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Comparison of Predictor of Desaturation Disorders and Daytime Sleepiness Based On Epworth Sleepiness Scale and STOP-BANG Questionnaires in Mild to Moderate Obstructive Sleep Apnea Patients

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Abstract

BACKGROUND: Obstructive sleep apnea (OSA) is characterised by recurrence in upper airway obstruction during sleep.

AIM: This study aimed to compare the predictive values of the Epworth Sleepiness Scale (ESS) and STOP-BANG in the desaturation of patients with mild to moderate obstructive apnea based on the apnea-hypopnea index (AHI) scale.

METHODS: A group of 79 patients (43 male and 36 female) were selected. The suspected patients were introduced to the sleep clinic, and the ESS and STOP-BANG questionnaires were filled up, then subjected to polysomnography test, and the scores of the disease were also determined based on an apnoea-hypopnoea index (AHI). Finally, the desaturation rate (SO_2 < 3% based on the baseline) and desaturation index were determined in patients. Consequently, the finding was compared with the results of the questionnaires.

RESULTS: Patients with STOP-BANG score above 3 had significantly higher weight, oxygen desaturation index (ODI) index and average desatu, while peripheral capillary oxygen saturation (SpO_2) base and average SpO_2 were lower than those with scores below 3 ($P < 0.05$). However, there was no significant difference between the patients with the ESS questionnaire score above 10 and below 10 ($P > 0.05$).

CONCLUSION: The results of these two questionnaires reflect the unsaturated oxygen index in the blood, and can be considered for the evaluation of the severity of the disease.

Introduction

Obstructive sleep apnea syndrome (OSAS) is the second most common disease among respiratory disorders after asthma. This disease is characterised by the recurrence of the complete or partial collapse of the upper airway during sleep, which leads to a disruption of air flow for over 10 seconds (apnea) or hypopnea and followed by transient awakening. The syndrome has many negative effects on the health and behaviour of adults millions around the world [1] [2]. OSAS can affect any age group, but it appears to be more common in middle-aged men [3][4]. Sleepiness is one of the most important symptoms of OSAS, which is characterised by the frequent awakening of sleep to end apnea and hypopnea. Other daily symptoms such as the inability to concentrate, morning headaches, amotivation, depression and decreased libido have been described, which are caused by drowsiness throughout the day. Other complications of this disease include hypertension, abnormal endothelial dysfunction, cancer, diabetes and other disorders, as well as insulin resistance and hyperlipidemia [5] [6] [7] [8] [9]. The severity of the disease is assessed by a series of indicators including excessive daytime sleepiness (EDS), apnoea-hypopnoea index (AHI), oxygen desaturation index range (ODI), polysomnography (PSG), nighttime oximetry, and apnea testing [9] [10]. Also, diagnosis of this syndrome requires a combination of clinical manifestations of abnormal breathing during sleep and clinical features. Furthermore, imaging studies using X-rays are important for identifying craniofacial anatomical changes. Questionnaires also have a prominent feature [11] [12].

The most common questionnaires are the Berlin questionnaire (BQ), STOP-BANG, and Epworth Sleepiness Scale (ESS) that have been widely used for detecting OSA. These questionnaires had an immense range of sensitivity and characteristics in various strains [13] [14] [15]. In parallel, ESS was originally designed to distinguish the hazard of daytime sleepiness, is proposed as a tool for OSA identification as well as the ESS had the highest characteristic for anticipating mild, moderate, and severe OSA [16].

The STOP-BANG questionnaire revealed a significant relationship between high-risk OSA (STOP-Bang ≥ 3) and elevated hazard of desaturation, critical care admission, and airway problem. This questionnaire contains several questions associated with snoring, tiredness during daytime, observed apnea, body mass index, age, neck circumference, high blood pressure, and in surgical patients, it indicates a moderately great level of sensitivity (65.6%) and specificity (60%) in evaluating OSA (AHI > 5 events/h). The sensitivity and specificity of this questionnaire for moderate-to-severe OSA (AHI > 15 events/h) are 74 and 53%, respectively. For severe OSA (AHI > 30 event/h), the sensitivity is 80%, and the specificity is 49%. Additionally, the sensitivities of this questionnaire with an AHI more than 5, 15, and 30 as cutoffs are 83.6, 92.9, and 100%, respectively [17] [18].

Therefore, we conducted this study to compare the predictive values of the ESS and STOP-BANG in the desaturation of patients with mild to moderate obstructive apnea based on the AHI scale and then the relationship between desaturation and drowsiness level was examined by using these two questionnaires.

Material and Methods

The study was approved by the ethics committee of the Tehran University of Medical Sciences. Participants who contacted us indicated their consent by signing a written consent form. They then completed questionnaires requesting socio-demographic information.

A sample of 79 patients (36 women and 46 men), who admitted to the respiratory centre of Imam Khomeini Hospital with daily sleepiness complaints about sleep testing, completely answered to the ESS and STOP-BANG questionnaires, included in this study.

The STOP-BANG questionnaire consists of four subjective (STOP: snoring, tiredness, observed apnea, and high blood pressure) and four demographics items (Bang: body mass index [BMI], age, neck circumference, gender). Answering yes to three or more items are classified as a great hazard for OSA, and also, the ESS has an eight-item questionnaire to measure daytime sleepiness. ESS has a four-point Likert reply format (0–3), and the score ranges from 0 to 24. ESS score ≥ 11 demonstrates inordinate daytime sleepiness and high hazard for OSA [19] [20] [21].

Patients with answering ‘‘yes’’ to two or more of items of these questionnaires were suspected to having OSA. Then, the polysomnogram (PSG) test was performed for them at the sleep test Center. After interpreting their testing by lung specialists, OSA was determined based on the AHI (mild and moderate) criteria. In standard PSG, electrocardiogram, electroencephalography, electrocoagulation, pulse oximetry, snoring voice recording, electromyogram (submental and bilateral anterior tibialis), thoracoabdominal movements, thermal sensors, and oronasal airflow were recorded.

Subjects with mild to moderate OSAS (5 ≤ AHI < 30) were evaluated in this study. Then, the desaturation rate (sulfur dioxide (SO_2) drop more than 3% based on the baseline) and desaturation index were determined in these patients, and the results were consequently compared with the results of the questionnaires. Exclusion criteria include patients with hypnotic drugs, AHI < 30, as well as patients who did not agree to participate in the study. The variables such as age, sex, height, weight, STOP-BANG scores, ESS, AHI per hour, desaturation rate and desaturation index were measured.

SPSS version 17.0 (SPSS Science, Apache Software Foundation, Chicago, IL, USA) was used. Patients’ characteristics or qualitative variables are presented as means (± standard deviation) or percentages. *A p* value less than 0.05 was defined as statistically significant.

Results

After scrutinising the results of the questionnaires, ESS was determined to be below 10 in 32.9% of cases, while it was above 10 in 67.1% of participants. Moreover, the findings of the STOP-BANG questionnaire showed that the score of the questionnaire was below 3 in 39.2% of the cases and above 3 in 60.8% of the subjects.

Table 1: Demographic data of the participants in the study of the variables studied

Variables		Frequency	Per cent
Sex	Female	43	54.4
	Male	36	45.6
ESS	<10	26	32.9
	>10	53	67.1
STOPBANG	< 3	31	39.2
	> 3	48	60.8
AHI	<15	26	32.9
	>15	53	67.1

The AHI index was also considered to be 15 for 32.9% of the cases, while 67.1% of patients were defined by an AHI index increase of >15. Population information is summarised in Table 1 and Figure 1.

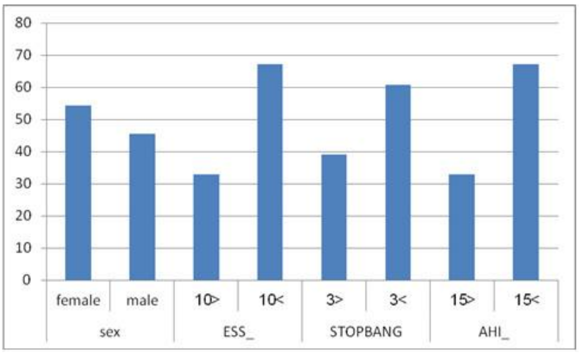

Figure 1: Demographic data of individuals

As shown in Table 2, there were only significant differences in weight ($p = 0.002$) between patients with higher and lower STOP-BANG scores. This means that weights variables were significantly higher than other among subjects with a mean score of >3.

Table 2: Comparison of demographic data of patients with STOP-BANG score (≥3 points or ≤3 points)

STOP-BANG		Age	Weight	Height	BMI
<3	Mean	45.55	77.90	159.5700	28.717419
	SD	12.871	12.330	30.55032	4.2491928
>3	Mean	51.44	89.31	165.5625	33.074375
	SD	14.862	16.844	9.69735	8.0332249
Total	mean	49.13	84.84	163.2110	31.364684
	SD	14.324	16.151	20.59868	7.1002533
P-value		0.07	0.002	0.2	0.007

However, there were no significant changes in patients with ESS scores above or below 10.

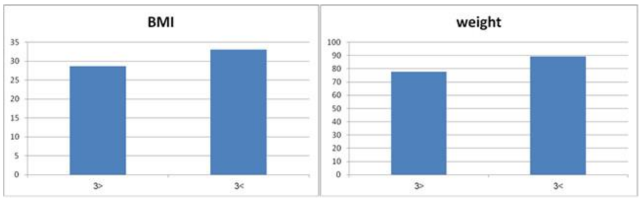

Figure 2: Body mass index and patient weight with STOP-BANG score (≥ 3 points or ≤ 3 points)

Based on the data presented in Table 4, there has been a significant difference in age among patients with AHI ≥ 15, and those with AHI ≤ 15**.**

Table 3: Comparison of demographic data in patients with ESS above or below 10

ESS		Age	Weight	Height	BMI
< 10	Mean	50.65	82.08	166.3077	29.675000
	SD	15.590	13.305	8.59195	5.0371669
> 10	Mean	48.38	86.19	161.6919	32.193585
	SD	13.755	17.335	24.36844	7.8290490
Total	Mean	49.13	84.84	163.2110	31.364684
	SD	14.324	16.151	20.59868	7.1002533
P-VALUE		0.5	0.2	0.3	0.1

This means that people with a mean AHI ≥ 15 were significantly older when comparing others.

Table 4: Comparison of demographic data in patients with AHI above or below 15

AHI		Age	Weight	Height	BMI
<15	Mean	44.15	81.19	166.4615	29.326538
	SD	12.945	13.943	9.34764	4.9433583
>15	Mean	51.57	86.62	161.6164	32.364528
	SD	14.450	16.969	24.21931	7.7958967
Total	Mean	49.13	84.84	163.2110	31.364684
	SD	14.324	16.151	20.59868	7.1002533
P-VALUE		0.03	0.1	0.3	0.07

As summarised in Table 5, there has not been a significant difference between the round neck and the AHI index (≥ 15, and ≤ 15), as well as ESS (≥ 10, and ≤ 10).

Table 5: The relationship between Round neck and STOP-BANG score, ESS and AHI

		Mean	SD	P-Value
STOP-BANG	< 3	38.45	2.850	
	> 3	41.71	3.464	0.001
	Total	40.43	3.594	
ESS	< 10	40.42	3.466	
	> 10	40.43	3.687	0.9
	Total	40.43	3.594	
AHI	< 15	39.54	3.524	0.1

The results of the blood oxygen levels revealed that there had been a significant difference between the subjects with the STOP-BANG score ≥ 3, and those with STOP-BANG score ≤3 regarding SpO_2, mean SpO_2, ODI index and average desatu ($p < 0.05$). However, based on the ESS questionnaire, there was no statistically significant difference between the oxygen indexes in the blood. The average of the ODI index was significantly higher in those with AHI above 15 as compared to others (Table 6).

Table 6: Evaluation of blood oxygen levels among AHI scores and the STOP-Bang and ESS questionnaires

STOP-BANG		SpO_2 base	SpO_2 min	Average SpO_2	Od index	Average desatu
STOPBANG <3	Mean	93.394	84.74	93.232	11.358	3.829
	SD	2.5432	8.037	2.6487	6.4699	0.6876
STOPBANG >3	Mean	91.531	81.29	90.979	16.735	4.313
	SD	2.9594	7.871	3.4616	8.6827	0.8557
P-value		0.005	0.06	0.003	0.004	0.01
ESS <10	Mean	92.627	84.54	92.319	12.573	3.981
	SD	2.5332	5.791	3.0039	7.5299	0.7082
ESS >10	Mean	92.083	81.72	91.640	15.632	4.192
	SD	3.1176	8.876	3.4963	8.5068	0.8735
P-VALUE		0.4	0.1	0.3	0.1	0.2
AHI <15	Mean	92.115	82.50	91.819	8.285	3.881
	SD	3.3980	10.148	3.9598	4.6693	0.7376
AHI >15	Mean	92.334	82.72	91.885	17.736	4.242
	SD	2.7086	6.932	3.0294	7.8942	0.8450
Total	Mean	92.262	82.65	91.863	14.625	4.123
	SD	2.9330	8.065	3.3384	8.2770	0.8243
P-value		0.7	0.9	0.9	0.001	0.06

Discussion

Over 85 % of individuals with OSA have never been diagnosed or treated; therefore applying credible and trustworthy tools are necessary for screening [18]. Among the various methods used to diagnose the disease, use of questionnaires can be useful in screening these patients. In parallel, in recent years, the STOP-BANG questionnaire was utilised broadly for screening OSA [18]. According to studies by Abrishami et al., 2010 and Farney et al., 2011 the STOP-BANG questionnaire has a high sensitivity in predicting moderate to severe OSA [22] [23]. Patients with a score of 0 to 2 can be classified as low risk for developing moderate to severe OSA, while those with a score of 5 to 8 are at high risk of moderate to severe OSA. In this regard, individuals with scores of 3 and 4 require other indicators, such as BMI, for division [24]. In a study by Zhong et al., 2012 reported that people with the ESS of over 10 were more likely to have a higher BMI. There was a significant difference in waking SpO2 of severe OSAS between EDS group No-EDS group [25].

Nevertheless, in the present study, we aimed to use the predictive value of the STOP-BANG, and ESS instead of performing the hypoxic assessment and PSG tests to determine the OSA in individuals with symptoms of sleep disorders. In this regard, it would be hoped that the results of the questionnaire would be used to detect the possibility of hypoxia which can be useful to provide more qualified centres for those who need more detailed examination. Our findings are similar to the studies by Azagra-Calero et al., 2012 and Young et al., 2004, where demonstrated increasing weight gain are associated with a higher incidence of disease, and the severity of the disease could increase with increasing age [22] [26]. The results of this study also revealed that there had been a significant difference between the subjects with the score of the STOP-BANG > 3 and < 3 regarding SpO_2, mean SpO_2, ODI index and average desatu. Meanwhile, there was no significant difference between these indices and the results of the ESS in both groups with score > 10 and < 10. Thus, it can be interpreted that the results of the STOP-BANG questionnaire were a good reflection of the unsaturated oxygen index in the blood. Because in individuals with an AHI index >15, the average ODI value was significantly higher, STOP-BANG findings could also be considered for the evaluation of the severity of the disease. In parallel, Du et al., 2015 assessed the predictive value of STOP-BANG and ESS in the screening of patients with obstructive sleep apnea, who showed the STOP-BANG questionnaire, had the highest sensitivity.

Moreover, a recent meta-analysis based on the STOP-Bang questionnaire in different populations demonstrated that the diagnostic attributes of STOP-Bang were commonly consistent with high sensitivities and low specificities [27] [28]. Although the classifications by two questionnaires revealed differences between the mean values of oxygen levels, only the STOP-BANG questionnaire showed significant differences, indicating a higher potential and predictive value of this questionnaire for determining desaturation disorders. This is consistent with previous studies, such as reported studies from Chung et al., 2016, Tan et al., 2016 and Nagappa et al., 2015, and the accuracy of this questionnaire was confirmed again for predicting OSA [28] [29] [30]. Also, it was found that STOP-BANG is not only important in predicting the incidence of OSA but also can even be effective in assessing the severity of the disease.

The main limitation of our study is that we have failed to optimise our findings to whole sleep clinics in the entire population regardless of symptoms as well as our population was not an exact sample of the general population. The populations of the sleep clinic have abundant diversities, and variety of these patients is different from one clinic to another depending on their communication to various medical sections. Although we tried to overcome this limitation with including a large number of patients, another limitation, it is also possible certain medical assistants and physicians did not feel invested in the quality improvement project and chose not to administer/review the questionnaire. Despite these limitations, the findings of our study still deserve attention.

In conclusion, we found that the patients with mild to moderate obstructive pulmonary obstruction, (which are calculated based on weight and height), and older ages can significantly cause sleep disorders. Also, the range of blood oxygen levels was significantly higher among those classified according to the STOP-BANG questionnaire than the ESS questionnaire. Therefore, the results of this questionnaire not only reflect the unsaturated oxygen content of the blood but also can be used to evaluate options such as the severity of the disease and the prediction of nocturnal desaturation and the occurrence of daytime sleepiness. In summary, it is essential to use reliable questionnaires such as STOP-BANG in one session.

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