

Sensitivity of Epworth Sleepiness Scale in Detecting Obstructive Sleep Apnea in Pakistani Adults

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ABSTRACT

Background: Self-reported measures of Excessive daytime Sleepiness, such as the Epworth Sleepiness Scale (ESS), have been widely used as a screening tool for OSA, but their accuracy in predicting OSA has been questioned.

Objective: The main objective of this research is to re-evaluate the usage of ESS in predicting Obstructive Sleep Apnea (OSA) and to consider additional screening tools, such as polysomnography, to improve the accuracy of OSA diagnosis in the Pakistani population.

Methods: It was a retrospective cross-sectional study design, conducted on 500 participants. Data was obtained from the hospital records at the Sleep Lab of Dow University Hospital from January 2021 to March 2023 who completed the Epworth Sleepiness Scale (ESS), received a clinical evaluation from a doctor, and underwent diagnostic polysomnography (PSG), polysomnography is a comprehensive sleep study that monitors various physiological parameters to diagnose sleep disorders.

Results: Out of a total sample of 500 participants, 272 were males and 228 were females. The average age was 51 ± 12 years. The average body mass index (BMI) was 37.2 ± 8.1 Kg/m². The average Epworth Sleepiness Scale (ESS) score of the participants was 12.4 ± 4.2 . The finding of our study shows Epworth sleepiness score is a good predictor of OSA (AUC: 0.84, 95% CI: 0.757-0.923). However, the optimal cutoff of ESS is 8.4 and above which shows sensitivity and specificity of 83.1% and 81.8% respectively.

Conclusion: The results suggest that the Epworth Sleepiness Scale may be a useful tool for identifying individuals with OSA, although it also has a low false positive rate, there is a need for further research, and the importance of combining clinical assessment and diagnostic tests for accurate OSA diagnosis.

Keywords: Excessive daytime sleepiness, Epworth score, ESS, EDS, OSA, Pakistani population.

INTRODUCTION

Obstructive sleep apnea (OSA) is a prevalent sleep disorder characterized by recurrent interruptions in breathing during sleep due to airway obstruction [1]. OSA has been recognized as a global health concern, [2] and in Pakistan; the prevalence of OSA is reported to be substantial, with a significant impact on public health. However, the accurate diagnosis of OSA remains a challenge. Self-reported measures of excessive daytime sleepiness (EDS), such as the widely used Epworth Sleepiness Scale (ESS), have been commonly employed as screening tools for OSA [3, 4]. The accuracy of ESS in predicting OSA has been called into question, as it has shown relatively low sensitivity and specificity in previous studies [5]. The study underscores the need for additional screening tools such as Polysomnography for detecting OSA. Notably, this research stands as the pioneering investigation of ESS sensitivity and specificity for OSA within the Pakistani population, offering a strong foundation for understanding and addressing the complexities of OSA diagnosis.

A study by Kapur *et al.* found that those individuals who have obstructive sleep apnea with AHI (Apnoea-Hypopnoea Index) ≥ 5 are more likely to get excessive daytime sleepiness (EDS) as compared to those who have an AHI of less than 5. The Apnoea-Hypopnoea Index (AHI), which quantifies the number of apnea and hypopnea events per hour, is commonly used to assess the severity of OSA. It is categorized into mild (5-14.9), moderate (15-29.9), and severe levels (>30). They observed that the prevalence of EDS, as ascertained by ESS > 10 , was 29% in individuals with an AHI ≥ 5 , while it was 21% in individuals with an AHI < 5 . Clinically, the presence of Excessive daytime sleepiness (EDS) and snoring may motivate individuals to seek medical evaluation for sleep disorders such as OSA. Prompt detection and therapy of sleep disorders can improve the quality of life and prevent serious health complications associated with untreated sleep disorders [6]. Cepeda *et al.* found minimal change in ESS scores among patients with sleep apnea, indicating variability in sensitivity, and only 21% of subjects showed significant score differences, implying the need for supplementary objective measures in OSA screening. [7]. Antic *et al.* found that ESS scores in OSA patients changed during treatment, with a temporary increase of 15% following bedtime restriction, highlighting the complex nature of CPAP (Continuous Positive Airway

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Received: May 15, 2023; Revised: July 25, 2023; Accepted: August 26, 2023
DOI: <https://doi.org/10.37184/lnjpc.2707-3521.6.11>

Pressure) adherence and the need for a comprehensive management approach [8].

Benjafield *et al.* provided valuable insights into the global prevalence of OSA using the AASM 2012 diagnostic criteria and AHI threshold values. According to their estimates, approximately 936 million adults aged 30–69 years have mild to severe obstructive sleep apnea, while 425 million adults in the same age group have moderate to severe OSA worldwide. This information highlights the significant burden of OSA on a global scale and emphasizes the importance of effective screening tools like the ESS to aid in early detection and management of this disorder [9].

Several studies highlight the low sensitivity of self-reported EDS in predicting OSA, with examples showing the Epworth Sleepiness Scale had 46% sensitivity for moderate to severe OSA prediction, missing over 50% of OSA patients [10]. ESS scores vary among populations; research indicates higher scores in individuals with South Asian backgrounds [11] and those with higher education and earnings, suggesting potential socio-cultural and socioeconomic influences on daytime sleepiness perception [12].

This study aims to re-evaluate the usage of ESS in predicting OSA and to consider additional screening tools, such as polysomnography, to improve the accuracy of OSA diagnosis in the Pakistani population. It is also important to educate patients, their family members, and medical professionals about the limitations of self-reported measures of EDS in diagnosing OSA and the importance of further evaluation and testing.

MATERIALS AND METHODS

The cross-sectional retrospective study was conducted at the Sleep Lab of Dow University Hospital from January 2021 to March 2023. Data was obtained from old medical records of study participants. This study was accepted by the Institutional Review Board of Dow University of Health Sciences. The study received no external financing. This retrospective study design allowed for the examination of data collected over a specific period to evaluate the association between ESS scores and OSA diagnosis. The sample size was determined using the formula [11]; $n = Z_{(\alpha/2)}^2 ((AUC)/d^2)$, where d represents the margin of error and $V(AUC)$ is the variance of the AUC. In our study, the AUC of the Epworth Sleepiness Scale in predicting OSA was 0.601, and a margin of error of 3.5% was chosen with a 95% confidence level. Based on these parameters, the minimum required sample size was calculated to be 488. Participants included in the study were adults aged 18 and above who had a diagnosis of obstructive sleep apnea ($AHI \geq 5$) based on polysomnography (PSG) results. Individuals with thyroid disorders, pregnant women, and those who had previously used CPAP therapy were excluded. The specific diagnostic criteria for OSA were based on the Apnea-Hypopnea Index (AHI) and the presence

of characteristic symptoms. The Epworth Sleepiness Scale is a standardized questionnaire that helps assess a person's level of daytime sleepiness [13]. It consists of eight questions that ask about how likely someone is to fall asleep or feel drowsy in particular situations, such as while sitting and reading or watching TV or while stopped in traffic. Each question in ESS that ranges from 0-3, results in a total score of 24. A higher score indicates greater daytime sleepiness [14].

Polysomnography is an effective diagnostic tool for OSA, which can cause daytime sleepiness and is considered the gold standard for diagnosis. It involves monitoring various physiological parameters during sleep to identify the number and severity of apnea and hypopnea events [15].

Polysomnography, the gold standard diagnostic tool for OSA, was performed at the Sleep Lab of the Pulmonology Department of Dow University Hospital. The Rechtschaffen and Kales (R&K) scoring system was used for sleep scoring, which involved trained sleep technologists visually examining EEG, EOG, and EMG recordings to assign sleep stages based on specific criteria [16]. The statistical software package SPSS (Statistical Package for the Social Sciences) version 20 was utilized for data analysis.

RESULTS

Out of the total sample of 500 participants, there were 478 participants with an $AHI \geq 5$ (indicating obstructive sleep apnea), while 22 participants had an $AHI < 5$ (without obstructive sleep apnea). The mean AHI in the sample was 33.8 events per hour, with a standard deviation of 20. The sample consisted of 272 males and 228 females, with a total sample size of 500 individuals. The average age was 51 years \pm 12. The average body mass index (BMI) was 37.2 ± 8.1 Kg/m².

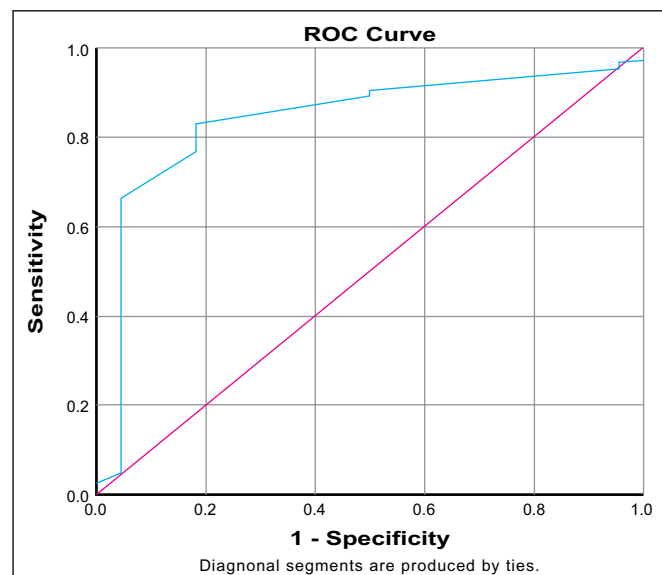


Fig. (1): ROC curve comparison for ESS using different Apnea-Hypopnea Index thresholds as state variables.

The average Epworth Sleepiness Scale (ESS) score of the participants was 12.4 ± 4.2 . The analysis showed an area under the curve of 0.84 ($p < 0.001$), indicating a statistically significant relationship between ESS scores and the presence of OSA.

A receiver operating characteristic curve (ROC) analysis was conducted using the ESS as the independent variable and an AHI positive score of at least 5 was used as the outcome measure. The analysis showed an area under the curve of 0.84 ($p < 0.001$), indicating a statistically significant relationship between ESS scores and the presence of OSA. This information is presented graphically in **Fig. (1)**. The finding of our study shows Epworth sleepiness score is a good predictor of OSA (95% CI: 0.757-0.923). However, the optimal cutoff of ESS is 8.4 and above which shows sensitivity and specificity at 83.1% and 81.8% respectively.

DISCUSSION

This research aimed to ascertain the ESS sensitivity in detecting a positive OSA diagnosis, through polysomnography with an Apnea-Hypopnea Index (AHI) greater than 5 (**Table 1**). It is interesting to note that the area under the curve was approximately 0.8. When an area under the curve (AUC) is 0.5, it suggests that the test does not discriminate better than chance alone. In our study, the AUC of approximately 0.8 suggests that the ESS is generally considered to have “good” discriminatory power between those with OSA and those without OSA, and it is considered an “acceptable” curve, indicating that there is still room for improvement in the accuracy of the ESS as a diagnostic tool for OSA. Furthermore, results were not significantly different when an AHI threshold of 12 or 20 was used.

The results of this study demonstrate that there are limitations to using the Epworth Sleepiness Scale (ESS) alone to diagnose obstructive sleep apnea (OSA). This is because the ESS has a low level of sensitivity and specificity as compared to other diagnostic procedures such as polysomnography. The study shows the importance of using a coalescence of clinical assessment and diagnostic tests to correctly identify and diagnose OSA. Insufficient sleep, sleep disorders such as OSA,

Table 1: Comparison of sensitivity and specificity of Epworth Sleepiness Scale at different thresholds.

Apnea Hypopnea Index ≥ 5		
ESS Score	Sensitivity (%)	1 - Specificity (%)
6	90.6	50
7	89.3	50
8	83.1	18.2
9	79.9	18.2
10	76.8	18.2
11	66.3	4.5
12	50.2	4.5

The sensitivity and specificity values for the Epworth Sleepiness Scale (ESS) were calculated using an apnea-hypopnea index (AHI) threshold of 5 as the positive state variable.

medication side effects, along certain ailments can all contribute to excessive somnolence [17]. Identifying the underlying source of excessive sleepiness is important to properly manage and treat the condition [18]. According to an epidemiological study, even in the absence of obstructive sleep apnea, one in five individuals in the general population experience excessive somnolence [19], likely due to aspects of modern lifestyle. Additionally, there have been a few concerns regarding the ESS's suitability as a tool to identify excessive somnolence. The literature has highlighted that there is merely a weak correlation between the ESS and the multiple sleep latency test, which is considered to be the most reliable tool to measure sleepiness in a laboratory setting [20].

In summary, the study findings illustrate the existing limitations in the subjective assessment of excessive somnolence in clinical populations. As a considerable proportion of patients experiencing excessive sleepiness may not have obstructive sleep apnea as the underlying cause, the study serves as a reminder of the crucial role of the diagnostic workup in the clinical evaluation of excessive somnolence. The observed findings suggest that an ESS score of 8 or more would be a better cutoff point for identifying clinically significant levels of daytime somnolence among individuals in a clinical setting. This adjustment in the interpretation of the ESS is particularly relevant since primary care doctors are increasingly responsible for detecting OSA but may have time constraints to assess the associated behavioral concerns.

The strength of our study is the use of the gold standard approach for OSA detection sets our study apart from those that have used the Epworth Sleepiness Scale and other OSA symptoms and indicators to identify OSA patients. Additionally, we established OSA predictors in our group and the study only included Pakistani participants.

CONCLUSION

The findings from our study suggest that the Epworth Sleepiness Scale may be a useful tool for identifying individuals with OSA with a moderate level of accuracy, although it also has a low false positive rate, which may lead to unnecessary PSG testing referrals. Notably, these findings may not generalize to other populations or diagnostic approaches because they are based on the specific population and diagnostic criteria used in this study. Therefore, it is important to use the ESS evaluation in concurrence with other clinical assessments and patient history to improve the accuracy of OSA diagnosis. Further research is needed to validate the findings in larger and more diverse populations.

ETHICAL APPROVAL

The study was approved by the Institutional Review Board of Dow University of Health Sciences, Karachi Pakistan (Ref. No: IRB-1896/DUHS/Approval/2021/303).

All procedures performed in studies involving human participants were by the ethical standards of the institutional and/ or national research committee and with the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the participants.

AVAILABILITY OF DATA

Data is the intellectual property of Dow University Hospital but is available on request from the corresponding author.

FUNDING

Declared none.

CONFLICT OF INTEREST

The authors affirm that there are no conflicts of interest to disclose. All co-authors have thoroughly reviewed and endorsed the manuscript's contents, and no financial interests need to be reported. We confirm that this submission represents original work and is not currently under consideration by any other publication.

ACKNOWLEDGEMENTS

We are thankful to the Department of Pulmonology, Dow University Hospital, Karachi, Pakistan for their support with the equipment and data.

AUTHORS' CONTRIBUTION

All authors have accepted responsibility for the entire content of this manuscript and approved its submission. Dr. Faisal Asad and Madiha Moin designed the study and carried them out. Ubedullah collected the data from the Sleep Lab. Saif ur Rehman entered the data into SPSS and performed the statistical analysis. Madiha Moin prepared the manuscript with contributions from all coauthors."

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