asymptomatic, without any recurrence of her CCHS symptoms. Her serial polysomnogram showed continued improvement in her baseline end tidal CO2 and the severity of hypventilation at night.

Conclusion: While respiratory arrest was believed to be the presenting feature of CCHS, it is now known that this syndrome has varied presentations. This is explained by reduced and variable penetrance of the autosomal dominant inheritance of this mutation. Spontaneous
improvement or resolution of symptoms has not been reported for CCHS. Findings like this could alter our understanding of the natural history of this condition which otherwise is usually considered to be grim. Further analysis of specific molecular mechanisms in these unusual cases could improve our understanding of this fascinating disease.

1018
A CASE OF NON-24-HOUR SLEEP-WAKE DISORDER IN A SIGHTED 29YO MALE
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Introduction: The prevalence of Non-24-Hour Sleep-Wake Disorder (N24SWD) is estimated to occur in 50–80% of totally blind individuals but reports of the disorder in sighted individuals is relatively rare.1 This poster presentation aims to describe a case of N24SWD in a 29yo sighted male.

REPORT OF CASE: A 29yo sighted male with Borlin Syndrome, chronic pain, and anxiety, received care at an outpatient sleep medicine clinic for chief complaint of difficulty with sleep onset and sleep maintenance. As a compensatory mechanism for pain, he developed the habit of staying in bed for extended hours “waiting for the pain to improve.” Upon completion of sleep logs, a pattern of successively delayed sleep and wake times were observed consistent with N24SWD.

CONCLUSION: Even though N24SWD is a disorder that most commonly afflicts the blind, it should always remain in the differential diagnosis for any patient who presents with insomnia. The pathophysiology of N24SWD is thought to be the result of lack of photic entrainment, decreased sensitivity of the circadian clock to light, or an alteration in entrainment pathways that result in weakened or lack of entrainment of the endogenous circadian clock.2 In sighted individuals, however, the etiology is less clear, but thought to be induced by certain environmental conditions such as limited exposure to light.1 This case report is one such example, and it demonstrates how essential sleep logs can be in aiding with the diagnosis.

SUPPORT (if any): None

1019
OSA CORRECTION WITH TORUS MANDIBULARIS RESECTION
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Introduction: Obstructive sleep apnea (OSA) is a rising issue worldwide. Oral anatomical anomalies are being linked to OSA. Obstruction of the oropharyngeal passage by any form: bony growth, increased tissue, over-relaxation, or genetically smaller maxillofacial features increase the risk of OSA. We present a patient that demonstrates resolution of OSA after successful surgical correction and the addition of an oral appliance after failing continuous positive airway pressure (CPAP) therapy.

Report of Case: 47-year-old female complained of sleep disturbance for her entire life with snoring, nocturnal arousals and daytime sleepiness. Home sleep apnea testing (HST) demonstrated moderate OSA with apnea-hypopnea index (AHI) 26.5. Patient was unable to tolerate CPAP therapy. Physical exam revealed bony prominences in the floor of the patient’s mouth. Patient underwent surgical resection of the torus mandibularis. After oral surgery a repeat HST with an oral appliance was performed showing resolution of patient’s OSA with AHI 1.6.

Conclusion: Due to the increase in diagnosis of sleep apnea. More patients are unable to tolerate PAP therapy. A complete oral examination is an important aspect in evaluating patients for sleep apnea. Surgical correction of torus mandibularis with the addition of an oral appliance was effective in treating this patient’s moderate OSA.

1020
ARTERIOVENOUS MALFORMATION WITH DEVELOPMENT OF NARCOLEPSY
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Introduction: Secondary narcolepsy, resulting from an underlying condition, is a rare disorder supported by few case reports and small patient series. More common causes include brain tumors, traumatic brain injury, multiple sclerosis or encephalitis. Dysregulation of the sleep-wake cycle by reduced hypocretin production is the primary pathophysiology. Locations of injury include the hypothalamus, amygdala and pontine region. We report a case of a 32-year-old female who underwent embolization of an arteriovenous malformation (AVM) which resulted in narcolepsy.

Report of Case: 32-year-old female was evaluated for complaints of excessive daytime sleepiness (EDS). In 2012 she had a stroke as a result of an AVM that was at the level of the pons, posteriorly. She underwent a vascular embolization to treat her AVM. Immediately following the embolization, she developed EDS. Symptoms worsened with bilateral cranial nerve 3 palsy. She denied hypnogogic hallucinates, sleep paralysis or cataplexy. A normal sleep-wake cycle was reported. The multiple sleep latency test (MSLT) demonstrated a mean sleep onset latency of 3 minutes with two episodes of REM during naps. Due to the cranial nerve 3 palsy the EEG was very difficult to determine REM sleep. However, the patient had classic sawtooth patterns without chin tone and underlying higher frequency wavelength confirming the diagnosis of REM sleep. She achieved REM sleep in three out of four naps. She was initiated on wake promoting therapy with dramatic improvement reaching a near normal sleep wake perception. Unfortunately, she had a divorce due to her EDS.

Conclusion: This is a novel presentation as it is confounded by the presence of cranial nerve 3 palsy resulting in an abnormal EEG pattern making the diagnosis more difficult. Delayed for several years is not uncommon. A high clinical suspicion, appropriate history, and accurate diagnostic testing can be life altering. Being able to recognize all EEG aspects of REM sleep and understanding the anatomical structures housing the neurochemical pathways for accurate diagnosis of narcolepsy. Early recognition and treatment have the potential to impact not only the patient, but also friends and family as in this case.

1021
IMPLEMENTATION OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (CBTI) FOR ASIAN-AMERICAN ADOLESCENTS WITH CHRONIC INSOMNIA AND SUICIDAL IDEATION
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Introduction: Awareness has increased regarding the unique suicidal risk factors affecting Asian Americans. Sleep disturbance is well established as a significant risk factor for suicidal behavior. CBTi has been demonstrated as a reliable intervention to reduce suicidal ideation among patients with insomnia; this case study is an example of successful implementation of CBTi with an adolescent, Asian-American patient exhibiting symptoms of anxiety, depression, and suicidal ideation, resulting in a reduction of psychological distress.
9) = 24. Additionally, she exhibited severe symptoms of anxiety and depression and had never been treated by a mental health professional. She believed that her anxiety and depression was largely the result of extreme pressure she placed on herself to succeed academically in order to avoid disappointing her parents, a common concern among Asian-American adolescents. After the initial evaluation, CBTi was implemented, including sleep hygiene, stimulus control, sleep restriction, relaxation, and cognitive therapy. As she began implementing strategies, she reported that she believed her sleep had mildly improved. Upon her second visit with the sleep psychologist, sleep efficiency was found to be equivalent to intake (70%) and the patient’s responses remained the same on the ISI and the FSS. However, her psychological distress improved, resulting in a score of 16 on the PHQ-9, an 8-point decrease from her initial score, including a reduction in the frequency of suicidal thoughts.

**Conclusion:** This case is ongoing and illustrates that adolescent patients who are experiencing chronic insomnia and suicidal ideation can benefit from CBTi and experience a reduction in suicidal thoughts. Furthermore, this case demonstrates the power of in-person therapeutic contact in the reduction of psychological distress.

Support: None.

**1022**

**THE “RESPIRATORY SIGNATURE” OF PERIODIC LEG MOVEMENTS – A POTENTIAL WAY TO TRACK INDIVIDUAL THERAPY RESPONSE OBJECTIVELY**

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**Introduction:** Each night millions of patients use continuous positive airway pressure (CPAP) to treat obstructive sleep apnea (OSA). Due to insurance regulations and to guide clinical management, CPAP devices routinely record users’ respiratory signal and analyze it in near real-time. Current Philips-Respironics devices upload these data into a central database which is accessible online by physicians via EncoreAnywhere™. Many medical conditions cause characteristic imprints (“signatures”) on the respiratory signal (e.g. atrial fibrillation increases central apneas); thus, in principal, CPAP devices allow detection and monitoring of such conditions. To our knowledge this is the first report of respiratory alterations due to periodic leg movements (PLMs; report covered by Beth Israel Deaconess Medical Center IRB protocol 2016P000058).

**Report of Case:** A 66-year-old man with severe OSA (apnea-hypopnea index, AHI3% 87/h; oxygen saturation nadir 87%) reported residual sleepiness despite excellent adherence with optimal CPAP therapy for months (residual machine-detected AHI 2.5/h, average nightly use 8h). Inspection of online respiratory data during follow-up revealed frequent, short-cycle (20-30seconds) hyperpeans especially during the first half of the night; he denied restless leg symptoms, but admitted to witnessed leg-kicking during sleep, and his prior sleep study had shown an increased number of PLMs (67/h; normal <15/h). During a diagnostic trial with pramipexole 0.125mg nightly for 10days he reported significant improvement in sleep quality and daytime symptoms which immediately reverted back to baseline upon termination; this was paralleled by a virtual resolution of hyperpeans during-and immediate recurrence after—the pramipexole-trial (Figure A-C). Machine-detected sleep apnea parameters (including AHI, nightly usage, respiratory rate or tidal volume) did not change compared with 10days before and after the trial (P Kruskal-Wallis >0.1 for all comparisons; R 3.0.3, the R Foundation).

**Conclusion:** PLMs are very common and their significance is often unclear, especially when observed in the setting of OSA. In this case, however, they clearly contributed to disturbed sleep and daytime symptoms. During the initial sleep study there were frequent PLMs paralleled by hyperpeans, about half of which were associated with EEG-arousals (suggesting subcortical arousals in the remainder; see Figure D & E); timely resolution of both symptoms and hyperpeans with pramipexole strongly suggests PLMs as the underlying cause of this unique “respiratory signature”, which may allow detection and monitoring of other patients with PLMs in the future.

Support: Matthew Light and Christopher Schmickl are supported by a NIH T32 grant “Training the Next Generation in Respiratory Science” HL134632.

**1023**

**RESOLUTION OF IDIOPATHIC CENTRAL SLEEP APNEA AFTER PROLONGED TREATMENT WITH ACETAZOLAMIDE: A CASE REPORT**

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**Introduction:** Idiopathic central sleep apnea (ICSA) is caused by instability of the control of breathing particularly in the transition from wakefulness to sleep. Literature regarding management of ICSA in children is limited. Current reported management options include watchful waiting, supplemental oxygen, NIPPV or tracheostomy depending on severity of illness and there is limited information regarding the efficacy of acetazolamide treatment for ICSA in children.

**Report of Case:** A 3-year-old girl with history Autism, and global developmental delay presented for evaluation of insomnia and restless sleep. She underwent diagnostic polysomnography for evaluation of sleep disordered breathing. Her initial polysomnography study (PSG) revealed a central apnea index (CAI) of 8.5/hour, obstructive AHI(AHl) of 0.3/hour, without hypoventilation. Workup revealed a normal MRI, long term EEG monitoring was done, and blood work showed no evidence of daytime hypoventilation nor hypercarbica. Acetazolamide therapy (3 mg/kg/day PO initially) was started for treatment of her central sleep apnea. The patient had initial weekly monitoring of bicarbonate levels to reach target medication levels. She then had subsequent laboratory monitoring with dose titrations during the treatment phase (6 m/k/d, 8m/k/d, 10 m/k/d, 12 m/k/d). A second PSG at 6 months after starting acetazolamide therapy, revealed CAI of 5.2/hour), and AHlTo 2.0/hour. Medical management for mild OSA was initiated. During follow-up visits, she reported significant improvement in insomnia, restless sleep and daytime mood symptoms. She was continued on the acetazolamide for 16 months from time of initial diagnosis of ICSA. She was seen for follow up and weaned off the acetazolamide. 2 months after discontinuing acetazolamide, a third PSG revealed sustained resolution of central sleep apnea (CAI=2.4/hour).

**Conclusion:** Low dose acetazolamide may be effective in sustained resolution of ICSA in children.
1024
LARGE POSTERIOR LINGUAL THYROGLOSSAL DUCT CYST PNEUMATICALLY SPLINTED WITH AUTO-CONTINUOUS POSITIVE AIRWAY PRESSURE AT LOW PRESSURES
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Introduction: Most common age of presentation for thyroglossal duct cysts (TDCs) is the first decade of life, however there is similar incidence of TDC in children and adults. Potential vertical locations of TDCs are: lingual, suprathyroid (including submental), thyrohyoid (between the hyoid bone and thyroid cartilage), or suprasternal. Large lingual TDCs are uncommon, usually situated posteriorly, and may cause significant airway obstruction, and in tragic cases sudden infant death, or fatal asphyxia in adults, perhaps by valve effect on the epiglottis, leading to closure of the trachea by a pressed epiglottis. Large lingual TDCs may potentially be pneumatically splinted with positive airway pressure therapy, given the compressible fluid filled nature of the TDC.

Report of Case: The patient is a 58-year-old Iranian American man with long-standing snoring that progressively worsened 4 years ago. Home sleep apnea testing (HSAT) showed an apnea hypopnea index (AHI) of 51.1 events per hour, and patient was started on auto-CPAP with pressure range of 5–20 cm delivered through a nasal mask. Auto-continuous positive airway pressure (auto-CPAP) download for 50 days prior to TDC surgical resection showed an average AHI of 3.6 events per hour, with auto-CPAP mean pressure 7.4 cm H2O, and average device pressure ≤ 90% of usage time 9.3 cm H2O. Recently while attempting to undergo elective cosmetic facial surgery, his anesthesiologist found his “tongue too large,” and the surgery was cancelled. Patient denied neck mass, throat pain or soreness, voice hoarseness, or cutaneous fistula; he did however endorse gradually worsening dysphagia with globus sensation. Subsequent Otolaryngology consultation, including computerized tomography revealed a 5.8 cm anterior-posterior diameter, by 5.1 transverse diameter, by 4.4 cm cranial-caudal diameter, homogeneous, hypo-dense round/oval base of the tongue lesion, slightly to the right of mid line, displacing the epiglottic vallecula posteriorly, and intimately associated with the hyoid bone, consistent with a large TDC. No internal nodularity, or suspicious enhancement was noted, which was resected along with central hyoid bone using a combined trans-oral robotic surgery (TORS)/Sistrunk procedure. Surgical specimen histopathology revealed a sub-acutely inflamed cyst lined by respiratory and squamous epithelium abutting resected hyoid bone, histologically consistent with a TDC. HSAT after TDC surgical resection revealed an AHI of 10.5 events per hour which was a significant drop from 51.1 events per hour noted before the surgery.

1025
PERIODIC LIMB MOVEMENTS DURING SLEEP NOTED ON VENTRAL THIGH SURFACE ELECTROMYOGRAPHY IN AN ABOVE THE KNEE AMPUTATED STUMP
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Introduction: Ventral thigh surface electromyography may be used to assess for periodic limb movements during sleep (PLMS) in a limb with an above the knee amputation. Presence of PLMS in the proximal portion of an amputated lower extremity supports theories of spinal and supra-spinal mechanisms in PLMS generation; and demonstrates that intact distal motor efferent pathways and distal sensory afferent pathways are not absolutely necessary for PLMs generation.

Report of Case: The patient is a 57-year-old white man, with past medical history of hypertension, hypercholesterolemia, and diabetes mellitus, who at age 50 suffered a severe motorcycle accident requiring a right lower extremity above the knee amputation. At age 51 he was diagnosed with obstructive sleep apnea, and has been on continuous positive airway pressure (CPAP) therapy of 11 cm of water pressures since. He presents to Sleep clinic with worsening daytime sleepiness, following 50-pound weight gain since start of CPAP. His current CPAP device does not provide residual apnea hypopnea index at applied pressure; as such an in-laboratory CPAP titration polysomnography was ordered to determine his current CPAP pressure requirement. He denies urge to move his lower extremities while sitting, or sleeping; and denies lower extremity kicking during sleep. On the polysomnography periodic limb movements during sleep (PLMS) were noted on right lower extremity above the knee amputation stump, with right lower extremity surface electromyography electrodes placed on the ventral right thigh surface.

Conclusion: Periodic limb movements during sleep (PLMS) are involuntary, repetitive, stereotypic, short-lasting segmental movements of the lower extremities consisting of dorsiflexion of the big toe with fanning of the small toes, accompanied by flexion at the ankles, knees, and occasionally the hip. The pathophysiology of PLMS is not yet completely understood. Because of their resemblance to the Babinski response, some attribute PLMS to suppression of supraspinal descending inhibitory pathways on the pyramidal tract. There are major controversies regarding the localization of the neural structures involved in their pathophysiology. Spinal and supra-spinal mechanisms have been implicated in PLMS generation and modulation. Indeed, PLMS have been reported in patients with spinal cord injuries, even in cases of complete spinal transection.
C. Case Reports

1027
EFFECT OF CLONAZEPAM ON OBSTRUCTIVE SLEEP APNEA COEXISTING WITH REM BEHAVIOR DISORDER: A CASE REPORT.
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Introduction: Rapid eye movement behavior disorder (RBD) is a parasomnia characterized by loss of muscle atonia during REM sleep, resulting in excess motor activity and dream enactment. These behaviors may lead to interrupted sleep and injury to the person or their bed partner. Obstructive sleep apnea can coexist with RBD and the treatment of one may affect the course of the other condition. We report a case of RBD and the effect of Clonazepam treatment on the severity of concomitant OSA.

Report of case: Sixty-six year old female without any significant past medical problems presented with abnormal behavior during sleep including screaming and attempting to ambulate, sometimes resulting in injury. She also had snoring and daytime fatigue. She did not have symptoms of cataplexy and she was not on SSRI. Detailed evaluation was negative for underlying neurological/psychiatric disorder. Her Epworth sleep scale (ESS) score was 2. Overnight polysomnography was significant for RBD and OSA (AHI 5.5/hour). She was initiated on Clonazepam & Melatonin for RBD and CPAP for OSA. Over next few years, she reported improvement in behavioral symptoms during sleep, but developed worsening of daytime sleepiness (ESS score 7). Repeat polysomnography showed AHI of 16/hour. There was significant improvement in observed REM behavioral abnormalities compared to previous study. Regarding OSA, she developed CPAP intolerance, eventually requiring BiPAP as indicated by titration study with subsequent improvement in symptoms.

Conclusion: There is paucity of data on the complex interplay between RBD and OSA. Clonazepam is commonly used to treat RBD, but the mechanism of action is unclear. Clonazepam may possibly be associated with worsening of OSA, as observed in our patient and few previously reported cases. Knowledge on the underlying cause of this effect is limited. Our patient was also on Melatonin, but previous reports showed Melatonin might be associated with improvement in OSA. Our case shows the need for watching for onset worsening of OSA symptoms in patients with RBD on Clonazepam. This observation also indicates the necessity of further research in this field.

Support: none

1028
MARIJUANA USE AND THE MULTIPLE SLEEP LATENCY TEST: A DIAGNOSTIC DILEMMA
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Introduction: A standardized Multiple Sleep Latency Test (MSLT) can help determine if a patient who suffers from subjective excessive daytime sleepiness has objective hypersomnolence. Marijuana is the most commonly used illicit drug in the US and recreational use is becoming legal in many states1. MSLT findings can be complicated by marijuana use and cause false positive diagnoses of narcolepsy2.

Report of Case: A 43-year-old woman presents to the sleep disorders clinic with excessive daytime sleepiness (EDS), insomnia, sleep disruption, sleep attacks, and cataplexy episodes. MSLT results: Mean sleep latency was severely reduced at 0.5 minute, with a total of 4 sleep-onset REM periods (SOREMPS) occurring during naps 1, 2, 3, and 4. Urine drug screen on the day of the MSLT was positive for marijuana.

Conclusion: Marijuana use can cause daytime sleepiness and shorten both REM onset and sleep onset times during the MSLT, causing false positive results. Given the potential for drug abuse in marijuana users, a urine drug screen should always be performed prior to the MSLT in order to mitigate the recreational use of potentially habit-forming medications for narcolepsy.

Support/Discussion: There are limited studies evaluating how MSLT results are affected by a positive urine drug screens. Positive screens may confound the diagnosis of idiopathic hypersomnia and narcolepsy without cataplexy as they rely heavily on positive MSLT findings for diagnosis2. Performing a drug screen before an MSLT can significantly alter the diagnosis and management of hypersomnolence. A positive urine drug screen may preclude the need for an MSLT altogether2. Marijuana use is also prevalent in adolescents. In one study, 10% of adolescents with EDS had both a positive drug screen for marijuana and positive MSLT findings3. There are no current guidelines on how to treat patients with concurrent positive drug screens and MSLT findings. Even if a true central hypersomnia is confirmed, treatment options may be limited as most treatments are controlled medications that may not be appropriate for patients with a history of illicit drug use.
during data collection, despite of reviewing the data with the physician. Patient was politely reminded of how her intentional manipulation had caused a breach in the therapeutic relationship. Further provision of stimulants was denied from the clinic.

Conclusion: The actigraphy data collected revealed a pattern supportive of device removal concerning for intentional deception in order to obtain higher doses of stimulant medications. Thus, it was quite useful in guiding the longitudinal management of the patient and prevented from unwarranted dose escalation of potentially dangerous stimulants with abuse potential. This case suggests that the indications for use of actigraphy should be broadened as it can prove to be of high utility in long term management of patients.

Support: N/A

1030
MELATONIN USE FOR INSOMNIA IN POST-TRAUMATIC SPINAL CORD INJURY.
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Introduction: Spinal cord injury, in particular cervical spinal cord injuries with tetraplegia, often leads to decreased sleep efficiency. Reasons for this might include pain, sleep disordered breathing or diminished melatonin secretion.

Report of Case: Here we present a case of melatonin use for insomnia following a spinal cord injury. The patient is a 43-year-old male with a history of cervical spinal cord injury after a vehicle accident and onset of insomnia immediately after the time of injury. Nineteen years after his accident, he was seen in Insomnia Clinic. At this time, he has recovered function of hands and arms and can walk. He has persistent dysautonomia and orthostasis. During his evaluation, he was found to have an insomnia severity index score of 25. He was treated with CBT-I, sleep hygiene, and increased mindfulness. A consultation with Sleep Medicine was requested. Polysomnography demonstrated no underlying sleep disordered breathing. Melatonin was recommended after reviewing the literature and finding that diminished melatonin secretion can be a secondary effect of cervical spinal cord injuries. He was started on 3 mg of melatonin one hour prior to sleep. At a follow up visit, the patient endorsed improved sleep time and quality.

Support: The pathway for melatonin release is a complicated one. Light signals are relayed from the retina through the suprachiasmatic nucleus of the hypothalamus. From there they are sent to the cervical spinal cord and superior cervical ganglion. From there the post ganglionic neurons ascend to the pineal gland, the organ producing melatonin. The fact that part of the pathway is in the cervical spinal ganglia lends credence to the theory that injuries in this area lead to decreased melatonin surge at night.

Conclusion: A case-controlled study performed in 2006 demonstrated that cervical spinal cord injury resulted in lower sleep efficiency with an absence of nocturnal melatonin surge. Other studies have revealed that patients with spinal cord injuries (SCI) experience greater amounts of excessive daytime fatigue and sleepiness, regardless of the presence of sleep disordered breathing. Based on this, it was extrapolated that the physiologic melatonin surge could be mimicked with exogenous melatonin be

1031
THE DIAGNOSTIC IMPACT OF APPROPRIATELY TIMED MSLT
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Introduction: The multiple sleep latency test (MSLT) is commonly used to assess daytime sleepiness. In the right clinical setting, an MSLT diagnostic for narcolepsy has a mean sleep latency ≤ 8.0 minutes with ≥ 2 sleep onset REM periods (SOREMs). The test is typically performed during the day. However, in today’s world many people work nontraditional hours requiring thoughtfulness in the timing of their evaluations.

Report of Case: A 50 year old female presented for management of excessive sleepiness which she reported as narcolepsy. She described a longstanding history of sleepiness, hypnagogic and hypnopompic hallucinations, and inadvertent napping. She did not endorse cataplexy. She slept from 8am until 1–2 PM. She worked two jobs between 4 pm – 7am. She denied sleep disordered breathing symptoms or other sleep disruptors. As part of her previous work up, she reportedly underwent a blood test, which was unavailable to us, diagnosing narcolepsy. Based on her history, she was encouraged to increase total sleep time. She was offered treatment for shift work sleep disorder; however, she desired formal confirmation of her narcolepsy diagnosis. Two weeks of actigraphy showing decreased sleep opportunity with the majority of sleep occurring the early morning hours. She then underwent a nighttime PSG revealing no sleep disordered breathing or excessive limb movements. Sleep onset and REM latencies were 7 and 360.5 minutes, respectively. The following daytime MSLT revealed a mean sleep latency of 4.5 minutes and two SOREMs. It was noted that the MSLT was performed during her normal sleep period, which likely skewed the results. Therefore, repeat testing was performed with a daytime PSG followed by evening MSLT. The PSG did not reveal any significant abnormalities. Sleep onset and REM latencies were 0.1 and 192.5 minutes, respectively. The evening MSLT revealed a mean sleep latency of 2.4 minutes and no SOREMs. Given the history and MSLT results, she was diagnosed with shift work sleep disorder with insufficient sleep time.

Conclusion: This case highlights the importance of actigraphy in understanding the typical sleep wake schedule and appropriately timing the MSLT based on this information to maximize the diagnostic accuracy of the MSLT.

1032
REVERSIBLE CENTRAL SLEEP APNEA SYNDROME INDUCED BY VALPROIC ACID TREATMENT: A CASE REPORT
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Introduction: Valproic acid (Depakine) is a commonly used agent in the management of epilepsy and psychiatric disorders. Common side effects include gastrointestinal disturbances, tremor and bodyweight gain, but central sleep apneas have never been observed as side effect. We report here a case of central sleep apnea without Cheyne-stokes breathing, induced by Valproic acid (VPA).

Report of case: The Patient presented is a 64 years old woman, who complained of snoring, non-restorative sleep and daytime sleepiness.
She was treated with VPA for one epileptic seizure from 10 years. A polysomnographic recording showed a central sleep apnea syndrome (CSAS) with an apnea hypopnea index (AHI) of 106.9/h with a central apnea index (CAI) of 61.2/h, without Cheyne-stokes breathing, and associated with obstructive sleep apnea (obstructive apnea/hypopnea index OAHI=43.8/h). Cardiologic examination eliminated heart failure or past stroke. Patient did not suffer from CNS disease and did not receive opioids or codeine which may induce breathing dysregulation and central apnea. CSAS was not due to acute or chronic alcohol intake.

On the follow-up polysomnography, 3 months after withdrawal of VPA, with no drug substitution, and without CPAP treatment nor weight loss, the patient presented a decrease of CSAS with a CAI of 12.4/h and a persistent OAHI of 45.7/h. On follow-up 5 months after withdrawal of VPA, polysomnography, performed without CPAP treatment nor weight loss showed resolution of CSAS with a CAI of 1.8/h, and a persistent OAHI of 44.2/h.

Conclusion: In our patient, the intrinsic imputability of VPA on occurrence of Central sleep apnea syndrome was considered strong by the drug safety unit because of temporal relationship, exclusion of other possible causes and reversibility when the treatment is withdrawn. A possible depressive role of valproic acid on central control breathing neurons cannot be excluded. Our findings need to be confirmed on a larger sample of patients but already raise attention for clinicians about the adverse effects of valproic acid on nocturnal breathing.

1033 HYPOXIA INDUCED SUPRAVENTRICULAR TACHYCARDIA, RESOLVED WITH CONTINUOUS POSITIVE AIRWAY PRESSURE TITRATION
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Introduction: Arrhythmogenesis in obstructive sleep apnea in a known but under-recognized phenomenon, which may be due to autonomic nervous system imbalance triggered by a combination of apnea and hypoxemia, as well as cardiac remodeling. This case demonstrates a dose-dependent reduction in atrial arrhythmia with increasing continuous positive airway pressure (CPAP) in the setting of moderate sleep apnea, AHI 17.8.

Report of Case: A 74-year-old female presents for sleep apnea evaluation. Past history of excessive daytime sleepiness and restless leg syndrome, asthma, hypertension, lupus. Vital signs blood pressure 140/80 saturation, HR72, 94% on room air weight 212 pounds, BMI 42.82 pounds per inches. Cardiovascular exam shows an apical impulse on the left fifth intercostal space midclavicular line, normal rate and rhythm without murmurs no pedal edema. Current medications include hydrochlorothiazide 25 mg, enalapril 10 mg, albuterol HFA, hydroxyzochloroquine 200 mg.

During PSG and CPAP titration, multiple atrial arrhythmias were noted during REM sleep with associated hypoxia. Patient was noted to have a total of 53 desaturation events, with 13 being less than 80%. The lowest SaO2% reached 67.0%. AHI was noted to be 17.8 with resolution to < 5 on 11cmh2O. Mean heart rate during REM elevated to 139 bpm. Following titration of pressures up to 11 cmH2O, not only did the apnea and hypoxia index normalize, the patient no longer experienced episodes of SVT. Unfortunately, after PSG completion, patient ultimately refused to tolerate PAP therapy due to mask intolerance and claustrophobia.

Conclusion: Appropriate titration of CPAP not only reduced OH/OA respiratory events and decreased AHI, but increases baseline saturation and normalization of heart rate. This case highlights a possible future clinical pattern. Criteria of a successful titration may not be limited to supine AHI reduction, but a more complex evaluation of baseline SaO2 and normalization of heart rate. With more evidence, further assessment and re-evaluation of the gold standard of a successful titration may be warranted. Furthermore, patient compliance with PAP therapy may be emphasized to serve a long term cardio-protective role.

1034 NASAL MASK AVERAGE VOLUME-ASSURED PRESSURE SUPPORT VERSUS CONVENTIONAL BILEVEL RESPIRATORY SUPPORT IN A 10-MONTH-OLD INFANT WITH CONGENITAL CENTRAL HYPOVENTILATION SYNDROME: A CASE REPORT
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Introduction: Congenital central hypoventilation syndrome (CCHS) is a rare lifelong disorder characterised by alveolar hypventilation and autonomic dysregulation secondary to mutations of the PHOX 2B genes. Treatment consists of assisted ventilation using positive pressure ventilators via tracheostomy, bi-level positive airway pressure (BPAP), negative pressure ventilators, or diaphragm pacing. Previous case studies have reported successful ventilation with early use of conventional nasal non-invasive BPAP in infants with CCHS without the need for tracheostomy. The case we describe is the first to report the use of average volume assured pressure support (AVAPS) feature through a nasal mask on an infant with CCHS.

Report of Case: The 10-month-old female infant was born with a birth weight of 4590 grams to healthy parents after an uneventful pregnancy and delivery. Hypoxia, hypercarbia, respiratory distress and hypotonia were noted soon after delivery and the infant was resuscitated using intermittent positive airway pressure ventilation. She was subsequent put on non-invasive nasal BPAP for respiratory support in view of unexplained hypercarbia (PCO2 ranging 70 to 90 mmHg) on capillary blood gas. DNA analysis revealed that she carried a 25-repeat polyalanine expansion mutation of the PHOX 2B gene confirming CCHS. Her first sleep study on BPAP showed high variability in TcCO2 tracing. There was a rise in TCO2 by more than 10 mmHg though it remained only slightly elevated above the normal range (35 to 47 mmHg). A second follow up sleep study was performed on the AVAPS feature, enabling the machine to automatically adjust the inspiratory pressures to deliver a constant targeted tidal volume. In our case, this feature led to a better transcutaneous carbon dioxide profile compared to conventional nasal non-invasive BPAP.

Conclusion: In summary, our case is unique as it is first to report the successful use of the AVAPS feature in an infant with CCHS. This case highlights that the AVAPS feature may be a reliable alternative to tracheostomy and conventional non-invasive BPAP in infants with CCHS. Randomised control trials are needed to compare the use of conventional BPAP and AVAPS feature in children and infants.

1035 DREAM ENACTMENT BEHAVIOR DURING NON-REM SLEEP IN THE SETTING OF SEROTONIN NORADRENERGIC REUPTAKE INHIBITOR THERAPY & REM SLEEP SUPPRESSION
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Introduction: REM Sleep Behavior Disorder (RBD) requires confirmation of loss of muscle atonia during REM sleep on video polysomnography (vPSG), often with dream enactment behavior (DEB). We report on patient with DEB during non-REM sleep in the setting of duloxetine-induced REM-sleep suppression.

Report of Case: A 71-year-old female with a history of depression on duloxetine presented with abnormal behaviors during sleep consisting of injurious and noninjurious DEB. She confirmed witnessed DEB prior to duloxetine, with worsening frequency and severity when the dose was increased. Neurologic examination was normal and there was no evidence of anosmia or constipation. vPSG revealed episodes of complex speech and DEB during N1 and N2 sleep in the absence of REM sleep, thus preventing documentation of REM-sleep-without-atonia. However, two episodes of DEB occurred where the patient hit the bedrail and swung her arms towards a supposed intruder during N1 and N2 sleep with corresponding EMG augmentation with amplitudes in excess of four times baseline levels. The patient’s vPSG did not reveal “pseudo RBD” related to sleep apnea, N3 disorder of arousal, periodic limb movements, or nocturnal seizures/ictal EEG.

Conclusion: DEB is not unique to RBD as DEB has also been previously described in non-REM sleep. However, in the setting of duloxetine therapy we report on a unique presumed RBD phenotype with DEB emerging from N1 and N2 sleep associated with drug-induced REM-sleep suppression.

DEB and elevation of EMG tone may be observed during non-REM sleep in patients with complete drug-induced REM-suppression, raising the need to be inclusive of EMG augmentation in support of RBD events manifesting during non-REM sleep.

Support: none.

1036 POLYSOMNOGRAPHY AS PROGNOSTIC INDICATOR FOR PIERRE ROBIN SEQUENCE (PRS)
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Introduction: Pierre Robin Sequence (PRS) is a heterogeneous condition presenting with upper airway obstruction, and polysomnography (PSG) is an objective way to determine the severity of obstructive sleep apnea (OSA), but its role in the management of PRS in neonates has not been well-defined. We are presenting two cases of PRS in which PSG was used not only to determine the severity of upper airway obstruction but also to objectively measure improvement after intervention.

Report of Cases: Case 1: A male infant born at 38-week gestation and found to have PRS was transferred to our hospital due to low oxygen saturation in mid-80’s and was initially managed by prone position. PSG was done on day 11 which showed severe obstructive sleep apnea in the side-lying position with an AHI of 34.2 and minimal oxygen saturation (O2 min) of 83%. Tongue lip adhesion (TLA) was done on day 16 and he was successfully extubated on post-operative day 7. Repeat sleep study on room air 2 weeks post-operatively showed improvement of AHI to 3.5. He was discharged home 3 days later room air.

Case 2: A female infant born at 40-weeks at home was noticed to have severe oxygen desaturation to 50’s and was transferred to hospital. She was also determined to have features of PRS with micrognathia, cleft palate amongst others. She was managed with laryngeal mask airway (LMA), high flow nasal cannula (HFNA) and prone positioning. PSG was done one week after birth on room air (after weaning O2) showed AHI of 94.8 with O2 nadir of 67%. TLA was done but she continued to have intermittent desaturations. Repeat PSG one week post-operatively showed persistent severe OSA. Internal Mandibular Distractors were placed surgically, and a repeat PSG done three weeks post-operatively showed resolution of OSA with AHI of 1.7 and O2 nadir of >90%. She was discharged home 2 days after PSG.

Conclusion: Our case reports signify that PSG can be used in the infancy period to characterize the severity of OSA but also in the immediate post-op period to make further decisions regarding prognosis and hospital discharge.

1037 WORTH A SECOND LOOK: A CASE OF AN INFANT WITH NP ARM CCHS WITH A NEGATIVE PSG AND NORMAL PHOX2B.
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INTRODUCTION: Congenital Central Hypoventilation Syndrome is a rare disorder characterized by alveolar hypoventilation and autonomic dysregulation. A PHOX2B gene mutation is required to confirm the diagnosis of CCHS.

REPORT OF CASE: A male term infant born to a 21-year-old primigravid without prenatal complications presented at 4 weeks old with cyanosis and apnea. Work-up showed hypoglycemia and leukopenia. He was intubated and given antibiotics for 7 days. He had persistent witnessed apneas post-extubation, despite bilevel PAP support. Brain ultrasound and MRI, EEG, echocardiography were reportedly normal.

Patient was transferred to our institution and re-intubated. He presented with fever, nasal congestion and intermittent stridor. He was started on empiric antibiotics and was extubated after a week. Initial PSG done at 6 weeks of age showed moderate OSA (AHI 11.7, RDI 11.2) with elevated pCO2 (highest 53mmHg), with 3 central apneas (CAI 0.5). Impression was Apnea and Acute Respiratory Failure due to likely viral infection. Patient was discharged home on room air with oral prednisone. Genetic testing was pending at discharge.

Patient was asymptomatic when genetic tests were resulted. PHOX2B gene test (RUSH Medical Laboratories) was normal with 20 repeats/allele. Critical Trio Whole Exome Sequencing (Baylor Genetics) showed a heterozygous c.945A>C (p.*315Cext*41) pathogenic NPARMs in the PHOX2B gene. WES showed that the mother is negative and father possibly mosaic for this change.

Repeat polysomnography at 11 weeks old showed severe OSA (AHl 135, RDI 135, with 122 obstructive events/hour) with oxygen nadir 70% and Moderate CSA (CAI 12.7) with severely elevated PCO2 values (highest at 76mmHg). Positive airway pressure (up to 14/4 cmH2O) with a back-up rate of 25cpm and supplemental oxygen at 1Lpm improved the obstructive events, however patient continued to have hypoventilation. He was placed on bilevel PAP during PICU re-admission. A tracheostomy tube was placed for long-term mechanical ventilation. He was discharged home with family at 19 weeks of age and has been doing well since.

CONCLUSION: ~10% of CCHS patients have non-polylalanine repeat mutations (NPARMs), which is associated with a more severe phenotype. We present an atypical presentation of a rare disease: NPARM CCHS in which the initial PSG did not demonstrate hypoventilation, and initial PHOX2B test was normal. Our case shows that close clinical monitoring and extended genetics should be considered.
if there is a high suspicion for CCHS. We hope to contribute to understanding the spectrum of disease patterns of this rare disease.

1038
RESOLUTION OF SLEEP DISORDERED BREATHING IN A PEDIATRIC PATIENT WITH ACQUIRED CHIARI I MALFORMATION FOLLOWING POSTERIOR FOSSA DECOMPRESSION
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Introduction: Chiari I malformations (CIM) are characterized by >5-mm herniation of the cerebellar tonsils through the foramen magnum. Herniation results in compression of the brain stem. Neuronal structures in this area are involved in control of respiration and pharyngeal wall muscle tone. Compression of the brainstem is known to result in respiratory complications. We present a case of a pediatric patient with central sleep apnea (CSA) due to an acquired CIM. Resolution of the compression via posterior fossa decompression (PFD) resolved the CSA.

Report of Case: A 4 year old male with a history of prematurity, 36 weeks, developed bacterial meningitis. Hydrocephalus developed as a complication of the meningitis requiring a ventricular peritoneal (VP) shunt to be placed. After surgery an acquired CIM was diagnosed at 2 years of age. At 4 years, he was admitted to the PICU with emesis and headache. The VP shunt was functional and a brain MRI was unchanged at that time. During this admission new onset episodes of apnea (up to 25 seconds in duration) and bradycardia (57 bpm) were observed. These events resolved with stimulation or elevating the head of the bed. A diagnostic polysomnogram (PSG) was performed showing an apnea hypopnea index (AHI) of 5.46 and an obstructive AHI (oAHI) of 2.18. The CSA index was 3.27. Oxygen nadir was 88% and transcutaneous CO2 was normal. He was placed empirically on BPAP ST 8/4 cm H2O with a backup rate of 12 breaths per minute and was discharged home. As an outpatient he underwent suboccipital craniectomy and right subtemporal decompression without complication. A repeat PSG was performed 3 months following surgery. The study showed an AHI of 2.29 and an oAHI of 1.78. The CSA index was 0.51. Oxygen nadir (96%) and TcCO2 levels were normal.

Conclusion: CIMs are known to cause CSA due to compression of the respiratory centers in the brainstem. This case demonstrates that mild CSA can be caused by a CIM. Resolution of the compression was successful in resolving the CSA in this case. Screening of children with known neurological conditions with polysomnography may be beneficial in identifying CSA due to CIM.

1039
ELECTROCUTION AS A RARE CAUSE OF REM SLEEP BEHAVIOR DISORDER
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Introduction: Rapid eye movement sleep behavior disorder (RBD) is a parasomnia characterized by dream enactment behavior and loss of rapid eye movement (REM) atonia on polysomnography (PSG). RBD is commonly associated with synucleiopathies seen in neurodegenerative diseases. In this novel case of REM sleep behavior disorder, however, the patient developed RBD after suffering an electrocution injury.

Report of Case: A 32 year old male fireman presented for evaluation of three years of abnormal sleep behaviors that had been occurring multiple times a week since an electrocution injury. This injury occurred when he entered a burning house to which electrical power had not been disconnected and came in contact with the 220 volt line of the washer and dryer. He was hospitalized following this injury with multiple trauma and burns. Since that injury, he acts out his dreams including calling out or talking during sleep. The patient reported that he had tried both zolpidem and trazodone. The zolpidem worsened his symptoms and trazodone made no difference. At time of presentation, he was taking eszopiclone 2 mg, cyclobenzaprine 10 mg, and acetaminophen with codeine for persistent chronic pain and muscle spasms. Polysomnography revealed an apnea hypopnea index of 1.4 events per hour. The study showed poor sleep efficiency at 38.7% with a total sleep time of 173.5 minutes and only 36 minutes of REM sleep. Loss of REM atonia was not appreciated during this brief recording. Given his classic symptoms of dream enactment, he was started on alprazolam 0.5 mg at bedtime. On subsequent follow up, he had complete resolution of parasomnia symptoms.

Conclusion: Electrocuption injury has been well studied with regard to damage to the heart, as well as both central and peripheral neurologic injury; however, to our knowledge electrocuption has never been associated with RBD. In this case, we suspect that the severe electrocuption resulted in neurologic injury that led to the development of RBD. This case also demonstrates the efficacy of alprazolam in the management of RBD.

1040
RESOLUTION OF EXFOLIATIVE DERMATITIS AND ALOPECIA AREATA OPHIASIS WITH THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

INTRODUCTION: The comorbidity of atopic dermatitis and obstructive sleep apnea can have a reciprocal improvement with the use of continuous positive airway pressure.

Report of Case: Patient is a 17 year old African American female with a history of severe exfoliative dermatitis exacerbations secondary to uncontrolled atopic dermatitis (AD) with eczema herpeticum who presented with dermatopathic lymphadenitis, alopecia areata ophiasis, night sweats, nocturia, habitual snoring with hypertrophy of the tonsils to the sleep medicine department for her snoring and nocturnal sweating.

Night time sweats produced an intense pruritic response. Nocturia occurred four times a night. Autoimmune and infectious disease work ups were negative. Skin and lymph node biopsies revealed dermatopathic lymphadenitis secondary to exfoliative dermatitis. Treatments included avoidance of suspected AD triggers, emollients, hypo-allergenic soaps and topical steroids. The application of topical steroids resulted in exfoliative dermatitis with eczema herpeticum and staph infections multiple times. Gabapentin improved her pruritic condition and a slight improvement in her skin and scalp was noted.

A sleep study revealed the patient to have an Apnea-Hypopnea index of 16.4, excessive sweating and severe snoring were also noted on her sleep study. The mother of the patient declined the use of immune modulating therapies including topical steroids, methotrexate, cyclosporine, and tacrolimus as well as the recommendation for a tonsillectomy. Patient and mother agreed to the use of CPAP and photographing the progression of the disease. No change in the patient’s medications nor consistency were noted. After 10 months of excellent CPAP compliance, photographical evidence as well as physical examination revealed the patient’s hair returned as well as her an improvement in her skin was noted. Nocturia resolved after the use of CPAP. Patient

A417
reported two weeks of not using her CPAP machine and reported a new onset of hair loss and worsening of eczema.

**Conclusion:** The use of continuous positive airway pressure has the potential for reducing inflammatory responses in the skin for patients suffering from atopic dermatitis as well as obstructive sleep apnea, reducing the need for immune modulating therapies.

### 1041

**THE CASE OF THE VACATIONING CENTRALS**  
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Case Western Reserve University School of Medicine

**Introduction:** Mysteriously low central apanes on a travel PAP device provided an illustration of physiology.

**Report of Case:** History of Present Illness: A 76 year-old man with atrial fibrillation and snoring had a diagnostic PSG with an overall AHI of 46, but events were mostly central with Cheyne-Stokes respiration, with some mixed apanes. Echo showed LVEF 50%, mild-moderate LA dilatation, and PASP estimated at 23 mmHg. He was treated with autotitrating PAP because a titration study was compromised by poor sleep efficiency; patient declined ASV because he travels a lot.

Patient presented for follow up in clinic feeling well, but noted that his AHI was much lower while using his travel PAP device, which was basically the same device as his home machine, just more compact. Whereas his home device had an average residual AHI of 30, his travel device had an average residual of about 11.

Comparison of the two device settings revealed that the Opti-Start feature was de-activated on his home device, but activated on his travel device. This feature is a proprietary algorithm of Philips Respironics that determines a starting pressure based on the patient’s pressure requirements during the previous 30 hours of use. It is designed to provide proactive pressure support during the wake-sleep transition, rather than simply relying on the auto-titration algorithm.

The feature was activated on his home machine, and after two weeks, his residual AHI went down to levels comparable to what they were on his travel machine.

**Conclusion:** PAP can effectively reduce CSR-CSA. Breathing during his travel machine.

His residual AHI went down to levels comparable to what they were on his home machine, just more compact. Whereas his home device had an average residual AHI of 30, his travel device had an average residual of about 11.

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The feature was activated on his home machine, and after two weeks, his residual AHI went down to levels comparable to what they were on his travel machine.

**Conclusion:** PAP can effectively reduce CSR-CSA. Breathing during his travel device, providing predetermined starting pressure support and minimal ramp time should be considered.

Support: No financial support. Technical support was provided by Philips Respironics, Inc.

### 1042

**RECURRENT RADIAL NERVE MONONEUROPATHY SECONDARY TO SODIUM OXYBATE IN A PATIENT WITH SEVERE NARCOLEPSY WITH CATAPLEXY.**  
**Grace Wang, MD and Shelley Hersher, MD**  
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**Introduction:** A patient with severe narcolepsy with cataplexy experienced recurrent radial nerve mononeuropathy, likely secondary to sodium oxybate (Xyrem). Sodium oxybate, a potent CNS depressant, causes heightened arousal threshold. Patients may not awaken from warning signs of nerve compression and are more susceptible to sequelae of prolonged compression.

**Report of Case:** A 29-year-old male with narcolepsy with cataplexy developed two episodes of radial nerve mononeuropathy on sodium oxybate.

He initially presented to the ER with paresthesias of his left hand and inability to extend his left wrist or fingers after playing guitar for 6 hours the day prior. The neurologic exam was otherwise normal. He was discharged with a splint. Ultrasound was negative for nerve entrapment.

Four months later, he woke up, unable to extend his left arm or wrist without a history of trauma/compression. Persistent decrements in radial nerve function were noted in clinic several months later. Neurological exam revealed 3+/5 of the left wrist and finger extensors and decreased sensation to pinprick in the 1st-3rd digits on the dorsum of the left hand.

Electromyography showed a >50% drop in motor action potential across the spiral groove, consistent with conduction block. Abnormal spontaneous activity (p-waves, fibrillation potentials) and decreased recruitment of voluntary motor units were noted in the left extensor indicis and brachioradialis. This EMG was diagnostic of a left radial mononeuropathy at the spiral groove with significant demyelination and notable axonal loss.

A sodium salt of gamma-hydroxybutyrate (GHB), sodium oxybate is a potent CNS depressant causing a heightened arousal threshold. We suspect that our patient may not have perceived warning signs of nerve compression (e.g. paresthesias) and was more susceptible to prolonged radial nerve compression. Associated sequelae (focal demyelination, axon degeneration, sensory loss, weakness) ensued.

While patients with hereditary neuropathy with pressure palsy can also experience isolated nerve palsies after trivial trauma, our patient lacked the cranial nerve involvement, sensorineural deafness, and scoliosis typically seen in this condition.

**Conclusion:** Sodium oxybate, a potent CNS depressant, causes heightened arousal threshold. Patients may not awaken from warning signs of nerve compression and are more susceptible to sequelae of prolonged compression.

### 1043

**UNEXPLAINED HYPOXEMIA IN A PATIENT WITH DUCHENNE MUSCULAR DYSTROPHY LEADING TO A DIAGNOSIS OF CHRONIC MYELOID LEUKEMIA.**  
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**Introduction:** Our patient with Duchenne Muscular Dystrophy (DMD) presented with unexplained hypoxemia during wakefulness and sleep (SpO2 85–90%), which led to a diagnosis of hyperleukocytosis/chronic myeloid leukemia.

**Report of Case:** A 14-year-old boy with DMD and restrictive lung disease underwent a diagnostic polysomnogram. The polysomnogram demonstrated non-apneic hypoxemia without hypoventilation during wakefulness (SpO2 87–90%) and sleep (85–90%) as well as hypopneas. BPAP 10/4 cm H2O effectively treated the hypopneas, but oxygen saturations did not improve with supplemental oxygen (max 1.5 LPM). The patient was healthy and denied fever, cough, or dyspnea. Without unexplained hypoxemia that was not responsive to supplemental oxygen, a chest CT was performed showing mild bissal atelectasis, without pulmonary AVM or consolidation. The radiologist also noted splenomegaly and upon additional questioning, the patient had unexplained weight loss and early satiety.
Therefore, a CBC was obtained showing hyperleukocytosis (WBC 629,000) and anemia (Hemoglobin 7.5). The patient was admitted to pediatric hematology-oncology. Bone marrow biopsy and peripheral blood smear showed chronic myeloid leukemia (CML).

After chemotherapy, the patient’s oxygen saturations normalized to SpO2 99%.

**Conclusion:** Common causes of hypoxemia in DMD include ventilation-perfusion mismatch due to mucus-plugging and hypoventilation, which should improve with supplemental oxygen. Since these mechanisms did not explain our patient’s findings, determining the etiology of hypoxemia through additional work-up and history was imperative. Patients with leukemia and hyperleukocytosis (leukemia cell count > 50-100x 10^9/L), are at risk for hypoxemia from infection, pulmonary embolism, pulmonary vascular leukostasis (small vessel occlusion by leukemic cell aggregates), leukemic infiltration, opportunistic neoplasms, and hemorrhage.

Hyperleukocytosis can be associated with spuriously-low PaO2 values on arterial blood gas due to oxygen consumption by metabolically-active white blood cells. Pulse oximetry is cited in the literature as a surrogate for arterial blood gas due to oxygen consumption by metabolically-active white blood cells. Although the etiology of hypoxemia was not entirely clear in our patient, pre-CML oxygen saturation (SpO2 85–90%) normalized to SpO2 99% after chemotherapy, suggesting potential pulmonary involvement by CML.

This case illustrates the importance of investigating the etiology of unexplained hypoxemia.

**Support:**


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**1044 A TREATMENT OF LACRIMAL DUCT AIR REGURGITATION IN A PATIENT INTOLERANT TO PAP THERAPY**

Paymon Ebrahimzadeh, DO, Kyle Almodovar, DO Mary Anne Tablizo MD

**INTRODUCTION:** Positive airway pressure is a standard treatment for severe obstructive sleep apnea syndrome (OSAS). However, compliance is a major issue due to discomfort, such as irritation to the conjunctivae from air leakage. Lacrimal Duct Air Regurgitation (LDAR) is a rare side effect with few reported cases. Treatment of this Positive Airway Pressure (PAP) complication is also not well documented.

We report a case of a patient diagnosed with severe OSAS requiring Bilevel PAP (BiPAP) with prior history of lacrimal duct dilatation.

**REPORT OF CASE:** Our case is a 62 year old Caucasian male with a history of obesity, hypertension, retinopathy and a known history of lacrimal duct obstruction requiring subsequent dilatation who presented for polysomnography (PSG) due to excessive daytime sleepiness (Epworth Sleepiness Scale 15). He was diagnosed with severe OSA (AHI 89.3, nadir SpO2 73%) on PSG. He was titrated on Continuous Positive Airway Pressure (CPAP) twice using a nasal and a full-face mask, which was not tolerated due to complaints of a sensation of bubbles and crackling sounds from the lacrimal ducts, consistent with LDAR. A subsequent BiPAP titration study using a F&P Oracle mask was successful in spontaneous mode IPAP 21 and EPAP 12. He had short term improvement in compliance but was eventually discontinued due to persistent mask leak, despite reduced pressures. He was seen by Ophthalmology who placed lacrimal duct plugs, with significant improvement in compliance with a full face mask.

**CONCLUSION:** LDAR can cause poor compliance in patients requiring high pressures on PAP therapy. Previous case reports suggest management with reduced PAP pressures, total face mask or interventions to avoid PAP therapy, such as turbinate reduction and mandibular advancement. To our knowledge, ours is the first reported case of a patient with OSAS and LDAR who was successfully treated with lacrimal duct plugs and full face mask. This demonstrates that a detailed history, including previous ophthalmologic interventions, is important for the evaluation of PAP intolerance. Early recognition and treatment of LDAR can increase PAP compliance.


**INTRODUCTION:** Narcolepsy is characterized by excessive daytime sleepiness and rapid eye movement (REM) sleep dysregulation. In addition, narcolepsy can be associated with REM sleep behavior disorder (RBD), often characterized by violent enactment of vivid dreams. We present a case of a recovering alcoholic with Narcolepsy Type 1, RBD, and obstructive sleep apnea (OSA).

**Report of Case:** A 39-year-old male with anxiety, depression, PTSD, prior alcohol dependence now 9 years sober presented to our sleep clinic complaining of frequent loud snoring, daytime somnolence with an Epworth sleepiness scale score of 18, and dream enactment behavior. The patient’s dream enactment behavior was frequently violent. Treatment with nighttime melatonin was initiated empirically for clinical suspicion of RBD. A split-night polysomnogram with expanded electromyography montage confirmed mild obstructive sleep apnea with an apnea hypopnea index of 5 events/hour as well as REM sleep without atonia. The patient was treated with positive airway pressure therapy (PAP) and despite adherence with PAP, excessive daytime sleepiness persisted. The patient then divulged development of cataplectic episodes while sharing emotional experiences at Alcoholics Anonymous meetings. A repeat polysomnogram with PAP titration with multiple sleep latency test was performed which was notable for a mean sleep latency of 0.9 minutes and 2 sleep-onset REM periods, consistent with the diagnosis of Narcolepsy Type 1. Treatment with nighttime sodium oxybate was initiated as well as daytime amphetamines. Symptoms of cataplexy, daytime somnolence, and sleep quality all subsequently improved. Dream enactment behavior continued but improved in severity after up-titration of melatonin to 15 mg of melatonin nightly. History of frequent head trauma was subsequently reported at follow-up, and work-up for traumatic brain injury is pending (TBI).

**Conclusion:** The relationship between RBD and narcolepsy was first described in 1992. RBD prevalence is increased in patients with...
C. Case Reports

1046
COGNITIVE BEHAVIORAL AND ACCEPTANCE BASED GROUP TREATMENT FOR INSOMNIA (CBT-I) & (ACT) IN ADULTS WITH COMORbid CHRONIC INSOMNIA AND CHRONIC PAIN.
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Virginia Consortium Program in Clinical Psychology and Eastern Virginia Medical School

Introduction: Due to the reciprocal nature of chronic insomnia and chronic pain, those who meet criteria for both of these diagnoses present with additional factors that often impede sleep treatment progress (Smith & Haythornthwaite, 2004). To assist with these factors, components of Acceptance and Commitment Therapy (ACT) were used in conjunction with Cognitive Behavioral Therapy for Insomnia (CBT-I) in a group of patients with comorbid insomnia and chronic pain.

Report of Case: A group consisting of three middle-aged adults (a Caucasian female, an African American male, and a Caucasian male) with comorbid chronic pain and insomnia are presented in this case. Although the duration, type, and intensity of both the chronic pain and insomnia symptoms varies between group members, all acknowledged the impact that both the physical sensations and pervasive thoughts related to their chronic pain had on the onset and duration of their sleep. A total of eight group sessions combining CBT-I and ACT were conducted. The primary components of CBT-I emphasized throughout treatment included sleep education, stimulus control, and sleep restriction. To assist with sleep interference related to chronic pain the addition of ACT techniques, such as, mindfulness, committed action, and cognitive defusion, strategies were employed. Sleep diaries were used to measure progress and determine the course of treatment throughout the sessions and the Pittsburgh Sleep Quality Index (PSQI) was administered before and after the group to examine changes in sleep quality. They reported shorter sleep onset and less time awake after sleep onset throughout the night. Moreover, total sleep time and sleep efficiency increased as well. Significant decreases in PSQI global scores indicate sleep quality improvement from pre-treatment (M=15, SD=1.00) to post-treatment (M=8.5, SD=1.73) scores t(2) = 4.58, p = .044.

Conclusion: After participating in combined CBT-I and ACT treatment, group members with chronic pain reported improved sleep and sleep quality after 8 weeks of combined CBT-I and ACT. The combination of these therapies provides techniques to assist pain-related barriers to treatment. Further research should examine the efficacy of this approach and specific mechanisms of change.

Support: N/A

1047
CAUGHT ON CAMERA: INTERPRETATION OF POLYSOMNOGRAM
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Introduction: As home sleep apnea testing becomes more popular, in laboratory attended polysomnograms (PSG) are done less frequently. However a PSG provides valuable information using multiple channels and diagnostic tools. We present a case where comprehensive review of a PSG highlights the importance of the multifaceted aspects of a PSG in making an accurate diagnosis.

Report of Case: Our case is a 24-year-old lady with chronic insomnia and daytime sleepiness with an Epworth Sleepiness Score of 13 out of 24. She suffered from anxiety, depression, post-traumatic stress disorder, and asthma. She also had symptoms suggestive of restless leg syndrome. Physical exam was unremarkable and overnight oximetry showed some heart rate variability with possibility of minimal to mild sleep disordered breathing.

Due to concern for undiagnosed sleep disordered breathing and periodic leg movements with restless leg symptoms, patient underwent diagnostic PSG. While the PSG did not show evidence of sleep apnea-hypopnea syndrome, there were periods with increased tibial electromyography (EMG) tone at regular intervals with simultaneous abnormal signals in the abdominal plethysmography band, suggestive of periodic limb movements. Video correlation reveals these abnormal findings were related to leg crossing. Abnormal EMG tone was absent when legs were uncrossed.

Conclusion: This case highlights the importance of the comprehensive review of an in-lab PSG. PSG is an invaluable tool to pick up artifacts, which would have otherwise been missed and resulted in false diagnosis and treatment of periodic limb movement.

Support: None

1048
SEXSOMNIA – AN UNUSUAL NREM PARASOMNIA
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Introduction: Sexsomnia is a parasomnia associated with sexual behavior. It arises from NREM Sleep and is commonly associated with other NREM parasomnias. To date only 96 clinical cases of sexsomnia have been described. The Differential Diagnosis includes REM Sleep Behavior Disorder and Sleep Related Epilepsy.

Report of Case: We present a case of a 40-year-old male with a history of sleep related sexual behavior since college. The patient has had 2 to 3 episodes per week which can range from kissing to actual intercourse. He has amnesia for the episodes until informed by his wife. His sleep related sexual behavior ended his first marriage and is straining his current marriage. He and his wife sleep apart. Our patient had a sleep log and a diagnostic polysomnogram. His AHI was 1.3/hour. Arousal index was 3.5/hour. Periodic limb movements were 2.6/hour and PLMs with arousal was 1.7/hour. The patient had Stage N3 13% and Stage R 29%. No REM or NREM parasomnias were observed. Sleep log showed 7.8 hours of sleep per night with sexual behavior occurring twice weekly and associated with alcohol consumption. The patient was counselled to abstain from alcohol. Anticipating cross-reactivity with alcohol we did not treat with clonazepam. We prescribed paroxetine with excellent results. In the two months since abstinence from alcohol plus addition of paroxetine he and his wife have been sharing the same bed again. Only one episode of kissing has occurred.

Conclusion: The clinical features of this rare NREM parasomnia are sexual behavior with total amnesia of the event by the patient. Events include moaning, masturbation, sexual intercourse and sexual assault. In published case series there is a strong male predominance. Nearly half of sexsomnia patients have a history of or concurrent sleepwalking or nightmares. Patients with sexsomnia also have more N3 awakenings than healthy matched controls and the same amount as regular sleepwalkers. Sleep specialists, mental health providers and primary care providers

Support: N/A
should be aware of sexsomnia in order to identify patients suffering from this atypical parasomnia. Undiagnosed sexsomnia can cause adverse psychological consequences and serious medico-legal issues.

1049
THE EMERGENCE OF CHEYNE-STOKES-BREATHING IN A PATIENT WITH ATRIAL FIBRILLATION AND AN IMPLANTED HYPOGLOSSAL NERVE STIMULATOR.

Introduction: Atrial fibrillation (AF) is a common arrhythmia associated with idiopathic central sleep apnea (CSA), even without congestive heart failure. CSA may predict subsequent AF.

TREATMENT associated with idiopathic central sleep apnea (CSA), even without con-

Report of Case: A 76 year-old male with chronic AF and severe CSA >25% of the total AHI is a contraindication for im-

1051
SECOND DEGREE HEART BLOCK IN A YOUNG MAN.

Introduction: Episodic sinus arrest and atrioventricular block occur in approximately 20% of patients with obstructive sleep apnea (OSA) in comparison to just 3% among the healthy population. Bradycardia is more commonly once during REM sleep and are associated with the severity of OSA and extent of hypoxemia. Here we present a case of a patient with second degree AV block discovered on diagnostic polysomnogram revealing severe obstructive sleep apnea (OSA).

Report of Case: A 28-year-old man referred to our center for hyper-

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study, most notably in phasic REM sleep and persisted during the titration, although with improvement once on appropriate PAP settings. Consequently, a 24-hour Holter ECG was recorded showing sinus rhythm with intermittent nocturnal second degree atrioventricular (Mobitz I) block with the longest pause of 2.5 sec. Cardiology decided to continue to monitor the patient since he is asymptomatic and the heart block most likely is related to his untreated OSA.

**Conclusion:** Many patients with sleep related bradyarrhythmias present with non-specific symptoms and may remain undiagnosed. Once diagnosed, many patient’s bradyarrhythmias resolve with adequate PAP therapy. Currently, the appropriate treatment of REM related bradyarrhythmias remains a topic of discussion.

### 1052 HYPERTROPHIC CARDIOMYOPATHY AND SLEEP APNEA- THE CENTRAL PLOT

**Introduction:** Limited data exists on sleep-disordered breathing (SDB) in hypertrophic cardiomyopathy (HCM) with an estimated frequency of 40–80%, predominantly of obstructive sleep apnea (OSA). We present a case of Central Sleep Apnea (CSA) and Cheyne-Stoke Respiration (CSR) in a patient with HCM and normal sinus rhythm (NSR). To the best of our knowledge this may be the first case that provides physiological insight to the pathogenesis of CSR in HCM patient in NSR.

**Report of Case:** A 62 y/o woman with a history of HCM underwent polysomnography (PSG) for excessive daytime sleepiness. The PSG demonstrated severe CSA with CSR with an apnea-hypopnea index of 65, and a central apnea index of 54. None of the tested continuous positive airway pressure settings effectively controlled the CSA. A repeat titration study with adaptive servo-ventilation demonstrated optimal control of the CSA.

Her echocardiogram showed asymmetric septal hypertrophy, ejection fraction (EF) of 80% and diastolic dysfunction. Brain MRI did not show any lesions which would account for CSA or CSR.

**Conclusion:** Very limited data exists on CSA in patients with HCM. CSA with CSR is common among patients with congestive heart failure with low EF, unlike our patient with preserved EF. We hypothesize that like systolic dysfunction, diastolic dysfunction with preserved EF may also contribute to CSR by elevating left sided pressure resulting in pulmonary congestion. This can stimulate pulmonary vagal afferent C fibers, which in turn stimulate respiration and drive the CO2 down resulting in CSA during sleep. CSR may also occur as a direct result of the prolonged circulation time that can occur in these patients. This case highlights that CSR could be a presentation of patients with HCM in NSR and preserved EF. They may represent a particularly important subgroup as CSA with CSR is independently associated with an elevated risk for appropriate cardioverter-defibrillator therapies and ventricular arrhythmias. Appropriate identification and treatment of these patients could have a mortality benefit, although further research is needed to answer these specific questions.

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### 1053 NARCOLEPSY IN TOURETTE SYNDROME

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**Introduction:** Tourette syndrome is a chronic disorder with involuntary motor and vocal tics. Sleep problems are common due to increased tics and comorbid conditions like attention deficit hyperactivity disorder (ADHD) and anxiety. Medications to treat tics or insomnia can cause daytime sleepiness.

**Report of Case:** A 14-year-old male presents with the complaint of excessive daytime sleepiness of more than 1-year onset. He has a past medical history of Tourette syndrome, ADHD, anxiety, depression, and adenosinergic subtype due to recurrent pharyngitis. He is homeschooled, and sleeps between 10 pm to 6 – 10 am every day. Naps >2 h every day. Snoring, gasping and sleep talking are reported. His Epworth sleepiness score was 24. He denied hallucinations or cataplexy. He denied alcohol/drug abuse, trauma, hospitalization or family history of narcolepsy. Physical exam was unremarkable except BMI 35.29 kg/m2. His differential included obstructive sleep apnea vs. narcolepsy. His extended release guanfacine to treat tics was stopped, and Neurology held off starting an antidepressant for the sleep studies. The in-lab polysomnography showed an Apnea-Hypopnea Index = 0.6/h, Total Sleep Time = 7.8 h, Sleep Latency = 1 min, REM Latency = 47.5 min, Sleep Efficiency = 85%, and Periodic Limb Movement Index = 0/h. The Multiple Sleep Latency Test showed a Mean Sleep Latency in 5 naps = 7 min and Sleep-onset REMs = 3, meeting criteria for narcolepsy. Anti-streptolysin O was less than 200 IU/mL. Guanfacine was switched to naps to reduce daytime sleepiness. Amphetamine-dextroamphetamine was started at 5 mg BID due to palpitations and slowly increased to 20 mg extended release in the morning and 10 mg immediate release in the afternoon. Modafinil has also been added, and both sleepiness and tics are under control.

**Conclusion:** This case reminds us that among other sleep related problems, narcolepsy can coexist in Tourette syndrome. It’s interesting that both conditions share an impaired hypothalamus-hypophysis axis but are not commonly linked together. Management is a concern as stimulants can cause tics. We consider medically appropriate to assess and study their sleep problems and treating with stimulants when necessary to improve quality of life.

**1054 CONGENITAL CENTRAL HYPOVENTILATION SYNDROME AND PHOX2B TESTING**

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**Introduction:** Individuals with congenital central hypoventilation syndrome (CCHS) have marked nocturnal hypoventilation and autonomic dysfunction. CCHS is commonly caused by a polyalanine expansion repeat mutation in PHOX2B. We describe a case of a child with hyperventilation and negative PHOX2B testing.

**Report of Case:** 10-year-old boy with tracheostomy and nocturnal ventilatory dependence presented for further evaluation of sleep-related hypoventilation. He was born full term and required intubation after birth. Stridor was noted that was felt to be from bilateral vocal cord dyskinesia and mild subglottic stenosis. Head ultrasound and brain MRI within the first month were unremarkable. At 1 month
old, he received a tracheostomy due to multiple failed extubation attempts. At 6 months old, he had negative screening PHOX2B testing (fragment analysis test). Notably, this sample was obtained a month after blood transfusion. He was discharged from the hospital with continuous ventilatory support. Additional pertinent history includes constipation and a history of pneumonia without signs of respiratory distress.

The patient was gradually weaned to nocturnal ventilatory support by 4 years old. To evaluate further weaning support, polysomnography performed initially on room air demonstrated evidence of sleep-related hypoventilation with severe oxyhemoglobin desaturations (nadir = 75%) and a peak end-tidal CO2 of 68 Torr. Including time ventilated, 40% of total sleep was spent with end-tidal CO2 > 50 Torr. Thus, he was continued on nocturnal ventilatory support.

Physical exam is notable for bilateral esotropia, squarishly shaped face, flattened forehead, possible inferior inflection of the lateral upper lip vermilion border, extremity hypertonia, right-sided 4/5 weakness, normal left-sided strength, brisk reflexes, and clonus bilaterally.

**Conclusion:** This case demonstrates the challenge of determining a diagnosis with initial negative genetic testing. Our patient had negative screening PHOX2B testing (fragment analysis test) in the setting of blood transfusion 1 month prior. He demonstrates physical features (esotropia, squarishly shaped face, flattened forehead, possible inferior inflection of the lateral upper lip vermilion border), autonomic dysfunction, hypoventilation, and constipation suggestive of CCHS. In cases of clinical suspicion for CCHS and negative PHOX2B testing, more sensitive studies can be performed including PHOX2B sequence testing then deletion/duplication multiplex ligation-dependent probe amplification if needed.

### 1055

**TRAUMA ASSOCIATED SLEEP DISORDER REVISITED**

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**INTRODUCTION:** Trauma associated sleep disorder (TSD) is a unique parasomnia characterized by nightmares, disruptive nocturnal behaviors (DNB), dream enacting behavior and PSG findings of sympathetic overdrive and REM sleep without atonia (RSWA). Underlying pathophysiology may stem from trauma coupled with sleep deprivation. Some excellent series of TSD have been published but underestimation of evaluation and treatment is in its infancy. We present a case series of veterans with TSD and our treatment approach.

Patients were recent combat veterans referred for dream enacting behavior. All underwent a comprehensive sleep medicine evaluation including in-laboratory level-1 video PSG at an academic sleep center. Treatments were individualized.

**Report of CASES:** We present three cases of TSD with prior traumatic experience and DNB evaluated with comprehensive video PSG who continue to receive care at our clinic.

1. A 40-year-old male with PTSD, TBI, depression and chronic pain presented for nightly history of thrashing, combative movements during sleep. PSG was notable for mild OSA and RSWA in 69% of REM epochs. Tachycardia and tachypnea were noted. The patient significantly improved with CPAP and prazosin.

2. A 35-year-old male with history notable for hypothyroidism and multiple deployments presented with combative dream enactments resulting in injury to bedpartners. PSG was notable for mild OSA, RSWA in 8% of REM epochs and tachycardia during REM. No abnormal behaviors were present on video PSG and treatment is in progress.

3. A 37-year-old male with depression, anxiety, nightmares and prior alcohol abuse on multiple antidepressants presented for DNB following deployment to Iraq. The patient did not have OSA, but PSG captured RSWA in 13% of REM epochs and a confusional arousal. He was started on melatonin due to concerns about prior alcohol abuse and awaits follow-up.

**Conclusion:** TSD is a disabling and underreported sleep disorder potentially representing an overlap syndrome with features of both NREM and REM parasomnias. Diagnosis requires a comprehensive evaluation with video polysomnography. As observed in all reported cases, RSWA is not consistently elevated in this population, and therefore its use in diagnostic criteria warrants further evaluation. Treatment must be individualized due to extensive heterogeneity of the population.

### 1056

**FEELING THE PRESSURE: RECURRENT PNEUMOTHORAX DUE TO NONINVASIVE POSITIVE PRESSURE VENTILATION IN A CENTENARIAN**

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**Introduction:** Negative pressure ventilation (NPV), via “iron lung” and cuirass devices, was an early modality of assisted ventilation in patients with acute respiratory failure. NPV largely fell out of favor with the advent of positive pressure ventilation (PPV) delivered via an endotracheal tube or tracheostomy. Invasive PPV is a well-known cause of barotrauma and pneumothorax, though noninvasive PPV has been rarely described as well. In this report, we present a case of recurrent pneumothoraces due to noninvasive PPV requiring transition to NPV.

**Report of Case:** A 100-year-old woman with congestive heart failure, pectus excavatum, and untreated obstructive sleep apnea was admitted to the hospital with progressive shortness of breath. Physical examination showed a thin elderly woman with severe pectus excavatum of the anterior chest wall. Auscultation demonstrated no overt wheezing or crackles.

Venous blood gas showed pH 7.34; PaCO2 73mmHg; HCO3 32mmol/L. CT scan of the chest confirmed the severity of the pectus excavatum, with marked reduction of the anteroposterior diameter of the chest, and a right sided pleural effusion. Her hypercapnic respiratory failure was attributed to a restrictive ventilatory defect in the setting of severe chest wall deformity, and she was initiated on average volume-assured pressure support (AVAPS) and diuresed. Her dyspnea resolved and repeat arterial blood gas five months later showed pH 7.44, PaCO2 45mmHg, HCO3 30mmol/L.

Six months later, she presented with acute dyspnea and was found on chest radiography to have a small right-sided pneumothorax, which resolved after three days of observation and supplemental oxygen. On discharge, she resumed nocturnal AVAPS. Three months later, she presented with dyspnea and was again found to have a right-sided pneumothorax. PPV was presumed to have precipitated her recurrent pneumothoraces. Therefore, AVAPS was discontinued, and the patient was prescribed cuirass NPV for her chronic hypercapnic respiratory failure.

**Conclusion:** Noninvasive PPV is not a well-known risk factor for pneumothorax. We describe a case of recurrent pneumothoraces in a centenarian without risk factors for spontaneous pneumothorax, aside from noninvasive PPV. PPV can be considered in such patients to control hypercapnia.

**Support:** None
**1057**

**DISTINGUISHING BETWEEN KLEINE-LEVIN SYNDROME AND BIPOLAR DISORDER; A DELAYED DIAGNOSIS OF A RARE SLEEP DISORDER**

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**Introduction:** Kleine-Levin syndrome (KLS) is a rare sleep disorder with a prevalence of one to two cases per one million population. The disease is characterized by episodic severe hypersomnia in addition to cognitive, behavioral, and psychological disturbances. Symptoms of KLS can mimic psychiatric disorders. Diagnosis of KLS in the setting of an existing psychiatric disorder can be challenging. We present a case of KLS in a patient with bipolar disorder.

**Report of Case:** A 32-year-old male with bipolar I disorder, post-traumatic stress disorder, and moderate obstructive sleep apnea with an Apnea Hypopnea Index (AHI) of 21/hour presented with recurrent episodes of daytime sleepiness. Hypersomnia episodes began at age 17 years, lasted between one to six weeks, and occurred with a frequency of two episodes per year. The patient reported an increase to 12–14 hours of sleep per day. These episodes were associated with an increased calorie intake, derealization (i.e. the patient felt like he was walking outside of his body), apathy, hypersexuality, and mental slowness. These episodes recurred despite excellent adherence to continuous positive airway pressure. The patient denied restless leg symptoms, sleep paralysis, hypnagogic hallucinations, and cataplexy. His bipolar disorder was well controlled on risperidone and lamotrigine.

**Conclusion:** KLS is a rare sleep disorder. Other psychiatric, neurologic and sleep disorders share some similar symptoms. Diagnosis of KLS in the setting of an existing psychiatric disorder is challenging, however KLS can be distinguished by its clinical features and should be considered even in the presence of such disorders.

**1058**

**UNIQUE TREATMENT OF PAP INtolerANCE DUE TO RETROGRADE LACRIMAL DUCT AIRFLOW LEAK**

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**INTRODUCTION:** Retrograde lacrimal duct airflow during positive airway pressure therapy is a rare complication which can lead to discomfort for the patient and non-compliance with PAP therapy.

**Report of Case:** Patient is a 68-year-old male with a history of atrial fibrillation status post electrical and chemical cardioversion therapy, obesity (BMI: 30.8), heart failure with preserved ejection fraction of 63% and central predominant sleep apnea with central sleep apnea index of 79/hr. CSA was refractory to CPAP and BiPAP, but responded to ASV.

**CONCLUSION:** Patient started experiencing a blowing sensation in his left eye along with dryness that was eventually diagnosed as retrograde lacrimal duct airflow leak facilitated by the use of nasal and oronasal mask. We surmised that the degree of the retrograde lacrimal airflow regulation likely resulted from excessive pressures in the initial titration, and we advocated for a repeat titration study with trial of O2 therapy and/or lower ASV settings as a contingency plan. On the following sleep study, supplementary oxygen therapy alone was able to decrease CAI to 38/h without attenuating obstructive events. Subsequently, lower ASV Pressure settings with low flow oxygen successfully eliminated central and obstructive events with persistent lacrimal duct reflux. Trialing the new ASV pressure with a total face mask, led to a significant improvement with retrograde lacrimal duct airflow. However, patient continued to have significant dryness of the eyes despite having normal eyelid closure during sleep. Eye dryness was further improved with patient wearing tanning bed goggles. Patient had improved compliance and resolution of the side effect with the interventions.

**1059**

**LUMBOSACRAL GANGLIONEUROMA-ASSOCIATED ROHHAD SYNDROME AND PULMONARY HYPERTENSION**

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**Introduction:** Rapid onset obesity with hypothalamic dysfunction, hypoventilation, and autonomic dysregulation (ROHHAD) is a rare diagnostic entity frequently associated with neural crest tumors and severe morbidity and mortality due to unrecognized hypoventilation and altered autonomic tone. We present a patient with some classic presenting features but delayed diagnosis and under-treated hypoventilation resulting in significant morbidity with development of pulmonary hypertension.

**Report of Case:** An 11-year-old morbidly obese (BMI 51.7 kg/m2) Chinese girl presented for evaluation of sleep-disordered breathing. Her weight dramatically increased at 3-years of age in spite of dietary and exercise interventions. An endocrinology evaluation at 8-years noted central hypothyroidism prompting hormone replacement, insulin resistance prompting metformin initiation, and potential adrenal insufficiency. Due to a history of snoring, a polysomnogram (PSG) performed at 9-years at an outside hospital showed severe obstructive sleep apnea (obstructive apnea hypopnea index [OAHI] of 21.4 events/hour, SpO2 nadir 81%, max ETCO2 55 torr with 41% of total sleep time with ETCO2 greater than 50 torr. At age 10 years, she was noted to have scoliosis and leg-length discrepancy for which imaging demonstrated (and later biopsy-proven) a left psoas lumbosacral ganglioneuroma. Based on the constellation of symptoms, a diagnosis of ROHHAD was made. Continuous positive airway pressure (CPAP) was started for her presumed OSA, but given the severity of hypoventilation, we repeated the PSG with a PAP titration at our institution. The PSG recapitulated severely elevated OAHI which prompted BPAP initiation due to treatment-emergent central apneas on higher CPAP pressures. The patient was referred to cardiology for concerns of right heart strain in setting of chronic hypoventilation due to ROHHAD; echocardiogram while...
In spite of its low frequency, sexsomnia may have severe psychosexual behaviors during sleep. 

Conclusion: Early diagnosis with a high index of suspicion, vigilant monitoring and optimization of ventilatory support is paramount in patients with central hyperventilation disorders such as ROHHAD, as severe consequences such as pulmonary hypertension may develop and pose future, severe health risks to patients.

Support: n/a

1060

NOVEL CASE OF REM BEHAVIOR DISORDER IN A PEDIATRIC PSG
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Introduction: Rapid eye movement (REM) behavior disorder (RBD) in the pediatric population is considered a rare disorder. Associated diseases have been published in case reports including neurodegenerative disease, autism, narcolepsy, Smith-Magenis Syndrome and Moebius Syndrome. We report a novel pediatric case of RBD as a result of neurologic injury from a non-demyelinating disease.

Report of Case: Four-year-old female was born prematurely at 23 weeks and 6 days. Her neonatal intensive care unit (NICU) stay was complicated with congenital CMV infection and periventricular leukomalacia (PVL). After hospitalization required oxygen for 4 months and weaned successfully. She was later hospitalized at the age of 3 for acute respiratory distress syndrome (ARDS) with viral pneumonia at which time she was found to have bronchomalacia and chronic lung disease. During her clinical follow up her mom described her to be a restless sleeper along with snoring and nocturnal arousals. A full night polysomnogram (PSG) was performed showing REM without atonia. There was no evidence of sleep disorder breathing or seizure activity. After in depth review there was no evidence or history of autism, seizures, narcolepsy, neurodegenerative disease, rare genetic syndromes, or RBD-inducing medications. The etiology of her RBD was determined to be related to her underlying neurologic injury in the form of periventricular leukomalacia.

Conclusion: RBD is usually seen in the adult population with infrequent presentations in children. The RBD in this case is novel as it is likely due to her underlying neurologic injury from congenital CMV infection and/or prematurity in the form of periventricular leukomalacia. Awareness of such problem may help to identify patients at increased risk for such disease and providing therapeutic interventions if needed.

Support: N/A

1061

CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS IN SEXSONMIA: A DESCRIPTIVE ANALYSIS.
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Introduction: Sexsomnia is a NonREM parasomnia characterized by sexual behaviors during sleep.

In spite of its low frequency, sexsomnia may have severe psychological, psychosocial, physical and legal consequences. Considering that current knowledge mostly comes from case reports and small series, and systematized data about the features of patients with sexsomnia is scarce, we conducted a systematic assessment of clinical and polysomnographic characteristics in patients with sexsomnia.

Report of cases: Our sample consisted of six patients referred to the sleep clinic because of sexual behavior during sleep. Sociodemographic and clinical features were obtained from medical records and interviews. Five patients underwent nocturnal polysomnography. Three patients were women; all had college, and four had bachelor’s degree. Age mean at clinical onset was 22.5 (15–37) year-old, age mean at diagnosis 33.3±10.27 years old. All had psychiatric comorbidity: 4 major depression, 1 psychotic disorder, and 1 cannabis use. Two patients presented with another sleep disorder (Hypersomnia and Shift Work Disorder). Three patients reported sleepwalking in childhood. Clinical assessment showed that all participants had suggestive scores for insomnia; 3 for excessive diurnal sleepiness; all of them had sleep apnea risk according to Berlin questionnaire but just one according to Sleep Apnea Clinical Score. In all participants, nocturnal sexual behaviors occurred between 1 to 3 am and none had recall of the events the next morning; four subjects reported behaviors 2–3 times/week. Five reported sexual intercourse and fondling to the bed partner; 4 pelvic thrusting, masturbation, self-dressing and groaning; 3 vaginal sex, masturbating sleep partner, undressing sleep partner and self-fondling; 2 anal sex; and 1 oral sex and dirty talk. The polysomnography showed: mean sleep latency 12.3±5.65 min, mean sleep efficiency 85.3±13.77%, N1 mean 10.7±9.46%, N2 43.3±13.95%, N3 16.9±5.4%, REM 14.3±5.65%, mean REM latency 169.8±109.0 min, AH1 0.12±0.13/h, arousal index 9.36±3.08/h, arousals in N1 20.4±11.63, N2 30.6±20.8, N3 3.4±2.88 and REM 6.8±3.83. Hypersynchronous delta waves were observed in four cases.

Conclusion: Our results suggest sexsomnia occurs equally in men and women, its onset is during the adolescence/young adulthood, and the sexual behaviors displayed are multiple. Comorbidity with psychiatry disorders is common and there are no relevant findings in polysomnography.

1062

DIFFERENTIATING CONFUSIONAL PARASOMNIAS FROM NOCTURNAL FRONTAL LOBE EPILEPSY
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Introduction: It can be clinically challenging to differentiate nocturnal frontal lobe epilepsy (NFLE) from parasomnias. Delays in effective treatment due to diagnostic error are not uncommon.

Report of Case: A 66-year-old woman was referred for management of adult night terrors. Her first incident occurred in 2007 followed by further incidents every few months until an apparent remission from 2009–2012. The incidents, however, returned in 2012 and persisted. She would awaken from sleep complaining of abdominal pain. She would then scream and yell repeatedly “I am sick” while appearing confused. She could follow simple commands during the incidents. She was able to recall part of the event in the morning. These events occurred in the middle to late sleep period and could happen several times per night. She was hospitalized for these multiple times in 2007 and 2008 and told the episodes were caused by a peri-infectious psychosis due to a urinary tract infection. The episodes improved with oral antibiotics and lorazepam in 2009 but returned despite these medications in 2012. Polysomnography in 2013 and 2018 showed no sleep-related breathing disorder, electroencephalographic abnormality, or unusual behaviors. Routine electroencephalograms were
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DIFFICULTIES IN DIAGNOSING Milder Forms of Kleine-Levin Syndrome

Author and Institutions: Leon Tung, MD (fellow), Anna Wani, MD, and Gregory Carter, MD, PhD., Departments of Family and Community Medicine and Neurology and Neurotherapeutics, University of Texas Southwestern Medical Center at Dallas

Introduction: The prevalence of Kleine-Levin syndrome (KLS) is 1 to 5 cases per million population. Milder forms of KLS can mimic narcolepsy, circadian rhythm disorders, idiopathic hypersomnias, and mood disorders.

Report of Case: A 15 year old white male with no significant past medical history, psychiatric history or family history of sleep disorders presented with episodic excessive daytime sleepiness. He reported a total of six episodes, lasting 2–3 days, with two per year in 2016, 2017, and 2018. During the events, he slept 15–18 hours per day with difficulty awakening, slowed cognitive function, a sensation of derealization and depersonalization, compulsive eating and hypersexuality. In between these episodes, he returned to his baseline, sleeping for 8 hours on weekdays and 13 hours on weekends with sleep latencies of less than 30 minutes. The patient denied symptoms of depression or anxiety. His school performance was below average. The physical exam was normal except for a BMI of 32. The MRI of brain and the EEG were normal. The polysomnogram showed mild snoring, decreased sleep efficiency (83.9%), a prolonged sleep latency (48 minutes), a normal REM sleep latency (117 minutes), and decreased total REM sleep (62 minutes, 15.4%). There was no significant sleep-related breathing, periodic limb movements, nocturnal hypoxemia, or parasomnia. No seizures were seen. The multiple sleep latency test was normal. Actigraphy showed more than 16 hours of sleep a day during the episodes and 7–8 hours of sleep per day at baseline. Bedtime was delayed to between 3:00 AM to 6:00 AM regardless of whether he was in an episode or at baseline.

Conclusion: The patient’s presentation would support the diagnosis of mild KLS, however, the shorter duration of the episodes is atypical. Confounding factors such as poor sleep hygiene and severe circadian rhythm disorder make certainty of this diagnosis more challenging.

1064
OBSTRUCTIVE SLEEP APNEA FOLLOWING TONGUE – LIP ADHESION (TLA) IN AN INFANT WITH PIERRE ROBIN SEQUENCE

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Introduction: Pierre Robin Sequence (PRS) refers to the triad of micrognathia, glossoptosis, and airway obstruction. Obstructive sleep apnea (OSA) and airway compromise is common in infants with PRS due to tongue-based airway obstruction. Tongue-Lip adhesion (TLA) is an effective procedure that prevents posterior prolapse of the tongue by temporarily adhering the tongue to the lower lip and mandible. This procedure allows time for catch up growth of the mandible and may avoid more invasive interventions such as mandibular distraction osteogenesis (MDO) and tracheostomy.

Report of Case: J.D. is a male infant born at 40 weeks and 3 days with Pierre Robin sequence. A polysomnogram (PSG) performed at 7 days of life showed an obstructive apnea hypopnea index (oAHI) of 50. At 14 days of life, flexible laryngotracheal endoscopy indicated that the tongue base was responsible for airway obstruction. By 3 weeks of life, the patient was able to regain his birth weight and maintain oxygen saturations independently. Tongue-lip adhesion (TLA) was performed at 4 weeks of life. A repeat PSG at 2 months of life showed a reduction of the oAHI to 11.4. The patient is scheduled for TLA take down at 12–14 months of life. Preoperative PSG at 1 year of life showed even further reduction of the oAHI to 5.2.

Conclusion: OSA can improve significantly after TLA. This patient was able to maintain his airway through one year of life without needing additional airway surgery. TLA could be considered before MDO or tracheostomy in patients with PRS who have primarily tongue based airway obstruction.

To date, there are limited consensus guidelines for predicting which infants with PRS will require more invasive therapy. PSG performed in the first few weeks of life may be helpful quantifying the degree of airway obstruction, with the most severe obstruction favoring more invasive procedures. Interpretation of the infant PSG may be difficult however, as there is no clear data on normal oAHI values in infants. The oAHI may naturally improve as the infant grows, which may account for improvement in oAHI over time regardless of the chosen intervention. More research is needed to examine how the severity of obstruction seen on PSG relates to long term airway outcomes.

1065
NEW DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA FOLLOWING ANTERIOR CERVICAL DISCECTOMY AND FUSION, WORSENED BY RHEUMATOID ARTHRITIS

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Introduction: Onset of obstructive sleep apnea (OSA) following anterior cervical discectomy and fusion (ACDF) has been published in a retrospective study of 12 patients. Association of obstructive as well as central sleep apnea with Rheumatoid arthritis (RA) affecting the cervical vertebrae has also been observed. Here we present a case of new diagnosis of OSA following ACDF and subsequent worsening caused by RA and further instrumentalization affecting the cervical spine.

Report of Case: A 66 yr old female with history of hypertension and rheumatoid arthritis and no prior diagnosis of OSA, underwent ACDF of C5-6 and C6-7 in 2012 due to progressive increase in pain, numbness and loss of grip strength in the right upper extremity. Postsurgically in recovery she was noted to have apneic episodes. Following discharge she underwent investigation with oximetry and subsequent polysomnography (PSG) and was diagnosed with mild OSA and placed of CPAP at 8cm H20. Two years later, her neurological symptoms worsened. Re Imaging showed pseudoarthrosis of C6-7 and autofusion of C3-5, likely from RA. She underwent C6-7 decompressive foraminotomy as well as C4-T2 posterior instrumented fixation. On recent followup with sleep medicine, her husband reported worsened snoring and increased apneic episodes. Since last PSG, she had lost 20-30lbs. On exam her Friedman score was 1. PSG demonstrated moderate OSA this time.

C. Case Reports from Clinical Trainees

Report of Case: A 15 year old white male with no significant past medical history, psychiatric history or family history of sleep disorders presented with episodic excessive daytime sleepiness. He reported a total of six episodes, lasting 2–3 days, with two per year in 2016, 2017, and 2018. During the events, he slept 15–18 hours per day with difficulty awakening, slowed cognitive function, a sensation of derealization and depersonalization, compulsive eating and hypersexuality. In between these episodes, he returned to his baseline, sleeping for 8 hours on weekdays and 13 hours on weekends with sleep latencies of less than 30 minutes. The patient denied symptoms of depression or anxiety. His school performance was below average. The physical exam was normal except for a BMI of 32. The MRI of brain and the EEG were normal. The polysomnogram showed mild snoring, decreased sleep efficiency (83.9%), a prolonged sleep latency (48 minutes), a normal REM sleep latency (117 minutes), and decreased total REM sleep (62 minutes, 15.4%). There was no significant sleep-related breathing, periodic limb movements, nocturnal hypoxemia, or parasomnia. No seizures were seen. The multiple sleep latency test was normal. Actigraphy showed more than 16 hours of sleep a day during the episodes and 7–8 hours of sleep per day at baseline. Bedtime was delayed to between 3:00 AM to 6:00 AM regardless of whether he was in an episode or at baseline.

Conclusion: The patient’s presentation would support the diagnosis of mild KLS, however, the shorter duration of the episodes is atypical. Confounding factors such as poor sleep hygiene and severe circadian rhythm disorder make certainty of this diagnosis more challenging.
**1066**

**OBSERVATOR SLEEP APNEA IN THE SETTING OF LARGE MANDIBULAR TORI, INTOLERANT TO POSITIVE AIRWAY PRESSURE THROUGH FULL-FACE MASK, RESPONSIVE TO POSITIVE PRESSURE THERAPY THROUGH NASAL MASK**

Faisal Zahiruddin, DO1, Romy Hoque, MD1

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**Introduction:** Mandibular tori, a common oral finding, are hyperostosis, the etiology of which is unclear, that are located on the lingual surface of the lower jaw. They appear from early adolescence and gradually grow into the third to sixth decade of life.

**Report of Case:** A 65-year-old African American male with history of hypertension presented for evaluation of possible sleep apnea with witnessed snoring and witnessed apnea. Physical examination revealed large mandibular tori. Split night polysomnography revealed diagnostic portion total sleep time respiratory disturbance index of 82.5 events per hour of sleep, with oxygen saturation nadir of 82%; and titration portion with CPAP by full-face mask showed frequent CPAP induced central apneas at pressures above 15 cm. Following subsequent BPAP titration, patient was placed on variable auto-BPAP with maximum BPAP inspiratory pressure of 22 cm, minimum BPAP expiratory pressure of 6 cm, and pressure support of 4 cm. Patient was not tolerant of variable BPAP delivered through a full-face mask, but when switched to a nasal mask he found BPAP quite comfortable, and showed good adherence, with device download showing residual average apnea hypopnea index of 3.4 events per hour, residual average central apnea index of 1.5 events per hour, and residual average obstructive apnea index of 0.9 events per hour.

**Conclusion:** The size and appearance of mandibular tori vary considerably, ranging from small knobs to bulky protuberances; may occur in single, multiple, or fused form; with surfaces that are either smooth or with bony projections. Though mandibular tori can reach a size at which they interfere with the space for the tongue; mandibular tori size is not directly correlated with obstructive sleep apnea severity, i.e. larger tori are not necessarily associated with larger respiratory event indices. Though the mandibular tori may not be entirely responsible for a patient’s sleep apnea, given that obstructive sleep apnea may be a multi-level phenomenon, it may affect the ability to tolerate positive airway pressure therapy delivered through a full-face mask, as large mandibular tori may hold the tongue upwards off the lingual surface of the lower jaw.

<table>
<thead>
<tr>
<th>POLYSOMNOGRAPHY 6/2012</th>
<th>POLYSOMNOGRAPHY 11/2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sleep time (TST): 415 mins</td>
<td>Total sleep time (TST): 440 mins</td>
</tr>
<tr>
<td>Mean O2: 95.6%</td>
<td>Mean O2: 95.3%</td>
</tr>
<tr>
<td>PLMI: 0.0 /hr</td>
<td>PLMI: 0.0 /hr</td>
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</table>

**Conclusion:** Association of OSA after ACDF has been investigated in the only retrospective study of 12 patients by Guilleminault. Development of positional dyspnea after ACDF was also reported by Zhang and associates. This case highlights the need for prospective investigation to establish association between OSA and ACDF. It also highlights the association of RA and OSA, which have been reported in the past, due to reduced neck width, subluxation of C3-4 and compression of medulla by odontoid.

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**1067**

**NARCOTIC ASSOCIATED BRADYPNEA MIMICKING CENTRAL SLEEP APNEA**

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**Introduction:** Bradypnea is slow breathing that is usually defined as less than 12 breaths per minute. Central apnea is characterized by a lack of drive to breathe during sleep. It is important to distinguish between the two as it can affect management.

**Report of Case:** The patient is a 72-year-old man with history of hypertension, diabetes mellitus, chronic obstructive pulmonary disease, coronary artery disease, coronary artery bypass graft, and posterior laminctomy from T10 to L1. He presented for evaluation of obstructive sleep apnea, with non-restorative sleep and excessive daytime sleepiness, with Epworth Sleepiness Scale score of 11/24. He is on fentanyl 25 mg transdermal patch every 72 hours for back pain. On physical examination lung fields were clear to auscultation bilaterally. Split night polysomnography revealed diagnostic portion total sleep time (TST) respiratory disturbance index of 93.1 events per hour, and oxygen saturation nadir of 78%. In the continuous positive airway pressure (CPAP) titration portion of the recording, sleep disordered breathing burden greatly improved, but on CPAP flow channel persistent bradypnea was noted, and occasionally the period between breaths met the American Academy of Sleep Medicine (AASM) scoring manual 10-second threshold for central apnea.

**Conclusion:** This patient had bradypnea mimicking central sleep apnea evident during titration portion of the split night polysomnography, occasionally meeting criteria for central sleep apnea. Recognition of bradypnea is crucial because misinterpretation as central apnea may dramatically affect the treatment option chosen, such as adaptive servo-ventilation versus CPAP. Our report represents clear visualization of this commonly discussed yet rarely published phenomenon.

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**1068**

**SEVERE CENTRAL SLEEP APNEA IN A PEDIATRIC PATIENT WITH KLIPPEL-FEIL SYNDROME**

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1Michael S. Aldrich Sleep Disorders Center, 2Division of Pediatric Pulmonology and Sleep Medicine, Department of Pediatrics, University of Michigan, Ann Arbor, MI

**Introduction:** Klippel-Feil Syndrome is characterized by congenital fusion of cervical vertebrae as well as bony abnormalities such as scoliosis and Sprengel deformity (failure of the scapulae to descend to the proper position), genitourinary, and cardiovascular anomalies. Its incidence is estimated at 1:40,000–42,000 live births. Rarely, Kippel-Feil syndrome can be associated with spinal stenosis and Chiari malformation with resulting hydrocephalus causing posterior fossa compression and sleep disordered breathing.

**Report of Case:** A 7-year-old female with a past medical history of Klippel-Feil Syndrome, Sprengel deformity, scoliosis (32 degree levo-convex cervicothoracic curve), and MURCS (nullerian duct aplasia, unilateral renal aplasia, and cervicothoracic somite dysplasia) presented to our pediatric sleep disorders clinic with an established diagnosis of central sleep apnea with a central apnea index (CAI) of 196 events per hour on a baseline study that was initially treated with supplemental oxygen, followed by treatment with adaptive servo-ventilation at an outside facility. The patient underwent foramen magnum decompression and laminectomy at 3 years of age due to MRI findings of a tight cranio-cervical compression by the odontoid. Post-membrane surgery polysomnogram revealed diagnostic portion total sleep time respiratory disturbance index of 11.5 events per hour of sleep, with oxygen saturation nadir of 80%. In the continuous positive airway pressure (CPAP) titration portion of the recording, sleep disordered breathing burden greatly improved, but on CPAP flow channel persistent bradypnea was noted, and occasionally the period between breaths met the American Academy of Sleep Medicine (AASM) scoring manual 10-second threshold for central apnea.
junction, syrinx, and foramen magnum compressing the brainstem in the context of bradyocardic episodes requiring admission to the intensive care unit. At our initial clinic visit, we ordered a split-night polysomnogram with transcutaneous-CO2 monitoring. The baseline portion of the study demonstrated severe central sleep apnea (CAI = 46.2, oxygen saturation nadir 74%) without hyperventilation. During the titration portion of the study, bilevel PAP with back-up rate did not effectively treat the central apnea, however average volume assured pressure support ventilation (AVAPS) treated the patient’s sleep disordered breathing.

Conclusion: This report highlights the importance of testing for sleep disordered breathing, specifically, central sleep apnea, in patients with cataplexy occurring for hours or days without a refractory period. It is a rare manifestation with Status cataplecticus is a rare manifestation with the correct dose of venlafaxine. Patient is currently being prescribed his usual dose of venlafaxine 225mg, escorted to the pharmacy to postpartum for thoughts of suicide and infanticide. Initial screening identified persistent insomnia and passive thoughts of suicide and infanticide. The patient revealed that cultural considerations, namely her “fuera,” or strength, kept her from sharing this previously. Focus shifted to risk assessment and safety planning. She endorsed an average sleep duration of ~4 hours/night. Sleep deprivation increased impulsivity, which likely contributed to spontaneous thoughts around harm. Her presenting concerns around sleep onset and insufficient duration were addressed by querying social support, immediate barriers to sleep, and constructing plans for toddler care to minimize nighttime interruptions. Her insomnia was treated using (a) sleep restriction and stimulus control, (b) relaxation/biofeedback for physiologic symptoms, (c) psychoeducation to normalize nighttime awakenings and reinforce sleep hygiene aligning with childcare, and (d) cognitive restructuring: reappraising her negative thoughts once awake. CBT-I encouraged exploration of cultural norms affecting symptom endorsement and therapeutic goals, together treating her anxiety and depression. She reported trouble swallowing medication (24% adherent), chewing prescribed morning and evening doses of bupropion (175mg BID), prompting pill swallowing training and coordination with her prescribing physician to promote adherence.

Conclusion: CBT-I over 6 sessions, with ecological/multicultural considerations, improved the patient’s presenting concerns. Bupropion was discontinued due to its activating effect, increasing sleep onset latency when given at night. The multi-dimensional assessment approach, while in development, rapidly provided treatment goals and priorities. Her depression and insomnia remission demonstrates the importance of interdisciplinary approaches to maternal care.

1070 INTERDISCIPLINARY APPROACH TO MATERNAL SLEEP
Sammy S. Dhaliwal, MSc; Nicholas R. Gregorio; Daniel S. Lewin, PhD
George Washington University

Introduction: Perinatal depression affects ~20% of women; persistent insomnia can be one of several debilitating symptoms. Contributors to postpartum sleep disruption include infant sleep, temperament, and feeding patterns, negative cognitions, mood and anxiety symptoms, and other comorbid sleep disorders. An assessment battery with validated measures of these factors is being piloted within a Perinatal Sleep Service co-located within an academic children's hospital. The assessment identifies Cognitive Behavioral Therapy (CBT) interventions that align with presenting complaints to create patient-centered sessions. Insomnia profiles distinguished by this assessment include chronic-stable, incident-perinatal, and postpartum-mood-related insomnia.

Report of Case: A 21-year-old Latina single-mother of a 23-month-old male was referred for severe sleep deprivation and persistent postpartum depression. Significant history includes psychiatric hospitalization 6-weeks postpartum for thoughts of suicide and infanticide. Initial screening identified persistent insomnia and passive thoughts of suicide and infanticide. The patient revealed that cultural considerations, namely her “fuera,” or strength, kept her from sharing this previously. Focus shifted to risk assessment and safety planning. She endorsed an average sleep duration of ~4 hours/night. Sleep deprivation increased impulsivity, which likely contributed to spontaneous thoughts around harm. Her presenting concerns around sleep onset and insufficient duration were addressed by querying social support, immediate barriers to sleep, and constructing plans for toddler care to minimize nighttime interruptions. Her insomnia was treated using (a) sleep restriction and stimulus control, (b) relaxation/biofeedback for physiologic symptoms, (c) psychoeducation to normalize nighttime awakenings and reinforce sleep hygiene aligning with childcare, and (d) cognitive restructuring: reappraising her negative thoughts once awake. CBT-I encouraged exploration of cultural norms affecting symptom endorsement and therapeutic goals, together treating her anxiety and depression. She reported trouble swallowing medication (24% adherent), chewing prescribed morning and evening doses of bupropion (175mg BID), prompting pill swallowing training and coordination with her prescribing physician to promote adherence.

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11071 SECONDARY HYPERSOMNIA IN A PATIENT WITH MYOTONIC DYSTROPHY
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Introduction: Myotonic dystrophy type 1 (DM1) is the most common adult-onset form of muscular dystrophy with autosomal dominant...
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inherited and incomplete penetrance. EDS is the most frequent non-muscular symptom and patients may present with EDS for years before DM1 is diagnosed. We are presenting an 18-year-old Caucasian female with myotonic dystrophy and progressive daytime sleepiness.

**Report of Case:** A 18 y/o female with medical history of myotonic dystrophy, scoliosis s/p spinal fusion, pectus excavatum, restrictive lung disease, exercise induced asthma, chronic abdominal pain was following-in the myotonic dystrophy clinic for 4 years. She has a long and complicated medical history and currently on Baclofen, Carbamazepine, Clonazepam, Duloxetine, Cyproheptadine, Diazepam, Gabapentin, and Prednisone. She had complaints of decreased exercise tolerance, daytime fatigue, snoring and excessive nocturnal sleep (11–12 hours) but no significant daytime sleepiness. She had three sleep studies done 2 years apart showing normal sleep with absence of significant sleep disordered breathing. In the past several months she reported more daytime sleepiness and occasional sleep in school. Multiple sleep latency test done after the third sleep study shows mean sleep latency of 3 minutes with no sleep onset REM episodes. She has recently been started on clinical trial of Modafinil.

**Conclusion:** In patients with DM1, sleepiness mainly occurs in monotonous situations in contrast to narcolepsy. Sleepiness is mostly unrelated to the duration and the quality of the night time sleep. Sleep phenotype is closer to that of idiopathic hypersomnia with long sleep time (ICSD-2), along with increased sleep fragmentation related to respiratory events, nocturnal agitation, reduced motility and pain. Increased SWS/REM and decreased N2 with impaired delta power dissipation have been reported. Different phenotypes mimic idiopathic hypersomnia, narcolepsy without cataplexy, sleep apnea syndrome, and periodic leg movement disorder, however there is no clear data on how and when to evaluate sleep complaints and clarify the indications of different tools and the frequency of repetition to identify and manage these problems.

**1072 OSA AND IPF EXACERBATIONS: A DEADLY DUALITY**

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**Introduction:** Obstructive sleep apnea (OSA) is common in Idiopathic Pulmonary Fibrosis (IPF) patients. IPF Patients with poorly controlled OSA appear to have worse in quality of life and possibly higher mortality than those with well controlled OSA.

The role of OSA in IPF exacerbation is currently unknown.

**Report of Case:** A 71 y/o man with PMH of IPF and OSA (on nocturnal BIPAP 16/4) presented to the ER with worse cough, dyspnea, and hypoxia. He was admitted to the ICU with a diagnosis of IPF exacerbation. He was restarted on his home BIPAP settings. His dyspnea improved, but did not quite return to baseline. An inpatient BIPAP titration study showed that the patient had significant obstructive hypopneas, as well as hypoxia and tachycardia, until his BIPAP was titrated up to 22/10 cm. At this pressure, his tachycardia, hypoxia, and hypopneas resolved. The patient’s BIPAP was adjusted to the new settings. Over the next few days, his dyspnea improved, and he was discharged. About six weeks after discharge, the patient returned to the sleep clinic for follow up. Review of his BIPAP machine data showed that he had developed new central apneas (27 per hour; none previously noted). The patient was diagnosed with severe treatment-emergent central sleep apnea. BIPAP settings were reduced to 13/7.

**Conclusion:** Non-adherence to nocturnal BIPAP may be a risk factor for hospital admission in patients with OSA and IPF. Patients experiencing an acute exacerbation of IPF may temporarily require higher BIPAP settings. However, continued use of higher pressures after resolution of the exacerbation may lead to emergence of central sleep apnea.

**Support:**


**1073 AN UNUSUAL CASE OF AV BLOCK MANAGEMENT WITH ARMODAFINIL IN A NARCOLEPSY PATIENT.**

**Rida Ezehra Shah, M.D; Julie Wang, MD, Anita Ko, M.D; Amina Batool Shah, M.B.B.S**

Drexel University College of Medicine, Philadelphia, PA

**Introduction:** Narcolepsy is a sleep disorder of hypersonnia with typical features. Some narcolepsy patients may also have autonomic dysfunction including bradycardia and hypotension. We report a unique case where armodafinil was used to treat high-grade atrioventricular (AV) block in a narcolepsy patient.

**Report of Case:** A 30 year-old woman presented with multiple events of transient dizziness, syncope, and excessive daytime sleepiness since age 16. Holter monitor demonstrated high-grade AV block with multiple sinus pauses up to 4–5 seconds in length. A tilt table test and EP study were negative. The patient was unable to tolerate a trial of theophylline due to tremors. Due to excessive daytime sleepiness, a sleep study was done which showed narcolepsy with cataplexy, and the patient was started on armodafinil. During follow-up, her syncope resolved, and repeat holter monitoring showed no more evidence of AV block or sinus pauses. Two years later, the patient stopped armodafinil, because she wanted to become pregnant. However, her syncope and arrhythmias recurred, and a pacemaker was implanted at the recommendation of her cardiologist.

**Conclusion:** Armodafinil is the (R)-enantiomer of the wakepromoting compound modafinil with a longer half-life. The α-1-adrenergic agonist properties of modafinil may promote wakefulness but appears to lack peripheral sympathomimetic effects seen with amphetamines. Modafinil is known to increase norepinephrine in hypothalamus, and may also have a slight role on cardiac α1-B receptors. Similarly noradrenaline may have played a role in the stimulation of cardiac alpha receptor signal transduction pathways, leading to resolution of a high grade AV block with armodafinil. While armodafinil is not typically used to manage arrhythmias, it may be used in highly select cases.

**1074 A CASE OF OBSTRUCTIVE SLEEP APNEA INDUCED BY A VAGUS NERVE STIMULATOR IMPLANTED IN AN EPILEPSY PATIENT.**

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1Department of Pulmonary, Critical Care, and Sleep Medicine, Drexel University College of Medicine, Philadelphia, PA. 2Department of Pulmonary, Critical Care, and Sleep Medicine, Cleveland Clinic Florida, Weston, FL.
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Introduction: Vagus nerve stimulator (VNS) devices are a treatment modality in refractory epilepsy and has been associated with the development of obstructive sleep apnea (OSA)\(^1\). VNS devices are typically implanted on the left vagus nerve, of which the left superior laryngeal nerve is a branch, and have been shown to cause left vocal cord adduction\(^2\). In some cases, adjusting VNS settings have reduced or eliminated obstructive events\(^3\).

Report of Case: A 26 year-old female with refractory epilepsy underwent VNS implantation for better seizure control. Post-procedure, she reported worsening nocturnal seizures, new nocturnal choking, falling out of bed, and even started sleeping on the sofa due to safety concerns. Additionally she reported new excessive daytime sleepiness. An overnight polysomnography (PSG) showed obstructive events at evenly-spaced 108 second intervals with an overall apnea-hypopnea index of 20.9 (Figures 1,2). The frequency and length of apneas correlated with VNS settings. Continuous positive airway pressure (CPAP) titration was unsuccessful. Her neurologist adjusted her VNS device settings, but the patient relocated before repeat polysomnography and reevaluation could be performed.

Conclusion: Our case demonstrates the obstructive sleep apnea (OSA) caused by VNS implantation resulting in worsening epilepsy symptoms. No obstructive events were observed outside of the VNS firing. Inducing OSA is a concerning complication as epilepsy control may be compromised in some VNS patients. Patients who fail CPAP therapy may need to have their VNS readjusted. Therefore, patients undergoing VNS implantation may benefit from sleep medicine evaluation due to the potential development of sleep-disordered breathing.

Support:

1075

UVULO P ALATOHYPOGLOS SOPLASTY FOLLOWING
HYPOGLOSSAL NERVE STIMULATOR PLACEMENT FOR
THE TREATMENT OF RESIDUAL SLEEP A PNEA

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Medical College of Wisconsin, Milwaukee, WI.

Introduction: The use of Hypoglossal Nerve Stimulator (HNS) implantation in the treatment of moderate to severe obstructive sleep apnea (OSA) refractory to or intolerant of non-invasive therapy is increasing in prevalence. Though the efficacy of HNS therapy has been well documented, the possibility of residual sleep disordered breathing (SDB) is possible and the manner in which to proceed under such circumstances is unclear. We present a case of HNS and reconstructive surgery, specifically uvulopalatopharyngoplasty (UPPP), to help resolve a patient’s residual SDB symptoms.

Report of Case: This is a 47 y/o male with a history of severe OSA (AHI of 47), Restless legs syndrome (effectively treated with ropinirole therapy) and no other associated comorbidities who was referred to sleep clinic due to his inability to tolerate CPAP therapy in the context of a history of PTSD. Physical exam was significant for a BMI of 29, Mallampati 3 airway with redundant palatal tissue and poor dentition, the latter of which precluded the use of an oral appliance as alternative therapy. The patient would ultimately opt to pursue HNS implantation upon confirmation of his candidacy following sedated endoscopy. Following implantation, the patient would continue to complain of restless sleep, snoring and excessive daytime sleepiness. A subsequent HNS titration study five weeks post-implantation would re-confirm the presence of severe OSA. Despite uptitrating to the maximally tolerated level of 3.2V, obstructive events failed to resolve with an overall AHI of 55. The option of pursuing UPPP as an adjunctive measure was offered and the patient decided to pursue this course of treatment. Upon four week follow up post-UPPP, the patient was seen in clinic and noted dramatic subjective improvement in his sleep, relaying a history of refreshing sleep without nighttime awakenings or snoring. Repeat PSG remains pending as of the time of this publication.

Conclusion: The use of HNS and UPPP may be considered as complementary therapies when a patient fails to respond to either intervention alone.

1076

CPAP AND BILATERAL PERIORBITAL EDEMA: A CASE REPORT

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Introduction: Obstructive sleep apnea (OSA) has a prevalence of 22% (9–37%) in men and 17% (4–50%) in women. Continuous Positive Airway Pressure (CPAP) is the leading therapy presently in use for OSA. As the disease and the therapy became widespread, so has the emergence of side effects. One such adverse effect attributable to CPAP, albeit rare, is peri-orbital edema.

Report of Case: A 59-year-old female presented for evaluation of bilateral eyelid swelling, which was noticed after two weeks of initiating treatment for severe OSA with CPAP at 16cm of water. Swelling subsided after she stopped using the CPAP for two days but returned once she resumed use. Further queries revealed that she was using a full face mask and swelling appeared after she began to tighten the mask to minimize air leaks. No past history of head trauma or facial bone fractures were reported. On examination she did not appear to be in distress, but had bilateral eyelid edema. There was no erythema, tenderness, subcutaneous emphysema or evidence of infection of the eyelids. The rest of the examination was unremarkable. ENT and Ophthalmology consultations were done and did not reveal any further pathology. Mask fitting was done in clinic and the full face mask was changed to Amara view mask. She was able to continue using the CPAP with resolution of the periorbital swelling.

Conclusion: Few cases of periorbital swellings have been reported after treatment with CPAP. A possible mechanism suggested is the obstruction to venous and lymphatic drainage leading to periorbital edema caused by tightening of the full face mask. Lower eyelid lymphatic’s drain into the submandibular gland and upper eyelid lymphatic’s drain into the parotid lymph nodes and compression of this passage can lead to edema above the level of obstruction. Review of the surface marking of lymphatic drainage and the point of contact of her full face mask suggested this could be the probable cause of the swelling. By switching to an amara-view mask this problem was overcome and the swelling resolved.

1077

EPIDURAL ABSCESS IN A 9 YEAR OLD BOY ON CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY

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Introduction: Intracranial extension of rhinosinusitis while on positive airway pressure (PAP) therapy is rare, particularly in children. We present the case of a 9 year old immunocompetent boy with central
precocious puberty (bone age 13 years, 6 months), obesity, prior adenotonsillectomy, and obstructive sleep apnea-hypopnea syndrome. At age five years, polysomnography after adenotonsillectomy showed an elevated apnea-hypopnea index of 7. Over the ensuing four years, he adhered to PAP treatment with improvement in symptoms. At age 9 years, he developed frontal headache with photophobia, thickened nasal discharge, and fever to 104.7 ten days after being diagnosed with influenza. Four days later, he developed lethargy, vomiting, worsened headache, and puffiness over his forehead.

**Report of Case:** Head CT showed pansinusitis and locules of gas adjacent to both the inner and outer calvarial tables over the right frontal sinus suggesting extension of a subperiosteal or epidural abscess. An MRI was consistent with epidural abscess. Surgical intervention was not indicated as he did not have mass effect nor did he further deteriorate clinically. Paranasal sinus cultures taken 2 days after starting antibiotics had no growth. He continued on broad spectrum antibiotic therapy and made a full recovery. He resumed intermittent use of CPAP within 2 months after infection. Nine months later, he was 32% compliant with PAP in the setting of mask discomfort. Apnea-hypopnea index was 1.3 when using the device.

**Conclusion:** A literature search using Medline and Cochrane revealed no prior reports of epidural abscess developing in patients receiving PAP treatment. Epidural abscess secondary to direct extension of frontal rhinosinusitis is uncommon in a nine-year-old. The active growth of the frontal sinuses and their rich blood supply during his precocious puberty may have increased his vulnerability to a rostral, intracranial spread of infection.

**Support:** None
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