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Original Article

Effectiveness of Epworth Sleepiness Score in the Diagnosis of Obstructive Sleep Apnea – A Cross-sectional Study

Punnam Pradeep Kumar[1], Mansoora Tasneem Shaik[2], Sailaja Reddy Thikkavarapu[3], SH Arastu[4], Hina Afreen[5]

[1]Assistant Professor, Department of Pulmonary Medicine, Ayaan Institute of Medical Sciences, Telangana, India, [2]Senior Resident, Department of Pulmonary Medicine, Teaching Hospital and Research Centre, Shadan Institute of Medical Sciences, Telangana, India, [3]Assistant Professor, Department of General Medicine, Teaching Hospital and Research Centre, Shadan Institute of Medical Sciences, Telangana, India, [4]Associate Professor, Department of Pulmonary Medicine, Teaching Hospital and Research Centre, Shadan Institute of Medical Sciences, Telangana, India, [5]3rd Year Postgraduate, Department of Pulmonary Medicine, Teaching Hospital and Research Centre, Shadan Institute of Medical Sciences, Telangana, India

Abstract

Background: Delayed diagnosis of obstructive sleep apnoea (OSA) in patients can cause neurocognitive and cardiometabolic sequelae, hence, requiring early diagnosis and treatment. One of the concurrent symptoms of OSA is excessive, daytime sleepiness can be clinically assessed by Epworth's sleepiness scale (ESS). However, the gold standard for OSA diagnosis is polysomnography (PSG).

Objective: The aim of the study was to measure the effectiveness of ESS among OSA patients and to compare the results of ESS with PSG.

Methods: It was a hospital-based cross-sectional study of 50 patients. After obtaining ethical committee approval and informed consent, patients were interviewed using the ESS questionnaire during their clinical assessment and later subjected to the PSG test. The data were analyzed using SPSS (Version_24) Software.

Results: The mean age of the study participants was 59.10 ± 8.51 years. The majority of them were obese (42%) and pre-obese (42%). In ESS scoring, 28% had severe daytime sleepiness and in apnea-hypopnea index (AHI) shows that 24% had severe OSA. The correlation between ESS and AHI to assess OSA severity shows medium strength ($r = 0.414$; $P < 0.001$).

Conclusions: ESS was efficient in diagnosing the moderate and severe OSA cases. Although it might miss diagnosing mild OSA cases, it can be used to rule out OSA in high-risk patients or for pre-operative assessments.

Key words: Apnoea-hypopnea index, Daytime sleepiness, Epworth sleepiness scale, Obstructive sleep apnoea, Polysomnography

INTRODUCTION

Sleep-disordered breathing is characterized by episodes of absent or reduced breathing, and/or by sustained reductions in breathing during sleep compared with wakefulness. It results from the closure of the upper airway during sleep and is called obstructive sleep apnea (OSA). Polysomnography (PSG) is a comprehensive multi-parameter study of sleep and is considered as a gold standard for OSA diagnosis.[1]

OSA severity is based on the apnea-hypopnea index (AHI), which is calculated as the number of apneas and hypopneas during sleep divided by total sleep time, represented in events per hour. The grading was normal (no OSA): AHI < 5; mild sleep apnea: 5–15; moderate sleep apnea: 15– 0; and if >30 is severe sleep apnea.[2]

The term sleep apnea syndrome refers to the concurrence of OSA with symptoms, classically excessive daytime

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Corresponding Author: Dr. Mansoora Tasneem Shaik, Department of Pulmonary Medicine, Teaching Hospital and Research Centre, Shadan Institute of Medical Sciences, Telangana, India.

sleepiness.[3] The latter is often identified by the Epworth sleepiness scale (ESS), in which the respondent indicates the likelihood of dozing (scale from 0 to 3) in eight common circumstances.[4] A score of 11 or greater is accepted as indicative of excessive sleepiness. At present, the international classification of sleep disorders identifies a diagnosis of adult OSA as an AHI of five or greater with symptoms, or an AHI of 15 or greater regardless of symptoms.[3]

The ESS currently plays an important role in the screening process for the determination of whether a patient should be referred to a sleep laboratory for PSG.[5] PSG is considered as a gold standard for diagnosing OSA. The test can be done in a laboratory with technologist-attended complete overnight testing.[5] Henceforth, our study aims to find out the effectiveness of Epworth's sleep score in diagnosing OSA.

MATERIALS AND METHODS

Study Area

The study was conducted in the Department of Pulmonary Medicine in a Tertiary Care Teaching Hospital in Telangana, India. This tertiary care institute is equipped with state-of-the-art equipment to understand and study OSA.

Study Design

It was a hospital-based analytical cross-sectional study.

Sample Size and Sampling Technique

Considering the prevalence of OSA in the Indian population to be 4.4%[6] with 6% absolute precision and 10% non-response rate, the sample size was 50 (calculated using OpenEpi software version 3.01; Open-Source Epidemiologic Statistics for Public Health). A consecutive sampling technique was used to include the study participants based on the inclusion criteria until the desired sample size was achieved.

Study Participants and Duration

Patients who were admitted to the Department of Pulmonary Medicine were considered for the study. Inclusion criteria used to select the participants include both genders aged > 35 years, body mass index (BMI) >18.5 kg/m^2, and patients who had complaints of obstructive sleep apnea symptoms. The patients who presented with central sleep apnea, restless leg syndromes, circadian rhythm disorders, parasomnias, hypersomnia, or narcolepsy were excluded from the study. Data collection was done for 6 months.

Data Collection Procedure

After obtaining informed consent, data were collected using a pretested structured questionnaire. It included demographic details, a general clinical assessment and ESS questionnaire.[7] All the patients underwent overnight PSG at the hospital and the results were collected and compared with the ESS data. Principle investigator conducted a face-to-face interview on the day of the clinical assessment. Confidentiality, anonymity, and privacy of the participants were guaranteed throughout the study.

Data Analysis

The collected data were entered in MS Excel and analyzed using IBM SPSS Statistics Version_24.0 (IBM Co., Armonk, NY, USA). Categorical variables were measured and expressed in frequencies and percentages, while the continuous variables were expressed in mean and standard deviation. Pearson's bivariate correlation (*r*) was done to find out the strength and direction of the association that exists between the dependent variable PSG and independent variables such as ESS, BMI, and AHI. Scatterplots were used to check the linear relationship between PSG and ESS. Correlation is significant at the 0.01 level (*P* value).

Ethical Consideration

Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of Shadan Institute of Medical Sciences Teaching Hospital and Research Centre, Telangana.

Guidelines Used for Reporting the Study

To ensure the present hospital-based cross-sectional study's systemic reporting, STROBE (Strengthening The Reporting of an Observational study in Epidemiology) guideline was followed.[8]

RESULTS

The sociodemographic details of the study participants were given in Table 1. The mean age of the participants was 59.10 ± 8.51 (SD) years. The clinical assessment shows that 58% of patients had diabetes and the majority of 88% presented with hypertension.

Among 50 patients, the assessment of daytime sleepiness using ESS shows that 28% had excessive and 28% had

Table 1: Sociodemographic details of the study participants (*n*=50)

Variables	*n* (%) or mean (SD)
Gender	
Male	38 (76.0)
Female	12 (24.0)
Body mass index (kg/m^2)	
Normal weight (18.5–22.9)	6 (12.0)
Overweight (23–24.9)	7 (14.0)
Pre-obese (25–29.9)	16 (32.0)
Obese (≥30)	21 (42.0)

severe daytime sleepiness. About 15% had mild daytime sleepiness. Then, the patients were subjected to PSG, where only 42% were diagnosed to have OSA. AHI calculated through PSG, showed that 12% had moderate and 24% had severe OSA [Table 2].

In Table 3, the results from ESS and PSG were compared and found to be significant ($\chi^2 = 2.56$; 95% CI: 2.517–43.11; $P < 0.001$), showing that PSG can be used to diagnose OSA 2.56 times even in the milder form than ESS scale. Similarly in Table 4, the relationship between AHI (obtained from PSG) and ESS was positive with moderate strength and it was statically significant at 0.001 ($r = 0.414$; $P < 0.001$). This finding shows that patients with higher ESS will subsequently increase the severity of the OSA.

Table 2: Assessment of obstructive sleep apnea among the study participants (*n*=50)

Variables	*n* (%) or mean (SD)
Epworth sleepiness scale (ESS)	
Normal daytime sleepiness (0–10)	7 (14.0)
Average daytime sleepiness (11–12)	15 (30.0)
Excessive daytime sleepiness (13–15)	14 (28.0)
Severe daytime sleepiness (16–24)	14 (28.0)
Apnea – Hypopnea Index (AHI)–OSA severity	
Normal sleep (<5)	29 (58.0)
Mild sleep apnea (5–15)	3 (6.0)
Moderate sleep apnea (15–30)	6 (12.0)
Severe sleep apnea (≥30)	12 (24.0)
Polysomnography	
OSA absent	29 (58.0)
OSA present	21 (42.0)

Table 3: Comparison between polysomnography and Epworth sleepiness scale (ESS) among the study participants (*n*=50)

Variables	PSG		χ^2 95% CI *P* value
	Present, *n* (%)	Absent, *n* (%)	
ESS scale			
Abnormal (>11)	13 (76.5)	4 (23.5)	12.56; 2.517–43.11<0.001*
Normal (≤11)	8 (24.2)	25 (5.87)	

*Pearson's chi-square test; 95% CI - Confidence Intervel; p value < 0.05 is statistically significant

Table 4: Pearson correlation coefficients of obstructive sleep apnea with other clinical variables (*n*=50)

Variables	Pearson's correlation (r)	*P* value# (2-tailed)
*AHI and BMI	0.715	<0.001
^ESS and BMI	0.509	<0.001
AHI and ESS	0.414	<0.001

*AHI: Apnea-Hypopnea index, ^ESS: Epworth sleepiness scale, BMI: Body mass index. #Correlation is significant at the 0.01 level (2-tailed).

Furthermore, BMI, a risk factor for OSA shows that an increase in BMI results in the severity of OSA and had a stronger relationship ($r = 0.715$; $P < 0.001$). Receiver operating characteristic curve demonstrating the sensitivity of ESS. Area under curve is found to be 0.741 and shows 74% sensitivity for ESS [Figure 1].

DISCUSSION

Our study shows that ESS was efficient in diagnosing the moderate and severe undiagnosed OSA cases. Although, the ESS questionnaire missed to diagnose mild OSA cases, the questionnaire can be used to rule out OSA in high-risk patients or for pre-operative assessments.

In our study, it has been shown that increase in ESS, there was an increase in AHI which was similar to the study done by Guo *et al.*,[9] where the higher the ESS item score, the closer the relationship with the corresponding AHI.

Similarly, the sensitivity of the ESS was found to be 74% in our study which was in concordance with the study findings by Rosenthal *et al.*,[10] where the ESS obtained a relatively low sensitivity (66%) in the identification of an AHI of five and above at the suggested cutoff of 10 and increased to 76% if the score is eight. Furthermore, our study results showed the fair discriminatory ability of the ESS as a screener for OSA rather than a diagnostic tool which is PSG.

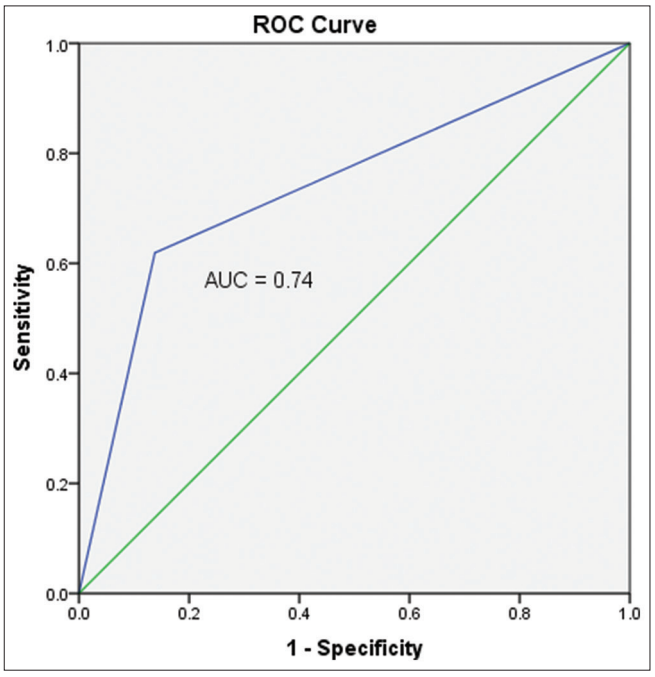

Figure 1: Receiver operating characteristic of polysomnography and Epworth's sleepiness scale

In another study done by Chakrabarti *et al.*,[11] the ESS had 53% sensitivity and 60% specificity for diagnosing OSA using a cutoff of 13 and they also concluded that questionnaires such as the ESS and STOP-BANG questionnaire which cannot replace the gold-standard PSG.

Several questionnaires such as the Epworth's sleep scale, Berlin, and STOP-BANG questionnaires have been developed to grade OSA risk.[12] These models tend to be relatively sensitive (76–96%) but not very specific (13–54%) when compared with PSG.[13] Thus, although questionnaires or prediction models are useful for screening or estimating pre-test probability, objective sleep recording is required to establish a diagnosis of OSA.

Our study supports the position of the AASM guideline that stated that clinical tools, questionnaires, and prediction algorithms should not be used to diagnose or exclude the presence of sleep apnea.[14]

The limitation of this study was due to the small sample size. ESS is non-specific as symptoms may be downplayed by patients, as only speculative questions are asked.

CONCLUSION

Thus, ESS can be taken as a helpful screening tool for OSA rather than to diagnose it. Due to the lack of resources and not many PSG laboratories in many areas of the country, along with the need to diagnose OSA to avoid complications, a questionnaire than can predict OSA with surety is needed.

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