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A CONVOLUTIONAL NEURAL NETWORKS MODEL FOR THE DETECTION OF CORTICAL AROUSALS FROM HEART RATE

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Introduction: Cortical arousals are transient events of disturbed sleep that occur frequently in sleep disordered breathing (SDB) and can be used as an indicator of sleep quality. While cortical arousals are typically scored from the electroencephalogram (EEG), arousals are associated with increased sympathetic activity and could therefore be detected from measures of sympathetic activity such as heart rate. Most home sleep test and consumer wearable devices enable continuous recording of heart rate via the electrocardiogram (ECG) or optical heart rate sensors without the inconvenience of EEG electrodes. In this preliminary study, we developed a deep learning-based convolutional neural networks (CNN) model to detect arousals from heart rate.
Methods: This study included 1,083 polysomnograms (PSGs) from five independent studies (Tucson Children's Assessment of Sleep Apnea, Mechanisms of Pharyngeal Collapse in Sleep Apnea, Impact of the Arousal Threshold in Obstructive Sleep Apnea, Predicting Successful Sleep Apnea Treatment with Acetazolamide in Heart Failure Patients, Combination Therapy for the Treatment of Obstructive Sleep Apnea) that were scored for arousals according to American Academy of Sleep Medicine scoring rules. These studies included PSGs from both children and adults (ages 6 and above), with most data coming from participants with evidence or diagnosis of SDB. We used the Pan-Tomkins algorithm to detect R-peaks from the raw ECG signal, transformed the peaks into normalized instantaneous heart rate at 1 Hz frequency, and produced arousal probability in 1-second resolution using a simple CNN model. Due to slight asynchrony between the appearance of arousals in the EEG versus the heart rate, all overlaps between model-predicted arousals and manually scored arousals were considered true-positives.
Results: We evaluated the model on a validation set (n=216). The model achieved a gross area under precision-recall curve score of 0.67 and a gross area under receiver operating characteristics curve of 0.91 Correlation between the number of model-detected and manually scored arousal events was r=0.76.
Conclusion: This preliminary study demonstrates that a deep learning approach has the potential to accurately detect arousals in home sleep tests and consumer wearable devices that measure heart rate.
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EXERCISE CAPACITY IS MAINTAINED IN OLDER MILITARY PERSONNEL WITH MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: The relationship between moderate to severe OSA and exercise capacity remains unclear. Prior studies showing a reduction in VO2 max in this population have mostly involved middle-aged and overweight patients. We looked to determine if this trend in VO2 max was present in a similarly aged population of military personnel with previously undiagnosed moderate to severe OSA.
Methods: We studied 170 middle-aged male military members who underwent cardiopulmonary exercise testing (CPET) and polysomnography (PSG) as a part of a comprehensive evaluation for an established military program. For analysis, patients were categorized either into an OSA group (apnea-hypopnea index (AHI) ≥ 15 events/h) or control group (AHI < 15 events/h). VO2 max was compared between groups.
Results: Mean AHI was 29.0 in the OSA group (n =58) versus 7.4 in the controls (n = 112). Patients were of similar age (53.1 vs. 53.7 years) and BMI was slightly higher in the OSA group (27.5kg/m2 versus 26.3 kg/m2, P = .0077). Percent-predicted VO2 max was supernormal in both groups, though was comparatively lower in the OSA group (117% vs. 125%; P <.001). There was a trend toward a blunted heart rate response to exercise in the OSA group as represented by peak heart rate (163 vs. 178; p=0.07).
Conclusion: Older military personnel with moderate to severe OSA have normal exercise capacity. This may suggest that the low-arousal OSA phenotype often noted in military personnel does not significantly influence exercise capacity or that regular exercise helps limit its impact. It remains likely that the effect of untreated OSA on exercise capacity is influenced by several variables including age, BMI, OSA phenotype, and regularity of exercise. Trends in VO2 max and peak heart rate noted in this study may suggest that untreated OSA in certain populations can negatively impact exercise capacity
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ETHNICITY MODIFIES THE ASSOCIATION BETWEEN CENTRAL SLEEP APNEA AND ATRIAL FIBRILLATION IN OLDER MEN: KUAKINI HAAS AND MR.OS

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Introduction: Several studies indicated there is an association between central sleep apnea (CSA) and atrial fibrillation (AF) in older populations. However, few studies assessed the impact of ethnicity on the association. We assessed the hypothesis that ethnicity modifies the association between CSA and AF in older men.
Methods: We did a cross-sectional analysis using two population studies of Japanese-American (JA) and White-American (WA) men. The Kuakini Honolulu-Asia Aging Study (HAAS) is a longitudinal cohort study of JA men living in Hawaii. Sleep data were collected between 1999–2000. The Osteoporotic Fractures in Men (Mr.OS) Sleep Study was conducted between 2003–2005 on the continental U.S. The majority of Mr.OS participants were WA. We selected 79–90 year old males, who had overnight polysomnography from both studies. Total participants were 690 JA and 871 WA men. Obstructive apnea-hypopnea index (OAHI) was the measure of the number of obstructive apneas and hypopneas with >4% oxygen desaturation. Additionally, the central apnea index (CAI) was the measure of the number of central apneas. Obstructive sleep apnea (OSA) was categorized as none (OAHI <5), mild (OAHI 5–14), moderate (OAHI 15–29), and severe (OAHI>=30). CSA was defined by CAI>=5. Cheyne-Stokes breathing (CSB) was defined as a minimum consecutive 5–10 minute period of a crescendo-decrescendo respiratory pattern associated with CSA. A board-certified physician confirmed AF by single lead electrocardiography of polysomnography.