Original Research

The Association between STOP-BANG and Mallampati Scores in Commercial Drivers Referred for Health License

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Received: 21 May 2016 Accepted: 08 Aug. 2016

Abstract

Background and Objective: Obstructive sleep apnea (OSA) is considered a common sleep disorder that increases the risk of traffic accidents among drivers. This study aimed to assess the association between Mallampati score and STOP-BANG (Snoring, Tiredness, Observed apnea, Blood Pressure, Body Mass Index, Age, Neck circumference, Gender) score in commercial drivers.

Materials and Methods: 1743 male drivers referred for their health license were recruited in this cross-sectional study during September 2013 to December 2015 in Baharloo Hospital, Tehran, Iran. The Persian version of the STOP-BANG questionnaire was used. STO symptoms were self-reported by drivers. Age, height (m), weight (kg), blood pressure (mmHg), neck circumference (cm), and Mallampati score were recorded by physician. STO and P-BANG scores were computed for all the participants. Data were analyzed using ANOVA test for comparing means among different classes of Mallampati score.

Results: Among 1743 participated drivers, mean (SD) age was 41 (10.6) years. STOP-BANG score was < 3 in 90.0% of them. Mallampati class II was the most frequent (36.0%) following by I, III, and IV, respectively. STO score was more likely to be higher in classes III and IV with no significant association. P-BANG score had significant linear correlation with Mallampati score (df: 3, F: 34, P < 0.001). STOP-BANG score was associated with higher Mallampati score (df: 3, F: 31, P < 0.001).

Conclusion: STOP-BANG and P-BANG scores were significantly associated with Mallampati score. Mallampati score may be used as a screening parameter for OSA in commercial drivers along with available tools such as STOP-BANG and Epworth Sleepiness Scale that is mainly based on self-reports of drivers.

Keywords: Commercial driver; Mallampati class; Obstructive sleep apnea

Citation: Saraei M, Chavoshi F, Najafi A, Heidari R, Rahimi-Golkhandan A. **The Association between STOP-BANG and Mallampati Scores in Commercial Derivers Referred for Health License**. J Sleep Sci 2016; 1(3): 120-4.

Introduction

Obstructive sleep apnea (OSA) is a disease characterized by partial or complete obstruction of upper airway due to collapse or narrowing. OSA has known adverse consequences including metabolic syndrome, cardiovascular diseases, neurocognitive disturbance, and decrease in quality of life due to its comorbidities. Patients with undiagnosed and or untreated OSA may develop Excessive Daytime Sleepiness (EDS) causing involuntary naps and or microsleeps that is particularly important for safety sensitive jobs such as commercial drivers (CDs) (1).

It is estimated that about 20% of road traffic accidents is contributed to sleep disorders such as OSA and narcolepsy (2). Thus, screening and diagnosing sleep disorders including OSA is considered an important issue for prevention of road traffic accidents especially among CDs (3). Screening OSA could be performed by completing validated apnea screener questionnaires such as Epworth Sleepiness Scale (ESS) and STOP-BANG [Snoring, Tiredness, Observed stop of breathing, Blood Pressure, Body mass index (BMI), Age, Neck circumference, Gender] ques-

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tionnaire (4, 5). ESS measures subject's excessive daytime sleepiness through eight self-reported questions and STOP-BANG asks about patients symptoms and apnea risk factors including age, sex, and BMI (4, 5). Several studies indicate screening OSA by validated STOP-BANG questionnaire (5).

Furthermore, several prediction models are studied for screening sleep apnea (6, 7). Multivariable apnea prediction (MAP) index is a prediction formula for detecting patients at high risk for OSA using questions regarding OSA symptoms and BMI, age, and sex. Sahin et al. has included several other objective items such as waist circumference, neck circumference (NC), oxygen saturation measured by pulse oximetry (SpO_2), and tonsil size for diagnosis of OSA and Apnea/Hypopnea Index (AHI) prediction (6).

Regarding aforementioned screening tools and contribution of drowsy driving in traffic accidents (2), it is important to develop a tool for screening OSA in CDs. Moreover, it has to be kept in mind that CDs' job is dependent on receiving a health license; this issue may lead to less willing to be truthful about their health problems (2). Otherwise, a truthful subjective assessment of the patient or a validated objective measurement is required for apnea screening in CDs. Excessive daytime sleepiness and a disorder such as OSA makes a CD unfit to drive and leads to his/her unemployment according to several states of United States and European countries regulations (2). Along with these countries, Iran health system has implemented regulations for screening apnea and driver's disqualification to drive because of sleep problems (8). STOP-BANG and ESS questionnaires are the currently used screening tools (8). Drivers with abnormal ESS score and or high score on STOP-BANG are required to undergo an overnight polysomnography before making decision about their health license (8).

Mallampati score is a well-known classification system for oral airway. It is categorized in four classes in terms of visualized normal anatomical structures (uvula, hard palate, soft palate, and tonsillar pillars) in oropharyngeal cavity (9). Increasing of Mallampati score is associated with OSA severity in terms of AHI (9-11). Furthermore, Mallampati classes of III and IV are contributed to near misses in truck drivers (12).

This study aimed to evaluate CD's pharynx exam in terms of Mallampati score and compare it with STOP-BANG score. Authors aimed to compare Mallampati score with objective (P-BANG) and self-reported items (STO) of STOP-BANG questionnaire. The findings would provide valuable information regarding future need to add an objective easy available cost-effective item such as Mallampati score to screening CDs' sleep apnea.

Materials and Methods

In this cross-sectional study, participants were recruited consecutively from the male drivers referred for health license to Occupational Medicine Clinic of Baharloo Hospital, Tehran University of Medical Sciences, Iran, during 2013-2015. Written consent form was obtained from all the participants.

Participants were asked to complete questionnaires including demographic characteristics, and subjective part of STOP-BANG questionnaire. Mallampati score was also recorded for the drivers by an occupational medicine specialist. Demographic characteristics including age, sex, height, weight, and BMI [weight (kg) divided by height square (m^2)] were measured by physician. STOP-BANG questionnaire that was validated previously in Persian by Sadeghniiat Haghighi et al. (5) was used in present study. The questionnaire includes eight questions; four ones (STOP portion: snoring, tiredness, observed apnea and using drug for high blood pressure) were asked from the drivers by the physician in a yes/no pattern. If the drivers' response was "yes" to each of the questions, one point was assigned in the STOP score. BANG portion also include four parameters (BMI, age, neck circumference, and gender). Moreover, blood pressure was measured for all the study participants.

Mallampati class or score is an objective method to estimate position of the tongue in the oral cavity. It is a well-known classification system for oral airway. It is categorized in four classes in terms of visualized normal anatomical structures (uvula, hard palate, soft palate, and tonsillar pillars) in oropharyngeal cavity. Class I is defined as visualizing all four anatomical structures and is considered normal. The soft palate, upper portions of uvula and tonsils can be seen in the class II of Mallampati score. Class III is defined as visualizing only the soft and hard palate and base of the uvula. The hard palate is the only anatomical structure visualized in the class four. Mallampati score was recorded by a physician for each driver and the point one, two, three, and four was assigned for the Mallampati score classes I,

II, III, and IV, respectively (9). Descriptive statistics and ANOVA test were used for data analysis. Collected data was analyzed by using SPSS software version 17 (SPSS Inc., Chicago, Il, United States). P value ≤ 0.05 was considered as statistically significant.

Results

Totally, 1743 male drivers participated in this cross-sectional study. Response rate was 93%. Drivers' mean (SD) age was 41 (10.6) years. Mean (SD) BMI was 23.6 (7.0) kg/m^2. The participants had nearly high neck circumference with mean (SD) of 39.5 (2.9) cm. Mean (SD) systolic blood pressure was 108.4 (33.3) mmHg. Most of the participants had STOP-BANG score < 3 [1569 (90%) with score < 3 versus 174 (10%) ≥ 3].

In physical examination of upper airway, Mallampati class II comprised the most frequent one among study participants following by class I, II, and IV, respectively (Table 1).

The mean of reported symptoms by drivers [Snoring, Tiredness, and Observed apnea (STO)] was more likely to be in higher mallampati classes including III and IV (0.08 and 0.15, respectively), however the observed trend between group analysis of ANOVA test was not significant (P = 0.190, Table 1).

Table 1. STO score in different Mallampati classes

Mallampati score	Number (%)	STO score [Mean (SD)]
I	552 (31.67)	0.08 (0.28)
II	628 (36.03)	0.10 (0.47)
III	385 (22.09)	0.80 (0.29)
IV	178 (10.21)	0.15 (0.43)

STO: Snoring, Tiredness, Observed stop of breathing reported by participants
P = 0.190 in between the groups, ANOVA test (df: 3, F: 1.57):

Regarding objective measurements of STOP-BANG questionnaire including blood pressure, BMI, neck circumference, and gender (P-BANG), ANOVA test showed significant statistical results between the groups. Mean P-BANG score was found to be significantly higher in classes IV and III of Mallampati (1.5 and 1.2, respectively) (P < 0.001, Table 2). Increasing mean score of P-BANG was associated with significant higher Mallampati class (Table 2). The score was also significantly different among Mallampati classes when groups of Mallampati were compared to each other (Table 2).

Table 2. P-BANG score in different Mallampati classes

Mallampati score	Comparison group	P value
I	II	0.050
I	III	< 0.001
I	IV	< 0.001
II	III	< 0.001
II	IV	< 0.001
III	IV	0.001

P-BANG: Blood Pressure, Body Mass Index, Neck circumference, Gender
Number (%) was 552 (31.67), 628 (36.03), 385 (22.09), and 178 (10.21) in classes I, II, III, and IV, respectively.
P < 0.001 in between the groups, ANOVA test (df: 3, F: 34.3)
Post Hoc Test results in different groups of Mallampati class

Furthermore, drivers with lower mean score of STOP-BANG had lower classes of Mallampati in their physical examination, and the relationship was significant among the groups (Table 3).

Table 3. STOP-BANG score in different Mallampati classes

Mallampati score	Comparison group	P value
I	II	0.030
I	III	< 0.001
I	IV	< 0.001
II	III	0.001
II	IV	< 0.001
III	IV	< 0.001

P STOP-BANG: Snoring, Tiredness, Observed stop of breathing, Body Mass Index, Neck circumference, Gender
Number (%) was 552 (31.67), 628 (36.03), 385 (22.09), and 178 (10.21) in classes I, II, III, and IV, respectively.
P < 0.001 in between the groups, ANOVA test (df: 3, F: 31.2)
Post Hoc Test results in different groups of Mallampati class

Participants with class I Mallampati in physical examination had the minimum mean of STOP-BANG score and those ones with the highest mean score had class IV of Mallampati (0.94 in class I versus 1.6 in class IV) (Table3). Different classes of Mallampati also had significantly different STOP-BANG scores when compared with paired groups together (Table 3).

Discussion

Current study indicated that the majority of studied drivers had STOP-BANG score less than 3. However, the findings showed significant association between mean P-BANG score and Mallampati classes III and IV. Total number of drivers with STOP-BANG score < 3 was less than the ones with higher Mallampati scores (classes III and IV). No significant association was found between self-reported parameters (STO) and Mallampati scores.

Sleepiness is associated to increased risk of accidents (2). Thus, screening sleep disorders in

CDs is considered an important issue in current transportation systems (2). In Iran, CDs job and continuity of employment is dependent on obtaining a heath license. According to current guidelines on drivers' examination, CDs are not allowed to drive till treatment of their apnea (2). ESS and STOP-BANG score are the screening tools of OSA in drivers. Self-reported base of ESS and several questions of STOP-BANG may lead drivers not to tell the truth to easy receive their health license. Mallampati score could be added as an objective parameter to this evaluation.

Moreover, the accidents of CDs like truck drivers have a significant public health hazard as their accidents is often associated with severe crashes, and the estimation of fatal or incapacitating injuries is more than 80% of the cases (13).

Several studies showed a high prevalence of excessive daytime sleepiness and other sleep disorder symptoms in CDs (8). It also is shown that STOP-BANG score is significantly associated with AHI (14). As indicated in the results, number of the drivers with high score on STOP-BANG was not the most prevalent fraction. This may mention unwillingness of CDs to tell the truth about their apnea symptoms. CD's Mallampati class had significant association with objective parameters (P-BANG). This could be considered as a future objective predictor of apnea. Nuckton et al. also has indicated significant increase of AHI as a marker of apnea severity by every point increase of Mallampati score (9). Kumar and Liistro has also recommended Mallampati score as a risk factor of apnea with significant association with its severity (10, 11). It also has been shown that Mallampati class is associated with AHI (11).

Therefore, Mallampati score as an objective measurement can represent a valuable cost-effective method to have more accurate data on the ones high risk for OSA. Although the findings tend to be more likely associate to Mallampati score as a tool for apnea prediction but the results are not consistent and controversy exists regarding specificity of combined STOP-BANG and Mallampati score. A recent study by Dette et al. has reported that Mallampati score in combination with STOP-BANG score cannot increase specificity to predict apnea (15). Accordingly, the results require to be explored more and compared with polysomnography as gold standard test for OSA diagnosis.

Polysomnography as the gold standard test for diagnosis of OSA is the best method to evaluate specificity of a new combined screening tool (STOP BANG plus Mallampati score). This could be considered as limitation of this study.

Conclusion

STOP-BANG and P-BANG scores were significantly associated with Mallampati score. Mallampati score may be used as a screening parameter for OSA in CDs along with available tools such as STOP-BANG and ESS.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

We would like to thank the staff of Occupational Sleep Research Center (OSRC), Baharloo Hospital, Tehran University of Medical Sciences, Tehran, Iran, for their nice collaboration.

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