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Correlation between self-reported and questioned Epworth sleepiness scale results including polysomnographic outcomes

Hazan Basak* and R. Yucel Anadolu

Abstract

Introduction: Obstructive sleep apnea (OSA) is characterized by a recurrent complete or partial obstruction in the upper airways accompanied by desaturation attacks and recurrent awakenings (arousal) during sleep and is associated with excessive sleepiness and poor quality of life. Excessive daytime sleepiness (EDS) has long been recognized as the most important symptom of OSA and Epworth sleepiness scale (ESS) is a simple, easy-to-understand, self-reported, validated scale used in the evaluation of patients with obstructive sleep apnea syndrome (OSAS).

Objective: Some researchers have reported that ESS has controversial results in evaluating OSAS due to the fact that it is based on self-reporting. It is known that ESS is a self-administered patient questionnaire, but it can also be administered by the doctor, and the information about the latter's validity, reliability, and correlation with OSAS is limited. This study was conducted to compare the outcomes of ESS self-administered by the patient and administered by a doctor in patients with OSAS.

Methods: Ninety-three patients with OSAS symptoms, with polysomnography test results, and who were presented in a tertiary hospital in 2019 for snoring and apnea problems were included in this study. ESS, consisting of eight questions and used to measure daytime sleepiness in various situations on the basis of self-reporting, was used. Subsequently, ESS was repeated, but this time verbally administered by the doctor to the patient. ESS is a 4-point Likert-type scale scored with 0, 1, 2, and 3. Excessive daytime sleepiness is accepted in individuals with a total score of 11 or more. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) program.

Results: Of the patients who participated in this study, 57% ($n = 53$) were male and 43% ($n = 40$) were female. The average age of the patients was 48.1 ± 9.71 . The body mass index (BMI) average was 29.7 ± 5.66 kg/m², and the average neck circumference was 38.6 ± 4.62 cm. The mean value of the completed ESS self-administered by the patient (ESSp) was calculated as 11.0 ± 5.25 and that of the ESS administered by the doctor (ESSd) was 7.9 ± 4.76 . For the results, while daytime sleepiness was 35.5% in ESSd, it was 52.7% in ESSp. A positive correlation was found between the ESSd and ESSp values and BMI. A positive correlation was also found between the apnea-hypopnea index (AHI) and BMI.

Conclusions: The ESS administered by a doctor will yield more accurate data about the severity of OSAS than the ESS self-administered by the patient.

Keywords: Obstructive sleep apnea, Epworth sleepiness scale, Polysomnography, Apnea

Introduction

Obstructive sleep apnea (OSA) is characterized by a recurrent complete or partial obstruction in the upper airways accompanied by desaturation attacks and recurrent awakenings (arousal) during sleep and is associated

*Correspondence: hasanbasak@hotmail.com

Department of Otolaryngology, Ankara University Medical School, Altindag, 06230 Ankara, Turkey

with excessive sleepiness and poor quality of life [1, 2]. OSA is defined by the apnea-hypopnea index (AHI) and the respiratory disturbance index (RDI), which are measured during sleep, recurrent upper-airway obstruction, and recurrent awakenings (arousals). The common risk factors for OSA include obesity, advanced age, male gender, female postmenopausal status, race, and craniofacial dysmorphism [1]. OSA is also associated with a number of systemic disorders. It is strongly linked to cardiovascular diseases such as congestive heart failure, cerebrovascular accident, atrial fibrillation, and ischemic heart disease and may play a causal role in the development of systemic hypertension [1–3].

Excessive daytime sleepiness (EDS) has long been recognized as the most important symptom of OSA, and most OSA patients have been shown to have EDS when assessed through objective means such as the Multiple Sleep Latency Test (MSLT) and the Maintenance of Wakefulness Test (MWT). To conduct MSLT and MWT evaluation, the patient is subjected to polysomnography (PSG) overnight. This test is complex, expensive, and time-consuming. It also provides information about the person's insomnia for only 1 day. The Athlete Sleep Screening Questionnaire (ASSQ) was proposed by Johns and has been widely used in clinical research settings since 1991 [1]. The Epworth Sleepiness Scale (ESS), on the other hand, is a simple, easy-to-understand, self-reporting-based scale with proven validity and reliability that is used for the evaluation of patients with obstructive sleep apnea syndrome (OSAS). In addition, the emergency severity index (ESI) measures the average sleep propensity over a longer period of time [3]. However, even with severe OSA, subjective daytime sleepiness is usually absent, and patients may reject or understate the symptoms. Therefore, the self-reporting-based EDS has led to suspicions of a lack of reliability in the evaluation of OSAS [4]. It has likewise been stated that ESS yields controversial results in evaluating OSAS because it is also based on self-reporting [5]. ESS is known to be a questionnaire self-administered by the patient, but it can also be administered by the doctor, and there is limited information about the latter's validity, reliability, and correlation with OSAS. For this reason, this study was conducted to compare the use of patient-administered ESS (ESSp) with the use of doctor-administered ESS (ESSd) for people with OSAS.

Materials and methods

This study was conducted in a cross-sectional, prospective manner and included 93 people who were presented in XXXXXXX for snoring and apnea problems and who had undergone polysomnography tests. Excluded from the study were people with a diagnosis of another sleep

disorder (e.g., narcolepsy, periodic limb sleep movements [PLSM], or rapid-eye-movement [REM] behavior disorder [RBD]) who were admitted to the outpatient clinic for evaluation after continuous positive airway pressure (CPAP) or surgical treatment, and people with cognitive disorders or communication problems. ESS is used to measure daytime sleepiness in various situations based on self-reporting.

The participants in this study answered the self-reporting ESS (ESSp) questionnaire while alone in the waiting room and without the help of a physician or their family members. ESS was later repeated, but this time, it was verbally administered by a sleep medicine physician (ESSd), who explained the questionnaire items to the patients and filled out the questionnaire himself with the patients' answers. The sleep medicine physician did not influence the patients' answers but only made these more precise. ESS is scored on the basis of a 4-point (0, 1, 2, and 3) Likert-type scale. It consists of eight items, as follows:

- (1). Sleepiness while sitting and reading.
- (2). Sleepiness while watching TV.
- (3). Sleepiness while sitting still in a community (theater, meeting, etc.).
- (4). Sleepiness when on a car ride without a break for an hour.
- (5). Sleepiness while lying down to rest for an afternoon.
- (6). Sleepiness while sitting and talking with a person.
- (7). Sleepiness while sitting calmly after a no-alcohol lunch.
- (8). Sleepiness when stopping for a few minutes due to traffic while driving a car.

Individuals with a total score of 11 and above are considered to have EDS [3].

A nightly sleep study was conducted in the sleep laboratory of otorhinolaryngology. All the polysomnographies were performed using Weinmann Sonolab 2 equipment, including an electroencephalograph, an electrooculograph, a submental and bilateral tibial electromyograph, an electrocardiograph, a nasal pressure transducer, an oronasal thermistor for airflow, thoracic and abdominal respiratory impedance plethysmography belts, and a pulse oximeter (SpO₂).

All the sleep studies were evaluated and scored by a board-certified sleep medicine physician using the standard the 2012 American Academy of Sleep Medicine criteria for scoring sleep, arousal, and respiratory events. Based on the AHI in the polysomnography results, the patients were divided into four groups according to the

severity of their illness: Group 1: patients where OSAS was not detected (patients with a less than 5 AHI); Group 2: patients with mildly obstructive sleep apnea (patients with a 5–20 AHI); Group 3: patients with moderate obstructive sleep apnea (patients with a 21–40 AHI); and Group 4: patients with severe obstructive sleep apnea (patients with a greater than 40 AHI).

The neck circumference (cm) was taken using a non-stretch tape measure. It was taken on a horizontal plane, just below the thyroid cartilage, while paying attention to the same level of anterior-posterior tape measure. Meanwhile, the patient was asked to stand upright and to look ahead. The height and body weight data of the patients were obtained verbally from them, and their body mass index (BMI) was calculated by dividing their body weight (kg) by the square of their height (m).

Statistical analyses were done by using the statistical package for the social sciences (SPSS) 22.0 program. Both patient-administered ESS (ESSp) and doctor-administered ESS (ESSd) found to be normally distributed, parametric tests (*t* test and Pearson’s correlation were done as appropriate). Also, linear regression was used to assess the relationship between them. Data were considered statistically significant if the value was less than 0.05.

Results

The demographic characteristics and basic sleep parameters of the study participants are shown in Table 1. The average age of the study participants was 48.1±9.71 years. A total of 93 individuals, 53 (57%) males and 40 (43%) females were included in the study. Their

Table 1 Demographic characteristics and basic sleep parameters of the study participants

Study participant characteristics	Findings
Age (year)	48.1±9.71
Gender	
Male, <i>n</i> (%)	53 (57)
Female, <i>n</i> (%)	40 (43)
BMI (kg/m ²)	29.7±5.66
AHI (respiratory event/h)	20.6±18.44
AHI supine/AHI nonsupine	29.0±23.98
OSA grade according to the AHI values	
OUAS undetected, <i>n</i> (%)	12 (12.9)
Mild OSAS, <i>n</i> (%)	36 (38.7)
Moderate OSAS, <i>n</i> (%)	24 (25.8)
Severe OUAS, <i>n</i> (%)	21 (22.6)
ESSp	11.0±5.25
ESSd	7.9±4.76
Neck circumference (cm)	38.6±4.62
minSpO ₂	79.3±9.73

BMI was 29.7±5.66 kg/m². Their average AHI value was 20.6±18.44. When the OSA severity was classified according to the study participants’ AHI values, 12 (12.9%) study participants were found not to have had OSA while the numbers of patients with mild, moderate, and severe OSA were 36 (38.7%), 24 (25.8%), and 21 (22.6%), respectively. The ESSp values were found to be higher than the ESSd values (11.0±5.25 and 7.9±4.76, respectively) (Table 1).

Table 2 shows the correlations among the ESSp, ESSd, and OSA parameters. Positive significant correlations were found between the ESSd and AHI values and between the ESSp and AHI values (*r* = 0.264, *p* = 0.011 and *r* = 0.210, *p* = 0.044, respectively), and negative significant correlations were found between the ESSd and minSpO₂ values and between the ESSp and minSpO₂ values (*r* = 0.264, *p* = 0.010 and *r* = -0.316, *p* = 0.002, respectively) (Table 2).

In Table 3, the correlations among the ESSp and ESSd values with BMI (kg/m²) and the neck circumference (cm) are given. Positive significant correlations were found between the ESSd values and BMI and between the ESSp values and BMI (*r* = 0.412, *p* < 0.001 and *r* = 0.409, *p* < 0.001, respectively), and positive significant correlations were found as well between the ESSd values and the neck circumference and between the ESSp values and the neck circumference (*r* = 0.240, *p* = 0.021 and *r* = 0.281, *p* = 0.006, respectively) (Table 3).

Table 4 shows the distribution of daytime sleepiness according to ESSp and ESSd. The percentage of daytime sleepiness was found to be 35.5% (*n* = 33) in ESSd and 52.7% (*n* = 49) in ESSp (Table 4) (Fig. 1).

The results of this study also show a correlation between the ESSp scores and the education level (*r* =

Table 2 Correlations of ESSp and ESSd with the OSA parameters

	ESSp		ESSd	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
AHI	0.210	0.044	0.264	0.011
minSpO ₂	-0.264	0.010	-0.316	0.002

Table 3 Correlations of ESSp and ESSd with BMI (kg/m²) and neck circumference (cm)

	ESSp		ESSd	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
BMI	0.412	< 0.001	0.409	< 0.001
Neck circumference	0.240	0.021	0.281	0.006

Table 4 Distribution of daytime sleepiness according to ESSp and ESSd

Daytime sleepiness	ESSp	ESSd
Detected, <i>n</i> (%)	49 (%52.7)	33 (%35.5)
Not detected, <i>n</i> (%)	44 (%47.3)	60 (%64.5)

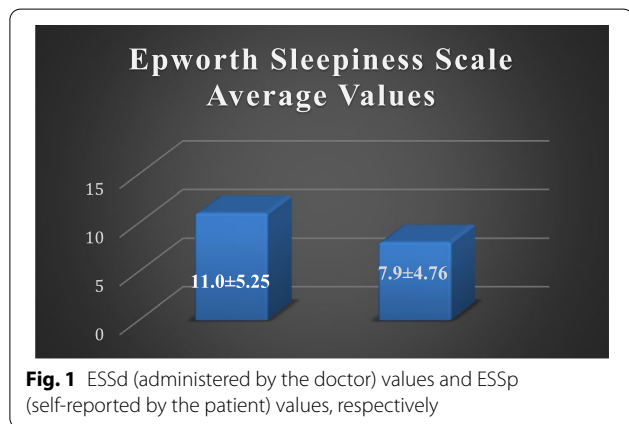


Fig. 1 ESSd (administered by the doctor) values and ESSp (self-reported by the patient) values, respectively

0.272, *p* = 0.012). The ESSp scores of those with a higher education level were more similar to the ESSd scores than were the scores of those with a lower education level. On the other hand, there was no difference between those with a lower and higher education level in the ESSd scores (*p*: 0.094)

Discussion

In this study, in a sample with suspected OSA, the traditional self-reporting ESS scores were compared with those obtained by a physician. In the study conducted by Damiani et al., the mean ESSd score (12.09±4.1) was found to be statistically higher than the average ESSp score (10.37±5.4) [6]. However, in the other study by Kaminska et al., 188 patients with suspected OSA were evaluated, and it was observed that the ESSp scores (9.4±5.9) were significantly higher than the ESSd scores (8.3±5.8) [7]. In this study, the ESSp scores were

significantly higher than the ESSd scores, supporting the findings of the study by Kaminska et al. In addition, when EDS was evaluated in this study, daytime sleepiness was found to be 35.5% (*n* = 33) in ESSd and 52.7% (*n* = 49) in ESSp. Some explanations can be given for the difference observed between the scores obtained from the self-reporting ESS questionnaire and from the ESS questionnaire administered by the doctor. The self-reporting questionnaire is answered individually, and patients may express their perceived problems even more strongly under these conditions than otherwise. On the other hand, it was stated that in an interview setup, patients could underreport the behaviors that they believed to be less socially acceptable [8].

Ugur et al. [9] evaluated two different application methods of ESS (self- and nurse-administrated). The study included 114 patients, and they found nurse-administrated ESS scores are significantly correlated with AHI but self-administrated ESS scores were not correlated with AHI. They concluded nurse-administrated ESS could change the reliability and sensitivity of the ESS.

Table 5 provides a summary of the previous studies including this current one. It has been shown in previous studies that the minSpO₂ values had a significant correlation with the ESS score [1, 9–12]. In this study, it was found that there was a positive correlation between the ESS score and AHI, and a negative correlation between the ESS score and the average minSpO₂ value.

In addition, in this study, a positive correlation was found between the mean ESSp score and the mean ESSd score and between the mean BMI and neck circumference values. These obesity-associated parameters can be considered to play an important role in the diagnosis and evaluation of OSA.

There are some limitations in our study, and these should be considered in future studies. The rule of history-taking from the family in the diagnosis OSAS is very important; unfortunately, our study did not include any information about this issue. Also, height and weight were obtained verbally: for further studies, we suggest to measure these variables separately to get a more accurate data. There are no homogenous groups according to the education level, and the results of the comparison of

Table 5 A summary of the related studies

Author	No	Mean age	Mean ESSp score	Mean ESSd score	Mean AHI (PSG)	Mean BMI	ESSp/ESSd AHI correlation (<i>r</i>)
Kaminska ²⁰¹⁰ [7]	188	54.2±11.9	9.4±5.8	8.3±5.8	27.3±24.2	31.8 ±6.9	<i>r</i> : 0.224 only ESS (no data specific to ESSp or ESSd)
Ugur ²⁰¹¹ [9]	114	45±12	10±5	9±5 (nurse administered)	30±28	30±6	No correlation/ <i>r</i> : 0.209
Damiani ²⁰¹³ [6]	225	52.44±14.22	10.37±5.49	12.09±4.1	30.28±24.46	29.53±4.63	<i>r</i> : 0.21/ <i>r</i> :0.51
Current Study ²⁰²²	93	48.1±9.71	11±5.25	7.9±4.76	20.6±18.44	28.7±5.66	<i>r</i> :0.210/ <i>r</i> :20,264

ESSp patient-administered ESS, ESSd doctor-administered ESS, AHI Apnoe Hypopnea Index, PSG polysomnography, BMI body mass index

these groups in this study will not be reliable. There is a need for further studies evaluating the correlation of the patient-administered ESS (ESSp) scores with different education levels. Another limitation of the study is the small patient group. Larger series are needed to confirm our findings.

Conclusion

The positive correlations between the ESS scores and AHI in this study show that ESS is a simple, easy-to-understand questionnaire that can be used to evaluate the daytime sleepiness of people and to evaluate people suspected of having OSA. In addition, the study results show that the ESS administered by a doctor would yield results that are more accurate and correlated with AHI and using ESS administered by a physician can give more reliable results without adding a great workload to daily practice.

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Authors' contributions

Conception: HB; Design: HB, YA; Data collection and/or processing: HB; Analysis and/or interpretation: HB, YA; Literature review: HB; Writing manuscript: HB; Critical review: YA. The authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the study are available from the corresponding author.

Declarations

Ethics approval and consent to participate

This study was approved by the Ankara University School of Medicine Ethics Committee (Approval number 15-183-19 Date : 14/11/2019) and was conducted in accordance with the Declaration of Helsinki. Signed written consent forms were obtained from all the patients before their participation in the study.

Consent for publication

This is a prospective study, and the patients' data collection does personal information. Therefore, informed consent was obtained from all participants.

Competing interests

The authors declare that they have no competing interests.

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