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IMPORTANCE OF BERLIN, STOP, AND STOP-BANG QUESTIONNAIRES IN EVALUATING OBSTRUCTIVE SLEEP APNEA SYNDROME IN THE BUS DRIVERS

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ABSTRACT

Objective: *To investigate the prevalence of obstructive sleep apnea syndrome (OSAS) symptoms in public transportation drivers, and the importance of the Berlin questionnaire (BQ), STOP questionnaire (SQ), and STOP-BANG questionnaire (SBQ) in OSAS screening, and the to evaluate correlations among these tests.*

Material and Method: *This cross-sectional study was conducted after obtaining ethics committee approval. Demographic data and risk factors were categorized as high-risk and low-risk for snoring and OSAS.*

Results: *All the drivers (n:392) were men and their mean age was 37.8±6.3(27-58). Even in the presence of any of the individual parameters of snoring, witnessed apnea, and increased daytime sleepiness in 392 drivers, a high risk was found in all for questionnaires developing OSAS ($p<0.001$). Body mass index ≥30 kg/m² and neck circumference ≥40 cm were associated with snoring ($p<0.05$) but not with age ($p>0,05$). The highest agreement was found between SQ and SBQ ($p<0.001$, kappa: 0.609, McNemar Test), a moderate agreement was present between BQ and ST ($p=0.05$, kappa: 0.607), and the weak correlation was found between BQ and SBQ questionnaires ($p<0.001$, kappa: 0.472, McNemar).*

Conclusion: *It will be possible to eliminate a preventable cause of traffic accidents by evaluating OSAS risks in vehicle drivers with valid and easily-applicable tests such as the SBQ and SQ, and to direct drivers to appropriate units for polysomnography.*

Keywords: *Obstructive sleep apnea syndrome (OSAS); drivers; snoring; Berlin questionnaire; STOP-BANG questionnaire; STOP questionnaire*

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OTOBÜS ŞÖFÖRLERİNDE OBSTRUKTİF UYKU APNE SENDROMUNU DEĞERLENDİRMEDE BERLİN, STOP, STOP BANG ANKETLERİNİN ÖNEMİ

ÖZET

Amaç: Çalışmamızda toplu taşımada görevli şoförlerde obstrüktif uyku apne sendromu (OUAS) semptomlarının sıklığının saptanması ve Berlin, STOP (ST) ve STOP BANG (STB) anketlerinin OUAS taramasında kullanılabilirliğinin ve kendi içindeki korelasyonunun araştırılması planlanmıştır.

Materyal ve Metot: Etik kurul onayı sonrası kesitsel tipte anket araştırması olarak planlanan çalışmada, demografik veriler ve risk faktörleri, horlama ve OUAS için yüksek riskli ve düşük riskli olarak kategorize edilerek incelenmiştir.

Bulgular: Şoförlerin tümü (n:392) erkekti ve ortalama yaşları 37,8±6,3 (27-58) idi. Araştırmaya alınan 392 şoförün horlama, tanıklı apne ve artmış gündüz uykululuğu tüm anketlerde OUAS gelişimi açısından yüksek riskle ilişkili bulundu (p<0,001). Vücut kitle indeksinin 30 kg/m², ve boyun çevresi 40 cm'den fazla olması horlama ile ilişkili bulunurken (p<0,05), yaşla ilişkili saptanmamıştır (p>0,05). En yüksek uyum ST ve STB arasında (p<0,001, kappa: 0,609, McNemar Testi) bulunurken, BQ ve ST arasında orta düzeyde uyum (p=0,05, kappa: 0,607), BQ ve STB anketleri arasında düşük uyum (p<0,001, kappa: 0,472) saptanmıştır.

Sonuç: Araç sürücülerindeki OUAS risklerini geçerli ve ST VE STB gibi kolay uygulanabilir anketlerle değerlendirerek önlenebilir bir trafik kazası nedenini ortadan kaldırmak ve bunları polisomnografi için uygun birimlere yönlendirmek mümkün olacaktır.

Anahtar kelimeler: Obstrüktif uyku apne sendromu (OUAS), şoför, horlama, Berlin anketi, STOP-BANG anketi, STOP anketi

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS), which is characterized by recurrent nighttime upper respiratory tract obstructions, interrupted sleep and daytime sleepiness, occurs in approximately 13% of males and 6% of females aged between 30 and 70 years. The prevalence of OSAS increases with advancing age and increasing body mass index (BMI).[1-3]

The main symptoms questioned for OSAS are snoring, witnessed apnea, and increased daytime sleepiness. The symptoms remain as subjective findings in OSAS screening because people are not usually aware of their occurrence during sleep.[4-7] Fidan *et al.* stressed the relationship between accidents and snoring in drivers.[8] Studies have also shown that the risk of having an accident is greater in drivers with OSAS compared with controls due to slower reaction times and decreased vigilance because of the increased daytime sleepiness.[9,10] Contrary to urban traffic, accidents occur more often in long-distance and intercity travels due to the increased tendency to have microsleeps.[9-13] Studies have assessed the severity of OSAS using the apnea–hypopnea index (AHI) or subjective sleepiness using the Epworth sleepiness score (ESS), demonstrating that these scores were associated with accidents.[14]

When drivers causing traffic accidents are reviewed, it has been shown that the prevalence of OSAS in drivers is 2-12–fold.[15] Even though the risk of OSAS is very high among drivers, there are many in this line of work who have not yet been diagnosed.[7] To prevent traffic accidents, it is important to quickly diagnose and treat motor vehicle drivers who have been diagnosed as having OSAS.[16] It has been shown that patients with OSAS who were given positive airway pressure (PAP) therapy had a similar risk of having accidents as those who were free of OSAS, and the risk could be reduced considerably with treatment.[9-17]

The gold standard in the diagnosis of OSAS is polysomnography (PSG). However, it is known that there is a substantial wait for PSG appointments due to patient load and the scarcity of laboratories offering this service. For this reason, screening tests are often used for the diagnosis of OSAS.[18] The most common questionnaires used for OSAS symptoms are the Epworth Sleepiness Scale (ESS), the Berlin questionnaire (BQ), the Stop questionnaire (SQ), and the STOP-BANG questionnaire (SBQ).[19-24]

Our study aimed at exploring the frequency of OSAS symptoms in bus drivers working in public transportation, which has an important place in the daily lives of people, and to evaluate them in terms of prediction during the PSG investigations. Moreover, we planned to investigate of the usability of the BQ, SQ, and SBQ in OSAS screening of this group and the correlation within themselves.

MATERIAL AND METHOD

Investigational Group

Route drivers working in the city center were included in the study. The inclusion criteria were age over 18 years, being a graduate of at least primary school, and absence of any neurodegenerative disease, cognitive disorder, and a visual or hearing problem. History of the drivers was evaluated along with the previous his history and family history.

Refusal to take part in the study and being unreachable were the exclusion criteria. The Izulaş (İzmir Transportation Services Machinery Industry Anonymous Company) drivers were administered the BQ, SQ, and SBQ by way of face-to-face interviews. All questionnaires were completed in a 10-15 minutes period.

Data collection was performed before the drivers started their duties because it could wear fatigue and sleeppiness.

Planned as a cross-sectional survey study, the tudy was conducted after obtaining ethics committee approval (Date: 28.02.2018, Number: 20.478.486). The study complied with the rules of the Declaration of Helsinki and personal consent forms were obtained from the subjects.

Questionnaires

Berlin Questionnaire (BQ)

The BQ forms the basis for this type of study and is used as an OSAS screening tool in social studies.[21] There are 10 questions in 3 categories relating to demographic characteristics, snoring, witnessed apnea, sleepiness, and BMI. Each category is evaluated within itself and if 2 or more categories result as positive, the risk of developing OSAS is considered high.[24]

The classification is as follows:
Category 1+: At least 2 or more positive responses between questions 2 and 6
Category 2+: 2 or more positive responses between questions 7 and 9
Category 3+: 1 positive response and/or BMI ≥ 30

Scoring is performed according to this classification.[21,24] If the characteristics specified in categories 1, 2, and 3 are present they are grouped as A, and if not as B. If at least two 'A's are present, it is assessed as high-risk, and if one 'A' or none is present, it is low-risk.

STOP Questionnaire (SQ)

STOP consists of 4 questions inquiring the presence of the 3 major symptoms of OSAS, snoring, sleepiness, and witnessed apnea, together with hypertension (HT).[21] Giving two or more 'yes' responses to the 4 questions is accepted as significantly high risk.[21]

STOP-BANG Questionnaire (SBQ)

This questionnaire was constructed by adding BMI, age, neck circumference, and sex to the SQ questionnaire. The SBQ was developed to meet the need for a compact and easily-used screening tool. If three responses of the total of 8 questions are answered as 'yes,' it is considered to be high risk.[22,23,25]

Statistical Analysis

The data obtained from the study were analyzed using the Statistical Package for the Social Sciences Version 18 (SPSS; SPSS Inc., PASW Statistics for Windows, Chicago, USA) software program.

The mean and standard deviation values of continuous variables and the frequency and percentage values of variables were calculated. All continuous variables and subgroups were tested for normal distribution taking into consideration graphical assessments, normality tests, and sample size. The independent group comparisons of normally distributed variables were performed using the t-test. The class variables were compared using the Chi-square test. The consistency between measurements was checked using the 'Kappa' test was run for them. The Type 1 error margin was set at α=0.05 and a *p* values less than 0.05 were considered statistically significant.

RESULTS

The study included 392 male route drivers. As risk factors, 27 (6.9%) drivers had BMI over 35 kg/m² (kilogram/meter²) and 222 (56.6%) had neck circumferences more than 40 cm (centimeter). The demographic characteristics of the study group are summarized in Table 1.

The relationship of snoring with demographic data is shown in Table 2.

The aspects of snoring were questioned in detail using the BQ. The snoring aspects of the drivers as per the BQ are summarized in Table 3.

In the BQ, almost all drivers (n=389, 99.2%) felt tired and listless at varying degrees after sleep. The number of those who reported fatigue and sleepiness during

Table 1. Demographic characteristics of the drivers included in the study

	Mean ± SD	Minimum	Maximum
Age (years)	37.8 ± 6.3	27	58
Height (cm)	177 ± 7	160	198
Weight (Kg)	88 ± 16	55	120
Body Mass Index (kg/m²)	28.07 ± 4.84	18.1	55.5

SD: Standard deviation, **cm:** centimeter, **kg:** kilogram, **m:** meter, **BMI:** body mass index

Table 2. Evaluation of demographic data according to the questionnaires in snoring patient group

	BQ n=312 (Mean ± SD)	ST n=179 (Mean ± SD)	STB n=182 (Mean ± SD)	*P* value
Age (years)	38 ± 6.43	39 ± 6.11	39 ± 6.12	0.119
Height (cm)	176 ± 6.36	176 ± 6.23	177 ± 6.31	0.271
Weight (kg)	88 ± 16.23	92 ± 14.43†	92 ± 17.30†	<0.001
BMI (kg/m²)	28 ± 5.03	30 ± 5.50†	30 ± 5.48†	<0.001

One way-Anova test, †p<0.001,
BQ: Berlin questionnaire, **SD:** standard deviation, **STB:** stop bang, **n:** number of subjects, **cm:** centimeter, **kg:** kilogram, **m:** meter, **BMI:** body mass index

Table 3. Features of snoring according to Berlin questionnaire

		Maximum
Do you snore?	Yes	312 (79.6)
	No	80 (20.4)
If you snore (n=312)	A bit noisier than breathing	234 (59.7)
	As noisy as talking	39 (9.9)
	Noisier than talking	14 (3.6)
	Very noisy, can be heard from neighboring rooms	25 (6.4)
How often do you snore?	Almost every day	74 (18.9)
	3-4 days a week	36 (9.2)
	1-2 days a week	81 (20.7)
	1-2 days a month	121 (30.8)
	Never or almost never	80 (20.4)
Have you disturbed other people due to your snoring?	Yes	109 (27.8)
	No	283 (72.2)

n: Number of subjects

the whole time they were awake was 258 (65.8%). Forty drivers (10.2%) stated that they fell asleep or dozed off when driving, and this occurred 1-2 days per month in 17 drivers (4.3%), 1-2 days per week in 9 (2.3%), 3-4 days per week in 7 (1.8%), and almost every day in another 7 drivers (1.8%).

The symptoms, number of subjects, and their percentages as per the SQ and SBQ are summarized in Table 4.

The evaluation and comparison of the tests used in terms of risks are shown in Table 5.

The relationship between high/low risk and demographic data was reviewed and the statistical assessments are summarized in Table 6.

High blood pressure was present in 43 (11%) drivers according to BA, and in 52 (13.3%) drivers according to ST and STB questionnaires.

No relationship was found in any of three questionnaires between advanced age (>50 years) and loud snoring (ST p=0.090, STB p=0.102, BA p = 0.083).

Relationship between neck circumference of more than 40 cm and presence of hypertension (HT) was found to be significant in all questionnaires (p<0.001 for all).

In regard to the correlation between body mass index (BMI) above 35 and noisy snoring, the correlation was significant in the ST and STB questionnaires and non-significant in BA a questionnaire (ST p<0.001, STB p<0.001, BA p=0.136).

A review of the association between increased risk and symptoms showed that according to the ST questionnaire, 64.2% of subjects with noisy snoring, 80% of those with daytime sleepiness, all subjects (100%) with witnessed apnea, and 80.8% of those with high at were in the high-risk group (p<0.001 for all).

According to the SBQ, 63.7% of subjects with noisy snoring, 77.5% of those with daytime sleepiness, all subjects (100%) with witnessed apnea, and 80.4% of those with high tension were in the high-risk group (p<0.001 for all).

It was found that 81.5% of subjects whose BMI was over 35 kg/m², 57.1% of those aged over than 50 years, and 45.9% of those with neck circumferences more than 40 cm were in the high-risk group. These parameters were found to have statistically significant correlations with snoring (BMI p<0.001; age p=0.043; neck circ. p<0.001).

Correlation Tests

In terms of the reliability and correlation between the questionnaires, the strongest correlation was between the SQ and SBQ (p<0.001, kappa=0.609, McNemar test). There was a moderate correlation between the BQ and SQ (p=0.05, kappa=0.607, McNemar test), and the weakest correlation was between the BQ and SBQ (p<0.001, kappa=0.472, McNemar test).

Regarding the consistency between the tests in the assessment of demographic data and risk factors, the greatest consistency was between the SBQ and ST (90-100%); there was moderate consistency between the BQ and SQ (70-90%), and the lowest consistency was between the BQ and SBQ (80% and 100%).

DISCUSSION

Questionnaires demonstrated that the bus drivers with OSAS involved in traffic accidents had serious alteration in neurocognitive function such as attention, decision making and reacting. Alterations in the defined functions became more prominent as severity of OSAS increased.[26, 27]

In men, signs and/or symptoms of snoring, witnessed apnea and snoring are more common than symptoms of depression, fatigue, and sleepiness.[28-32] In addition, physical examination reveals that neck circumference is larger in men.[28-32] All participants of our study were male and their mean age was 37.8 ± 6.3 years. It was seen that 6.9% of the participants had BMI above 35, and 56.6% of them had neck circumference more than 40 cm. There are many studies where different rates were found for the main symptoms of OSAS.

Using BQ, Akkoyunlu *et al.* found that 65.7% of drivers using vehicles in cities were snoring.[25] In our study where we used the BQ, SQ, and SBQ in public transport drivers, the rates of snoring and noisy snoring were as 79% and 46% according to the BQ, noisy snoring 45.7% according to the SQ, and 46.4% according to the SBQ, respectively.

Witnessed sleep apnea is one of the most serious symptoms of OSAS. Taşbakan *et al.* found that witnessed apnea occurred in 24.3% of urban bus drivers.[33] In our study, different rates of apnea were found in different questionnaires. Witnessed apnea was present at a rate of 15.5% as per the BQ, and 12,8% in the SQ and SBQ.

Daytime sleepiness is another important symptom of OSAS. In a study by Catarino *et al.*, the proportion of drivers who stated that they had daytime sleepiness on more than 3 days per week while they were driving, especially when they were working during the day, was found as 15%.[29] In our study, as for symptom of apnea, different rates of daytime sleepiness was found in different questionnaires. In our study, a total of 258 drivers (65.8%) felt fatigue or sleepiness throughout the time when they were awake as per the BQ, 135 drivers (34.4%) as per the SQ, and 138 drivers (35.2%) as per the SBQ.

Table 4. Evaluation of the symptoms based on Stop and Stop-Bang questionnaires

SYMPTOMS		STB QUESTIONNAIRE n / %	STB QUESTIONNAIRE n / %
Presence of noisy snoring	Yes	179/45.7	182/46.4
	No	213/54.3	210/53.6
Feeling tired, listless, sleepiness daytime	Yes	135/34.4	138/35.2
	No	257/65.6	254/64.8
Presence of someone who witnessed cessation of breathing in sleep	Yes	50/12.8	50/12.8
	No	342/87.7	340/87.2
Presence of high HT, use of drugs for HT	Yes	52/13.3	51/13
	No	340/86.7	341/87
BMI >35 kg/m^2	Yes		27/6.9
	No		365/93.1
Age over 50 years	Yes		14/3.6
	No		378/96.4
Neck circumference more than 40 cm.	Yes		222/56.6
	No		170/43.4
Male patient	Yes		392/100
	No		0/0

ST: stop, **STB:** stop bang, **HT:** hypertension, **BMI:** body mass index, **cm:** centimeter, **m:** meter, **kg:** kilogram

Table 5. Evaluation of the rates of high and low risk based on the questionnaires

Risk Evaluation	BQ (n)	BQ (%)	ST (n)	ST (%)	STB (n)	STB (%)
High-risk	100	25.5	123	31.4	198	50.5
Low-risk	292	74.5	269	68.6	194	49.5

BQ: Berlin questionnaire, **ST:** stop, **STB:** stop bang,

Table 6. Evaluation of correlation of rates of high and low risk with demographic characteristics

TESTS-RISK EVALUATION	BQ n=100 (Mean ± SD)	ST n=123 (Mean ± SD)	STB n=198 (Mean ± SD)	*P* value
Age (years)	41 ± 6.08	40 ± 5.93	40 ± 6.34	0.367
Height (cm)	176 ± 6.32	176 ± 5.94	176 ± 6.38	NS
Weight (kg)	99 ± 18.38	95 ± 18.77	94 ± 17.15	0.072
BMI (kg/m^2)	32 ± 5.77 ^	31 ± 5.87 ^	30 ± 5.36 ^	0.013

One way-Anova test, ^p<0.05
BQ: Berlin questionnaire, **ST:** stop, **STB:** stop bang, **cm:** centimeter, **kg:** kilogram, **m:** meter, **BMI:** body mass index

We think that the differences between the questionnaires may arise from differences in the vehicles they drove, as well as factors such as cultural differences and the fear of being dismissed from their jobs when completing the questionnaires.

Unlike other studies, we made high and low risk assessments for the development of OSAS with respect

to both the main three symptoms and the other parameters. Even when the three main symptoms of OSAS, snoring, witnessed apnea, and increased daytime sleepiness were evaluated alone in our subjects, they were found to be at high risk for developing OSAS in all questionnaires.

Besides the main parameters, other demographic factors and risk factors were also investigated. In the present study, 57% of the drivers above 50 years old with loud snoring was found to be at risk for development of OSAS while 81.5% of drivers with association of BMI above 35 and snoring was found to be at risk of development of OSAS. When we made a general assessment under the light of all questionnaires, it was shown that higher BMI, advanced age, neck circumference of more than 40 cm, and especially presence of loud snoring were risk factors for development of OSAS.

Different tests have been used in various combinations and evaluated in studies trying to identify patients with OSAS. The SBQ could be used to identify patients with moderate and severe OSAS in sites where PSG cannot be utilized.[34,35] Although the specificity of SBQ was low in the identification of OSAS, its sensitivity was found to be very high, and as the severity of OSAS increased, its sensitivity also increased.[25,34-36]

In terms of the reliability and correlation between the questionnaires, it was found that the strongest agreement was between the SQ and SBQ. There was a moderate agreement between the BQ and SQ, and a weak agreement between the BQ and SBQ. This showed us once more that, as in other studies, people concentrate better on short tests with fewer items and they give more precise and correct answers. There was a problem of adaptation with the BQ because it is a long test with many items. The correlations related to the BQ were lower compared with its correlations with shorter questionnaires (SQ and SBQ).

In assessing demographic data and particularly risk factors (high-risk / low-risk), the greatest consistency was between the SBQ and SQ (90-100%), there was moderate consistency between the BQ and SQ (70-90%), and the lowest consistency was between the BQ and SBQ (80% and 100%).

Although the proposed screening methods cannot identify all drivers with OSAS, it is important because they are the first step in raising awareness in the elimination of concerns about the diagnosis of OSAS in vehicle drivers. The questionnaires considerably increase the chances of identifying OSAS and provide an priority for PSG. However, there is still the need to show the positive effect of diagnosis and treatment of OSAS on public safety and driver health through studies using PSG. The lack of PSG in our study is one of our limitations. Another limitation of our study is that daytime sleepiness was assessed only with the questions in the SQ and SBQ questionnaires instead of the Epworth test.

It was observed that different answers were given by the drivers even to similar questions from different tests due to the fear of losing their job and lack of attention. Despite this, shorter tests seemed to be more reliable than BQ, which is longer and contains more choices.

It is very important in terms of public health to include OSAS in licensing regulations and to assess drivers and driver candidates suspected of having OSAS using sleep tests.

Highlights

1) Evaluating the correlation between the used questionnaires (Berlin, Stop, and Stop BANG questionnaires)

2) Evalution of risk factors and demographic characteristics of the subjects for being high versus low risk in the questionnaires (in contrast to others, the present study evaluated the main parameters (snoring, witnessed apnea, and daytime excessive sleepiness) as well as

Ethical approval was obtained from Ethics Committee of Manisa Celal Bayar University.

*The authors declare that there are no conflicts of interest.

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