[1]Cleveland Clinic, [2]Department of Quantitative Health Sciences, Cleveland Clinic, [3]Sleep Disorders Center, Neurological Institute, Cleveland Clinic

Introduction: Although sleep disruption in Alzheimer's disease (AD) pathogenesis has been described, the role of circadian rhythm dysfunction (CRD) is less understood. We hypothesize greater CRD and sleep disruption with poorer cognitive function in AD compared to normal cognition.
Methods: We examined 3 groups:1)mild cognitive impairment with positive AD biomarkers(MCI-AD),n=18, 2)cognitively normal at high risk for AD(HR)(APOEε4 carriers),n=19, 3)cognitively normal APOEε4 non-carriers(CL),n=16 (National Institute of Aging, IMMUNE-AD). DNA extraction and APOEε4 genotyping were performed under the Cleveland Clinic Lou Ruvo Center for Brain Health Aging and Neurodegenerative Disease Biobank. We evaluated actigraphy-based (Motionlogger MicroWatch, Ambulatory Monitoring,Inc®) sleep (wake episodes(WE), total sleep time(TST), sleep efficiency(SE), sleep fragmentation index(SFI)) and circadian (mesor, amplitude, robustness, sleep regulatory index(SRI), intradaily stability) predictors and sleep study-based (ApneaLink Air by ResMed®) predictors (apnea hypopnea index(AHI,3% desaturation) and recording time<90%SaO2) across the groups and assessed association with cognition (Mini-Mental State Exam(MMSE)). Analysis of variance (ANOVA) or Kruskal-Wallis with Bonferroni adjustment was used for cross-group comparisons. ANCOVA assessed cross-group association of MMSE and sleep/circadian indices. Models were adjusted for age, sex, race, education, and BMI.
Results: Age differed across MCI-AD, HR, and CL groups (68.4±6.2,71.2±3.7,73.7±3.7 respectively,p=0.008). MCI-AD had more WE than HR and CL (14.4±5.6,10.9±3.9,10.9±3.5 respectively,p=0.033). In MCI-AD, the following associations were observed: 5% increase in SE was associated with 0.49 point higher MMSE (coefficient0.49, 95%CI[0.03,0.95],p=0.038), 1 hour increase in TST was associated with 0.81 point higher MMSE (coefficient0.81, 95%CI[0.24,1.37],p=0.006), and 1 unit increase in SFI was associated with 0.36 point lower MMSE (coefficient-0.36, 95%CI[-0.64,-0.08],p=0.013). Key measures differed: CLs had lower AHI, MCI-AD had less TST SaO2<90%, MCI-AD had the largest and HR the lowest SFI, and MCI-AD had lesser robustness but higher mesor and amplitude.
Conclusion: In this comparative study of carefully AD biomarker-phenotyped and APOEε4-genotyped patients and normal cognition controls, less sleep time and more fragmented sleep are associated with poorer MMSE scores in MCI-AD. Preliminary results show cognitively normal participants at risk of AD(HR) do not show CRD seen in MCI-AD and are more consistent with controls (CL).
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INFLUENCE OF SEX-SPECIFIC DIFFERENCES IN INPATIENT SLEEP TESTING APPROACH FOR DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

Cinthya Pena Orbea,[1] Cody McIntire,[1] Lu Wang,[2] Reena Mehra[1]
[1]Sleep Disorders Center, Neurological Institute, Cleveland Clinic, [2]Department of Quantitative Health Sciences, Cleveland Clinic

Introduction: Increased attention has been focused on sex-specific differences in approaches to diagnostic testing for obstructive sleep apnea (OSA) given differences in hypoxia, arousal thresholds and sleep state dependent influences, but with sparse data available for inpatient testing. We postulate that women are more likely to have a lesser degree of sleep apnea on inpatient home sleep apnea testing (HSAT) versus polysomnography (PSG).
Methods: The Cleveland Clinic Sleep Laboratory registry was queried for inpatient sleep testing (HSAT or PSG conducted over the last 15 years. Demographics, comorbidities, and sleep study (Nihon Kohden®) data were collated. Logistic regression was used to examine sleep study type predictive of OSA at various severity thresholds (apnea hypopnea index (AHI, 3 or 4% hypopnea rule)>5,>15 and >30 and hypoxia (11% (median) time spent with SaO2<90%) adjusted for age, race and body mass index and comorbidities (hypertension, coronary artery disease, arrhythmias, heart failure, diabetes, stroke, chronic obstructive pulmonary disease, mood disorders, respiratory failure and epilepsy with a sex interaction term) (OR, 95%CI presented).
Results: The analytic sample was comprised of 639 patients: age:55.8±16.3 years, 45% female, 73% Caucasian, BMI:37.5 ± 13.3kg/m2, 74% had OSA and 51% HSAT. Men had higher AHI:16.2 [5.9, 42.3] vs 8.2 [2.9, 20.7]p<0.001, higher arousal index:33.1[18.9,.54] vs 25.3 [15.6, 39.2]p=0.003. Women had higher BMI:40.2 ±14.7, vs 36 ±11.7kg/m2,p<0.001. Unlike AHI>5, at AHI>15, men had lower odds of OSA: OR=0.51:0.32–0.80,p=0.004 for HSAT versus PSG compared to women: OR=1.03:0.61–1.72,p=0.92; interaction p-value=0.046. Men had lower odds of OSA (AHI >30): OR=0.57(0.35,0.92,p=0.022) in HSAT vs PSG; albeit sex-interaction was not statistically significant. Men versus women had 2-versus 3-fold higher hypoxia ie. OR=2.04:1.22–3.41,p=0.006 in men undergoing HSAT versus PSG with strength of association higher in women: OR=3.03:1.68–5.46,p=0.001, interaction p-value=0.32
Conclusion: We unexpectedly observe sex-specific differences in inpatient sleep testing such that men had an overall lower odds of detection of moderate to severe and OSA and nocturnal hypoxia relative to women with HSAT versus PSG. Future investigation focused on concurrent inpatient PSG and HSAT should verify these sex-specific findings and clarify potential biophysiologic rationale
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EVALUATION OF ELECTRONIC MEDICAL RECORD ARTIFICIAL INTELLIGENCE SCREENING TOOLS FOR UNDIAGNOSED OSA

Sam Rusk,[1] Yoav Nygate,[1] Fred Turkington,[1] Chris Fernandez,[1] Nick Glattard,[1] Nathaniel Watson[2]
[1]EnsoData Research, EnsoData, [2]Department of Neurology, University of Washington School of Medicine,

Introduction: The STOP-Bang is a concise, simple and widely adopted obstructive sleep apnea (OSA) screening tool. However, it has limited predictive ability and is susceptible to subjective reporting bias. Artificial Intelligence (AI) methodologies can be utilized together with existing data in electronic medical records (EMRs) to create new screening tools to increase diagnostic sensitivity and facilitate discovery of preclinical OSA phenotypes.
Methods: The study comprised two independent retrospective sleep study datasets: 1) Type III HSATS (N=5583) and, 2) Type I polysomnograms (N=1037). Each contained raw sleep study waveforms, manually scored sleep events (respiratory, arousal, sleep staging), and standard report indices (apnea-hypopnea index; AHI, arousal index). Additionally, the first dataset contained 90 EMR based

metadata variables and the second dataset contained 54 EMR based metadata variables. Three random forest models were trained to detect OSA diagnostic thresholds (AHI> 5, AHI>15, and AHI>30) over three different screening models: STOP-Bang, P-Bang (blood-pressure, BMI, age, neck-size, gender), and Common Clinical Data Set (CCDS)-OSA (all metadata variables simulating EMR CCDS standard).
Results: CCDS-OSA ROC-AUC exceeded STOP-Bang and P-Bang for both sleep study collections, resulting in AHI>15 ROC-AUC values of 0.73 and 0.71 (CCDS-OSA) compared to AHI>15 ROC-AUC values of 0.68 and 0.69 (STOP-Bang). Additionally, we analyzed the Gini feature importance ranking of the trained CCDS-OSA model to evaluate which variables showed highest predictive value of OSA. The ranking revealed the top 5 features were the five physiologic based STOP-Bang parameters, followed by EMR based physiologic measurements such as HDL, triglycerides, systolic BP, and disease conditions such as diabetes, hypertension, and depression.
Conclusion: This study shows that while STOP-Bang contains data critical to OSA screening, a variety of other EMR-based parameters can improve performance of OSA detection. AI-based EMR screening can provide a critical tool for more systematic and accurate screening of undiagnosed sleep apnea. Nationwide standards facilitating patient EMR data interoperable health information exchange, particularly the United States Core Data for Interoperability (USCDI CCDS), holds promise to foster broad clinical and research opportunities. Resulting data sharing will allow application of AI screening tools at the population health scale with ubiquitous, existing EMR data to improve population sleep health.
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ADVANCED GESTATIONAL AGE IS A PREDICTOR OF NON-COMPLETION OF SLEEP APNEA TESTING IN PREGNANCY

Mihaela Bazalakova,[1] Abigail Wiedmer,[1] Lauren Rice,[1] Sakshi Bajaj,[1] Natalie Jacobson,[1] Kathleen Antony[1]
[1]University of Wisconsin-Madison

Introduction: Sleep apnea is emerging as an important and underdiagnosed comorbidity in pregnancy. Screening, diagnosis, and initiation of therapy are all time-sensitive processes during the dynamic progression of gestation. Completion of referral and testing for sleep apnea during pregnancy requires a significant commitment of time and effort on the part of the pregnant patient. We evaluated for predictors of non-completion of sleep apnea testing within our obstetric-sleep referral pipeline, in an effort to inform and optimize future referrals.
Methods: We performed a retrospective chart-review of 405 pregnant patient referrals for sleep apnea evaluation at the University of Wisconsin-Madison/UnityPoint sleep apnea pregnancy clinic. We used logistic regression analysis to determine predictors of lack of completion of sleep apnea testing.
Results: The vast majority of referrals (>95%) were triaged directly to home sleep apnea testing with the Alice PDX portable device, rather than a sleep clinic visit. The overall rate of referral non-completion was 59%. Predictors of non-completion of sleep apnea evaluation in our pregnant population included higher gestational age (GA) at referral (1–12 wks GA: 30%, 13–26 wks GA: 31%, and 27–40 wks GA: 57% non-completers, p=0.006) and multiparity with 1 or more living children (65% non-completers if any living children, compared to 45% non-completers if no living children, p=0.002). Age, race, and transportation were not predictors of failure to complete sleep apnea testing.
Conclusion: We have identified several predictors of pregnant patients' failure to complete sleep apnea evaluation with objective home sleep apnea testing after referral from obstetrics. Not surprisingly, higher gestational age emerged as a strong negative predictor of referral completion, with >50% of patients referred in the third trimester not completing sleep apnea testing. Early screening and referral for sleep apnea evaluation in pregnancy should be prioritized, given the time-sensitive nature of diagnosis and therapy initiation, and demonstrated reduced completion of referrals in advanced pregnancy.
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INVESTIGATING THE UTILITY OF ROUTINE CARBON DIOXIDE MEASUREMENTS DURING POLYSOMNOGRAPHY IN THE EVALUATION OF OBESE ADULT PATIENTS

Valentin Nuzhny,[1] Ruckshanda Majid,[2] Komal Imtiaz,[3] Reeba Mathew[1]
[1]McGovern Medical School, UT Health, Houston, [2]McGovern Medical School, [3]McGovern Medical School. UT Health, Houston

Introduction: With the increasing prevalence of obesity, the diagnosis of obstructive sleep apnea (OSA) and obesity hypoventilation syndrome (OHS) have also increased. Adding routine transcutaneous carbon dioxide (TcCO2) or end-tidal carbon dioxide sensors (EtCO2) may add beneficial information to the polysomnogram (PSG) and expand the diagnostic and treatment capabilities in this population. Our study looks at the use of this parameter in obese adults on whom CO2monitoring has been used.
Methods: We performed a retrospective chart review of obese adult patients (body mass index [BMI] >30) undergoing a PSG. We documented the EtCO2 values at baseline (supine awake) and during sleep. Correlations between the EtCO2 readings and BMI were reviewed. We excluded patients that had poor EtCO2 waveforms and patients with known preexisting hypoventilation syndromes, such a COPD.
Results: Fifty patients were identified between January and November 2020 at the Memorial Hermann Sleep Center. 54% were female and 46% were male with an average age of 55.3 years (range 26–73) and an average BMI for the cohort of 40.1 (SD +/-9.5). The average AHI on the diagnostic study (CMS criteria) was 30.9 events/hour (SD +/-43) and the average oxygen desaturation nadir was 79%. Sixteen patients (32%) met diagnostic criteria for OHS based on the baseline awake EtCO2 which would have otherwise been missed without CO2 monitoring. When comparing the mean values of the ETCO2 between Group 1 whose BMI was less than 40 kg/m2 (39.9 mmHg) to Group 2 whose BMI was greater than 40 kg/m2 (45.9 mm Hg), the difference was statistically significant with a p-value is 0.001.
Conclusion: OHS is reported to have greater mortality when compared to OSA. CO2 monitoring is currently only routinely required in pediatric PSGs. Our review suggests a higher diagnostic yield of OHS in adults with the use of CO2 monitoring especially when morbidly obese. Given the alarming trend towards obesity in the US, this advocates for the routine use of CO2 monitoring in adult obese patients. Although more research is needed, we may draw a conclusion that there is meaningful data to support the use of routine ETCO2 monitoring in this adult patient population.
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CLINICAL VALIDATION OF A.I. ANALYSIS OF PHOTOPLETHYSMOGRAM (PPG) BASED SLEEP-WAKE STAGING, TOTAL SLEEP TIME, AND RESPIRATORY RATE

Nathaniel Watson,[1] Chris Fernandez,[2] Sam Rusk,[2] Yoav Nygate,[2] Fred Turkington,[2] Justin Mortara[2]