ORIGINAL ARTICLE

Smartphone Addiction and Obstructive Sleep Apnea Syndrome: An Evaluation of the Possible Association

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Abstract

Background: Smartphones and other electronic devices have become a large part of our day-to-day lives, and their influence on our lifestyle is not a matter anyone can disregard. This study evaluates the association between the smartphone addiction scale (SAS) and the Apnea-Hypopnea Index (AHI) with adjustment for possible confounders.

Methods: Sixty patients of a sleep clinic with recent polysomnography results (<6 months) who were referred for evaluation of obstructive sleep apnea (OSA) were included in the study. The participants' demographic data such as body mass index (BMI), age, gender, and educational level were collected. Participants were then asked to complete the SAS. AHIs of the study participants were extracted from their polysomnography reports.

Results: Multivariable analysis revealed no significant association between SAS and AHI after adjustment for demographic variables (beta=0.006, 95% CI=-0.022 to 0.033, P=0.678). Age was a substantial confounder of the association (beta of SAS after adjusting=0.009).

Conclusion: Smartphone use does not affect the risk of OSA, as determined by AHI when adjusted for age.

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Keywords: Obstructive sleep apnea, Smartphone addiction scale, Cellphone abuse, Technology related diseases

Introduction

Obstructive sleep apnea (OSA) is defined as disrupted sleep, multiple awakenings, and excessive daytime sleepiness caused by repetitive collapses of the pharyngeal muscles and tissue structures during sleep.[1] OSA affects 9- 38% of individuals.[2] Therefore, the condition could be recognized as one of the growing health concerns of modern population. Although there is an increasing amount of information available on the association between OSA as a sleep disorder with development and progression of many chronic diseases, including type 2 diabetes mellitus, hyperlipidemia, hypertension, and ischemic heart disease,[3] there is a scarcity of evidence on lifestyle determinants of this disorder.

As ubiquitous and indisputable influencers on people's lifestyles, smartphones have been arising concerns about the population's health for years. Evidence has shown that problematic smartphone usage could be associated with many physical and psychological problems, such as frequency and duration of migraine,[4] anxiety, musculoskeletal pain in the neck, back, and upper limbs,[5] decreased quality of sleep, and depression.[6] However, there is insufficient evidence to establish a link between smartphone use and OSA as a sleep disorder to warrant a public health message. Therefore, this study aimed to evaluate the association between the smartphone addiction scale (SAS) and the extent of OSA syndrome among patients with sleep disorder.

Methods

The study population consisted of consecutive patients of a sleep disorders clinic referred to be evaluated with polysomnography from 2015 to 2021. Patients who were at least 18 years old with a recent polysomnography result (<6 months) were asked to give their informed consent. Exclusion criteria were incomplete polysomnographic data and clinically relevant comorbidities, including smoking, asthma, chronic obstructive pulmonary disease (COPD), and cystic fibrosis. Also, patients with uncompleted data or questionnaires were excluded. Recruitment continued until 60 participants were enlisted. Participants were then asked to complete the Persian version of the smartphone addiction scale (SAS), which is a self-report questionnaire validated in Persian with a specificity of 86% and sensitivity of 80% (Cronbach's alpha coefficient for the total scale was 0.93).[7] The SAS consists of 33 items with a six-point Likert scale. The total SAS score ranged from 48 to 288, with higher scores presenting higher dependency.

The Apnea-Hypopnea Index (AHI) is the main parameter of OSA determined by polysomnography characterized by hypopnea and apnea episode numbers per hour of sleep. Apnea is defined as airflow completely stopping for more than 10 seconds. The description of hypopnea is a decrease in airflow equal to or more than 50% from the baseline, which lasts similar to or more than 10 seconds and is related to arousal or 3% desaturation. OSA is defined if AHI is ≥5 events/hour.[8] AHIs of the study participants were extracted from their polysomnography reports as continuous and binary variables. Demographic variables, including age, gender, education level, and body mass index (BMI) were collected from the electronic database of the clinic.

Statistical Analysis

The SPSS software version 24 was used to perform the statistical analyses. The population characteristics were summarized following their format. Categorical variables were presented as number (%), continuous variables as mean and Standard Deviation (SD), and skewed continuous variables as median and Interquartile Range (IQR). A logistic regression analysis was applied for the association between SAS and OSA (AHI>5). The association between SAS and AHI was obtained by linear regression, using a univariable model to obtain the beta coefficient and corresponding 95% Confidence Interval (CI). AHI was skewed with no patient of zero scores and, therefore, was log-transformed and standardized before running the model. A Multivariable model was applied to adjust for demographic variables and investigate the possible interactions. P values<0.05 were considered as statistically significant.

Results

Table 1 demonstrates the descriptive characteristics of the participants. The participants' mean age was 39.45±11.54 years, and 45% of them were female. The mean BMI was 26.89 Kg/m^2. The mean SAS score was 38.98, and the Mean AHI was 15.79.

Univariable analysis of the association between SAS and AHI showed a positive significant association (beta=0.032, 95% CI=0.004 to 0.06, P=0.026) (Table 2). Multivariable analysis was applied to evaluate the association between SAS and AHI further. Age was a substantial confounder of the association when added to the model (beta of SAS after adjusting=0.009). No interaction was found between the variables and outcomes. Multivariable analysis did not show a significant association between SAS and AHI after adjusting for demographic variables (beta=0.006, 95% CI=-0.022 to 0.033, P=0.678) (Table 3).

Discussion

This study evaluated the relationship between the apnea-hypopnea index and the smartphone addiction scale. Age was a significant confounder in this association, and we

Table 1: Demographic characteristics of the population

Variable	Value	Min-Max
Age Mean (SD) (years)	39.45 (11.54)	18-69
Sex, female, N (%)	27 (45)	-
BMI Mean (SD) (Kg/m^2)	26.89 (5.98)	18.9-56.80
Educational Level, N (%)		-
Doctorate	5 (8.33)	
Master's degree	15 (25)	
Bachelor's degree	26 (43.33)	
Undergraduate	14 (23.33)	
SAS Mean (SD)	38.98 (8.91)	12-57
AHI Mean (SD)	15.79 (19.72)	0.4-78.7
Median (IQR)	5.7 (16.9)	

AHI: apnea hypopnea index, SD=standard deviation, SAS: smartphone addiction scale, BMI=body mass index, kg=kilograms, m^2=square meter

Table 2: Univariable analysis of the association between SAS and AHI

	Beta coefficient	95%CI	P value
SAS	0.032	0.004 to 0.06	0.026

SAS=smartphone addiction scale, AHI=apnea hypopnea index, CI=confidence interval

Table 3: Multivariable analysis of the association between SAS and AHI

	Beta coefficient	95% CI	P value
SAS	0.006	-0.022 to 0.033	0.678
Age	0.048	0.027 to 0.070	0.000
Sex (male)	0.235	-0.252 to 0.722	0.338
BMI	-0.017	-0.059 to 0.025	0.421
Education=Doctorate	-0.568	-1.531 to 0.396	0.242
Education=Master's degree	-0.334	-1.035 to 0.367	0.343
Education=Bachelor's degree	-0.340	-0.931 to 0.250	0.253

SAS=smartphone addiction scale, AHI=apnea hypopnea index, BMI=body mass index, CI=confidence interval

found no significant association between SAS and AHI after adjusting for confounders.

The gold standard method for diagnosing OSA syndrome is the Polysomnography test. The primary metric is AHI, which points to the average number of breathing disturbances per hour. An AHI of more than 5 is determined as OSA and categorized as mild, moderate, and severe as AHI increases.[9] A study on 251 patients with OSA found that, when correlated with patients with mild to moderate OSA, people with severe OSA (higher AHI) had higher BMI and lower mean oxygen saturation (SPO2).[10] The decrease of SPO2 in patients with OSA reflects intermittent arterial hypoxemia. The compensating responses of the sympathetic nervous and respiratory systems result in vasoconstriction of the peripheral vessels, decreased myocardial contractility, increased inflammation, oxidative stress, and endothelial dysfunction, which can lead to a rise in the risk of cardiovascular diseases.[11]

In a study on adolescents in Shanghai, excessive smartphone use was associated with increased obesity.[12] A randomized prospective study in Iraq on 440 overweight or obese patients revealed that overuse of smartphones could be a potential risk factor for obesity.[13] Former epidemiological studies have found that higher BMI is associated with higher OSA prevalence.[2, 14] A significant risk factor for the progression and development of OSA is obesity. OSA prevalence in obese individuals is two times that of individuals with average weight. The proposed reason for this is that the fat sediments wrap around the upper airway in the tissues, narrowing the lumen, raising the probability of airway collapse, and predisposing one to apnea. Thoracic fat depositions (truncal obesity) can also decrease the chest functional residual capacity and compliance.[15] Therefore, we hypothesized that increased smartphone use might be associated with OSA. However, the results of our study indicated that SAS was not associated with AHI, and BMI was not a significant confounder.

Multiple studies have described a relationship between excessive smartphone use and sleep disorders.[16-18] Emotional and exciting content on smartphones may engage the mind and cause sleep disturbance.[17] The pineal gland secretes the melatonin hormone in the brain, regulating the circadian clock and helping sleep. The melatonin secretion has a circadian rhythm, and light stimulation caused by smartphone use at night inhibits melatonin synthesis and secretion, leading to sleep disturbance.[18] However, in our study, SAS was not associated with AHI after adjustment for confounders.

Age was a significant confounder of the association between SAS and AHI in our study. Previous studies have demonstrated that age can affect the risk of OSA. One study in Japan indicated that women aged >50 years had a higher risk of OSA than those aged <50 years. They attributed this finding to lower female sex hormones and reduced airway patency in older women.[19] Conversely, in another study, age was a protecting factor against functional impairment in type 2 diabetes mellitus in patients with comorbid insomnia and OSA.[20] Another study also showed that for any duration of sleep, younger veterans with OSA reported higher levels of insomnia than older veterans.[21] Age also affects the smartphone use, and different factors seem to have a role in maintaining and developing problematic smartphone use in different generations.[22]

Our study had some limitations. The single-center design and small sample size of our study may reduce the generalizability of the results. We recommend further studies investigating the relationship between OSA and smartphone use in larger populations.

Conclusion

In conclusion, smartphone use does not affect the risk of OSA as determined by AHI when adjusted for age. The effects of smartphone use on sleep architecture and OSA and their underlying mechanisms should be further investigated to prevent functional impairment and long-term complications.

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Ethics Considerations

The research has followed the tents of the Declaration of Helsinki. Written and verbal informed consent were taken from all participants to use their data and reports to perform this study.

Conflicts of interest*:* None declared.

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