EXCESSIVE DAYTIME SLEEPINESS AMONG TURKISH PUBLIC TRANSPORTATION DRIVERS: A RISK FOR ROAD TRAFFIC ACCIDENTS?

Aclan Ozder*, Ersin Gunay**, Hasan Huseyn Eker***, Sevinc Saris Ulasli**

*Bezmialem Vakif University, Faculty of Medicine, Department of Family Medicine - **Afyon Kocatepe University, Faculty of Medicine, Department of Chest Diseases - ***Bezmialem Vakif University, Faculty of Medicine, Department of Public Health, Istanbul, Turkey

ABSTRACT

Aims: This study evaluated the prevalence of, and the risk factors for, obstructive sleep apnoea syndrome (OSAS) and excessive daytime sleepiness (EDS) as well as its relation to road traffic accidents (RTA) among Turkish public transportation drivers.

Materials and methods: Male public transportation drivers (618) from the largest public transportation corporation (IETT) in Turkey were analysed after responding to questionnaires about their demographics, traffic accident histories, sleep habits, excessive daytime sleepiness (Epworth), and the likelihood of having apnoea (STOP-BANG). We also measured anthropometric data for all of the drivers. Frequency, mean, Chi-square, student T-test and regression analyses were used in statistical analyses.

Results: Six hundred and eighteen male public transportation bus drivers with mean age (years) of 43.08 ± 5.41 and with mean BMI (kg/m2) 29.01 ± 3.92 were recruited. There was a positive and significant relation between age and BMI with obstructive sleep apnoea (OSA) (p= 0.000). OSA risk was high in 442 (71.5 %) drivers and 297 (48.1 %) had EDS. There was a positive relationship between OSA risk and the risk of EDS (p = 0.000). Five hundred and thirtyone (86.6 %) drivers had a past history of RTA but there was no significant relationship between a past RTA and OSA risk (p = 0.06). However, there was a statistically significant difference in the risk of EDS (ESS ≥10) in those with past history of RTA compared to those without (p = 0.000). The independent determinants of excessive day time sleepiness were the OSA risk and the abdominal adiposity (p < 0.001).

Conclusion: In conclusion, we found a high prevalence of OSAS in the largest city transportation company in Turkey. Our results further suggest that age and BMI increase the risk of developing obstructive sleep apnoea syndrome (OSAS). We confirm a high incidence of falling asleep while driving and a high rate of road traffic accidents in OSAS patients.

Key words: OSAS, EDS, RTA, Public transportation, Bus driver, STOP-BANG, Epworth.

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Introduction

Obstructive sleep apnoea (OSA) is the most prevalent breathing disorder with an incidence of one in four men and one in ten women. The signs, symptoms and consequences of OSA are a direct result of the derangements that occur due to repetitive collapse of the upper airway: sleep fragmentation, hypoxemia, hypercapnia, marked swings in intrathoracic pressure, and increased sympathetic activity. Clinically, OSA is defined by the occurrence of daytime sleepiness, loud snoring, witnessed breathing interruptions, or awakenings due to gasping or choking in the presence of at least 5 obstructive respiratory events (apnoeas, hypopnoeas or respiratory effort related arousals) per hour of sleep(1). In the general population, moderately severe OSA is present in 11.4% of men and 4.7% of women(2, 3). OSA is associated with several comorbidities, including acute myocardial infarction, heart failure, arrhythmias, refractory hypertension, cerebrovascular diseases, and metabolic syndrome(4-9).

Persons may exhibit more than 15 obstructive respiratory events per hour of sleep and yet show no overt signs and symptoms of distress, such as loud snoring, gasping, choking, awakening from sleep, or excessive daytime sleepiness(10).
Several screening questionnaires have been developed to identify individuals at high risk for OSA, including the checklist of the American Society of Anesthesiologists, the STOP questionnaire (snoring, tiredness, observed apnea, and high blood pressure), the STOP-BANG questionnaire (STOP plus BMI, age, neck circumference, gender), the Wisconsin questionnaire, and the Berlin Questionnaire.

The STOP-BANG questionnaire is a concise and easy-to-use, eight points, dichotomized (yes/no) screening tool for OSA. In a systematic review of screening questionnaires for OSA, the STOP-BANG questionnaire had the highest methodological quality and sensitivity. Its use has been validated in different populations, including pre-operative patients, hospitalized patients, and patients presenting to a sleep disorders unit. Validation tests of OSA screening tests STOP-BANG and its short version STOP have been done in a Turkish population.

Several studies have demonstrated that obstructive sleep apnoea syndrome (OSAS) patients have a higher rate of road traffic accidents. Excessive daytime sleepiness (EDS) indubitably increases the risk of traffic accidents. Accidents that are caused because of driving when drowsy can result in disastrous outcomes, with resultant high economic costs. In particular, public transportation accidents including buses or trains may cause serious injuries to many people.

Therefore, the early diagnosis and treatment of sleep disorders that related to EDS is essential to maintain traffic safety. It has been generally accepted that OSAS frequently accompanies EDS. OSAS is common not only in the general population but also in occupational drivers. OSAS drivers are known to have an increased risk of accidents 2- to 15-fold higher than the general population. Despite the high prevalence of OSAS and associated complications, majority of the patients remain undiagnosed. For example, in US 93% of women and 82% of men with moderate to severe OSA are clinically undiagnosed.

The purpose of this cross-sectional study is to perform a survey of a Turkish public transportation drivers using the STOP-BANG questionnaire and estimate the prevalence of individuals who are at high risk for OSAS. The STOP-BANG questionnaire is a scoring model consisting of eight easily administered questions starting with the acronym STOP-BANG and is scored based on Yes/No answers (score: 1/0). Thus, the scores range from a value of 0 to 8. A score of ≥3 has shown a high sensitivity for detecting OSA: 93% and 100% for moderate and severe OSA, respectively. Owing to its high sensitivity at a score of ≥3, the STOP-BANG questionnaire is considered very helpful to rule out patients having moderate and severe OSA.

Materials and methods

This study was conducted on a sample of 618 public transportation drivers chosen randomly among 5468 drivers employed by largest public transportation corporation in Turkey who were evaluated between April 2013 and June 2013. All of the drivers in the sample were male. The participants were informed about the study procedures prior to signing informed consent forms. The protocol was approved by the Ethics Committee at the University of Afyon Kocatepe. Of the 618 bus drivers, all of them were working in shift. The work schedule of bus drivers mainly consisted of three shifts: a) early-morning (05:30 - 06:30) to mid-afternoon (13:30 - 14:30), b) morning (06:30-08:00) to evening (21:00 - 22:30) with about 4 hours of rest time around noon, and c) early-afternoon (13:30 - 14:30) to late-evening (21:30 - 22:30). The drivers starting to drive in the early-morning were working in this shift for one week period and then in the afternoon in the coming week.

The rest of the drivers working in morning to evening with about 4 hours of rest time around noon were always driving in same schedule.

The bus drivers were invited to complete anthropometric assessments (weight, height, waist, hip, and neck measurements) to determine their BMI, obesity, and risk for cardiovascular disease. BMI calculations were determined using the criteria established by the World Health Organization. After responding to the general questionnaire (to assess demographics, lifestyle, daily routine, traffic accident history) the Epworth Sleepiness Scale (ESS) and the STOP-BANG questionnaire as well as a visual analogue scale (VAS) score for snoring were applied to participants by face-to-face interviewing.

The Epworth Sleepiness Scale (ESS) is the most widely used subjective scale for assessing daytime sleepiness because it is able to distinguish people with and without sleepiness from those with...
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Excessive sleepiness. The ESS consists of eight questions that describe everyday situations that can induce sleepiness. Each question is graded from 0 to 3; total scores above 10 indicate significant daytime sleepiness, and scores above 15 are associated with pathological sleepiness present in specific conditions, such as sleep apnoea and narcolepsy\(^3\)

The STOP questionnaire consists of four yes/no questions, with one point given for each yes answer. A score of 2 or more positive responses out of a possible total score of 4 is considered high risk for OSA on the STOP questionnaire. The STOP-BANG questionnaire incorporates the STOP questions as well as assigns one point for each yes answer on the following: BMI>35, age>50 years, neck circumference> 40 cm, and male gender. A score of 3 or more positive responses out of a possible total score of 8 is considered high risk for OSA based on the STOP-BANG questionnaire\(^3\)

We did not perform a polysomnography (PSG) in patients at high risk to suffer from OSAS because of the cost of and delays in scheduling an appointment for PSG. It seems assessment of the high risk cases will occupy a long time. However, PSG for these cases were planned to be performed in the future time.

Data obtained was analysed using the SPSS version 16. Continuous variables with normal distribution (age, blood pressures, BMI, waist circumference, STOP-BANG and ESS scores) are expressed as means and standard deviation and compared using the Pearson’s correlation. Group differences in discrete variables (e.g., BMI category, OSA risk category, ESS category (presented as frequencies), are compared with the Pearson X2 test. Independent predictors of OSA risk were assessed in multivariate logistic regression analysis.

Results

The study group was entirely male. In the overall sample of bus drivers, the average age was 43.08 ± 5.41 years. The mean BMI was found as 29.01 ± 3.92 kg/m2. With regard to obesity, 84.1% of all bus drivers taken into the study had above average weight (BMI > 25 kg/m2); 279 of 618 bus drivers (45.1 %) were overweight and 241 (39.0 %) were obese. There were 68 (11.0 %) drivers with abdominal adiposity and 100 (16.2%) with hypertension. Neck circumference was 41.31 ± 1.71 cm. Median duration of working as a bus driver in the corporation was 12.24 ± 4.83 years. Two-hundred and fourteen (34.6%) of the participants were never smoked, 240 (38.8%) were currently smoking and 164 (26.6 %) were quit smoking. More than half of the respondents (51.0 %) were high school graduated (Table 1,2).

![Table 1: Baseline characteristics of study participants. SD - Standard deviation; ESS - Epworth sleepiness scale; IQR - Interquartile range; BMI - Body mass index](image)

![Table 2: Demographic characteristics of the study population (n=618). Data presented as the mean and SD (±), comparison made using student T-test. Data presented as the absolute frequency (relative frequency %), comparison performed using Chi-square test.](image)
ing symptoms (STOP), 374 (60.5%) snored loudly, 367 (59.4%) felt tired or sleepy during the day, 228 (36.9%) had witnessed apnoea and 100 (16.2%) had hypertension. With regard to the data on demographic and anthropometric aspects of the questionnaire (BANG), 39 (6.3%) had BMI greater than 35, 58 (9.4%) were aged ≥50 years, and 484 (79.3%) had neck circumference greater than 40 cm.

ESS median score was detected as 8.93 ± 5.78 in entire sample group. Based on the ESS score, 202 (32.7%) of the 618 drivers were getting restful sleep (ESS score = 0‑5), 119 (19.3%) could have their sleep improved (ESS score = 6‑9) and 297 (48.1%) had EDS, possibly due to OSA (ESS score ≥10). (Table 3) In correlation analysis, OSA score correlated positively and significantly with the ESS score (X2 = 69.0 P = 0.000). In intra-group comparison based on risk category, 259 (58.6%) of those at high risk of OSA also had excessive day time sleepiness compared to 38 (21.6%) of those with low risk of OSA (X2 = 28.2, P = 0.000).

Multiple logistic regression analysis was done to identify the independent determinants of OSA risk. After univariate regression, abdominal adiposity, tobacco usage and risk of excessive day time sleepiness were included in the model. Potential determinants represented in the STOP-BANG questionnaire (snoring, tired or sleepy during the day, hypertension, obesity, age, neck circumference and male gender) were excluded from the model. Abdominal adiposity (P < 0.001) and excessive daytime sleepiness (P < 0.001) were significantly associated with OSA risk and are thus independent determinants of OSA. To assess the independent determinants of excessive daytime sleepiness, a multiple logistic regression analysis was also conducted. The model included, current smoking, abdominal adiposity, and the OSA risk after univariate analysis. The independent determinants of excessive day time sleepiness were the OSA risk (P < 0.001) and the abdominal adiposity. (P < 0.001).

Five hundred and thirtyfive (86.60 %) of the study participants had a traffic-accident history. Of these 543 drivers, 365 (59.1%) believed that excessive day time sleepiness contributed to the accident, 137 (22.2%) stated that occurred RTAs might have been caused because of EDS and 41 told they were not in the opinion that EDS made a contribution to the RTA they have had. The mean accident number per driver in the study was 2.83. There was no difference in the prevalence of high risk of OSA in drivers with and without a past history of RTA (X2 = 2.7, P = 0.06). However, unsimilarly there was a statistically significant difference in the risk of EDS (ESS ≥10) in those with past history of RTA compared to those without (X2 = 26.7, P = 0.000). The BMI category (obese or not obese) was also not associated with a past history of RTA (X2 = 2.7, P = 0.07).

<table>
<thead>
<tr>
<th>Variables</th>
<th>OSAS (n: 442)</th>
<th>Non-OSAS (n: 176)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤50</td>
<td>69.46%</td>
<td>30.54%</td>
<td></td>
</tr>
<tr>
<td>&gt;50</td>
<td>91.38%</td>
<td>8.62%</td>
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</tr>
<tr>
<td>Total work time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤10 years</td>
<td>63.84%</td>
<td>36.16%</td>
<td></td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>79.10%</td>
<td>20.90%</td>
<td></td>
</tr>
<tr>
<td>Waist circumference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;102 cm</td>
<td>68.55%</td>
<td>31.45%</td>
<td></td>
</tr>
<tr>
<td>≥102 cm</td>
<td>93.58%</td>
<td>4.42%</td>
<td></td>
</tr>
<tr>
<td>Neck circumference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤40 cm</td>
<td>35.82%</td>
<td>64.18%</td>
<td></td>
</tr>
<tr>
<td>&gt;40 cm</td>
<td>81.40%</td>
<td>18.60%</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 kg/m²</td>
<td>64.80%</td>
<td>35.20%</td>
<td></td>
</tr>
<tr>
<td>≥30 kg/m²</td>
<td>86.72%</td>
<td>13.28%</td>
<td></td>
</tr>
<tr>
<td>EDS (Epworth Sleepiness Scale)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No (&lt;10)</td>
<td>57.00%</td>
<td>43.00%</td>
<td></td>
</tr>
<tr>
<td>Yes (≥10)</td>
<td>87.21%</td>
<td>12.79%</td>
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<tr>
<td>Tobacco use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>72.94%</td>
<td>27.06%</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>69.17%</td>
<td>30.83%</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 4: Variables analyzed for the chance of OSAS.

Age, BMI, neck circumference, waist circumference, ESS score and over 10 years total work time ratios in the OSAS group were significantly

Table 3: Comparison of measures of central tendency of the ESS scores across the STOP-BANG risk category.
higher than subjects with negative symptoms at questionnaire. Almost three-in-four participants (74.58%) aged 40 or more in high risk for OSAS. On the other hand, the highest proportion of high risk individuals (91.38%) was found in the age group 50 or above. Our data shows that the risk for OSAS increased with age up to 65 years of age. (Table 4)

Among the OSAS high-risk group, 47 (10.63%) had normal BMI (< 25 kg/m2) and it is important to note here that all of the 39 individuals (100 %) who had BMI greater than 35 kg/m2 were in high risk for OSAS (X2 = 16.5 p = 0.000).

The number of drivers with EDS was 297 of 618 participants (48.10 %) and 285 drivers (46.11%) without EDS met at least two of the screening criteria items for OSAS (ie, obesity with hypertension and habitual snoring associated with several witnessed episodes of respiratory pauses during sleep).

Bus drivers who were suspected with OSAS were more obese, older and had worked for the company longer, compared with non-OSAS bus drivers.(p<0.001)

In the study, 365 bus drivers (67.20 %) whom had past RTA stated they believe that their sleepiness has an impact on having RTA and 137 (25.20%) gave a probability to it.

Using the ESS to compare abnormal daytime drowsiness showed that the patients who self-reported RTA had significantly higher scores: 9.49 ± 5.74 versus 5.29 ± 4.54 (p <0.000).

Discussion

To our knowledge this is the first study focusing on sleep disorders among public transportation drivers in this sample size. Many studies have been done on patients with sleep disorders or in samples of the general population. However, the specific aim in our study was to determine sleep disorders and the risk of traffic accidents in regular public transportation drivers. We also departed to determine the sooth condition of sleep disorders underlying EDS among occupational drivers working shifts. Several factors have been associated with an increased risk of OSA, including age, male gender, obesity, otorhinolaryngological changes, inherited traits, and aging. It has been found out that risk of OSA increases by obesity. Two hundred and nine participants (86.72%) with BMI>30 have been found to have high risk of OSAS. (p<0.000).

Our study result corroborate previous findings that obesity is a major modifiable risk factor for OSA. The potential impact of OSA on the performance of commercial drivers in relation to driving safety is of major public health importance. In this study, approximately more than half of the drivers were found to have a high risk of OSA, and this in turn was associated with excessive daytime sleepiness in about half of the respondents. The prevalence of OSA in our study affirms the figures reported from other populations.

In a study in the literature about 50% of over 3000 drivers assessed using a questionnaire had a high risk of OSA, while 45% of drivers in another study had OSA based on an apnoea/hypopnoea index (AHI) greater than 5 on polysomnography. The AHI index is the number of episodes of apnoea or hypopnoea occurring per hour of sleep during a polysomnography test. Apnoea is the complete cessation of airflow or greater than 50% reduction in airflow lasting at least 10 seconds, while hypopnoea is <50% reduction in airflow lasting longer than 10 seconds that is accompanied by ≥4% oxygen desaturation or by arousal from sleep. We demonstrated 193 (47.53%) bus drivers have EDS among 406 bus drivers working in rotating shiftwork. (p>0.05) In general, rotating shiftwork contributes to increased levels of daytime sleepiness. Despite the diversity of prevalence rates in the literature, we found that the prevalence of excessive daytime sleepiness in (overall: 48.10% and shiftwork: 47.53%) bus drivers was higher when compared with the rates ranging from 6.3% to 22.6% among the general population or non-shiftworkers, from 5.9% to 44.8% in shiftworkers, but similar to that other studies, which shows a prevalence of EDS as 7.1% to 60.9% in occupational drivers.

The occupational hazards attributable to OSA and EDS in commercial drivers are particularly significant because the risk extends, not just to the drivers themselves, but also to third parties including passengers and other individuals in the traffic. It has been demonstrated that commercial drivers with OSA had marked sleepiness and impaired driving performance in a study in the literature. It is clearly shown that there is an increased risk of RTA among patients with OSA and this risk is actually more profound in those patients with very severe OSA (AHI ≥30) in two meta-analyses.

We report 60.5% prevalence of snoring in our study population, which is similar to that reported
in the US population as high as 52-54\%\textsuperscript{(49, 50)}.
Possible explanation perhaps is that our study population has similar characteristics as western populations which have a higher prevalence of obesity and mean BMI\textsuperscript{(51)}.

BMI has been reported to have a linear relationship with OSAS risk in Asian\textsuperscript{(52, 53)} as well as Western populations\textsuperscript{(54)}. It has been detected a statistically significant difference between obesity and OSAS in the study. (p<0.000)

It has been detected a statistically significant difference between snoring and obesity in our study (p<0.001). We also demonstrated that a statistically significant difference was found between snoring and EDS (p<0.000). There are some studies showing that primary snoring is not a benign symptom in the literature\textsuperscript{(54, 55)}. We think that those individuals have to be investigated particularly because of the significance we have found in the study between snoring and EDS. (X\textsuperscript{2} = 10.4 p = 0.002)

In the study, we showed that 93.93\% of bus drivers with EDS had RTA. We demonstrated a relation between EDS and RTA and it has been detected a statistically significant difference between them. (p<0.000) Drivers with EDS were experienced more RTAs compared to drivers without EDS. This is not consistent with a study in the literature made among drivers\textsuperscript{(56)}. It might be originated from the differences in means of anthropologic features between the study groups of two studies.

In the study, two-in-three (67.20\%) bus drivers whom had past RTA stated they believe that their sleepiness has an impact on having RTA. It was detected a statistically significant difference between past RTA and their opinion that having sleepiness had an impact on having RTA. (X\textsuperscript{2} = 618.0 p = 0.000)

We have detected that among 442 participants having high risk of OSAS, the neck circumference was > 40 cm in 89.14\% (n: 394) of them and a statistically significant difference was detected. (p<0.000). The accumulation of fat in the neck (leading to the obstruction of airways) is one of the primary reasons for the onset of OSAS\textsuperscript{(57)}. In the study 14.70\% (n: 65) of the respondents having high risk for OSAS also have a waist circumference over 102 cm. (p<0.000) The accumulation of abdominal fat and the presence of metabolic syndrome can also lead to the onset and development of OSAS due to declining respiratory function (e.g., a reduction in pulmonary volume)\textsuperscript{(58, 59)}. There were fifty-three bus drivers over 50 years old (11.99\%) among 442 participants with higher risk of OSA. Our sample of individuals over the age of 50 years had a higher chance of developing OSAS. (p<0.000) These data are supported by other studies reporting that difficulties in sleeping normally increase with advancing age\textsuperscript{(60)}.

In conclusion, we found a high prevalence of OSAS in the largest city transportation company in Turkey. Our results further suggest that age and BMI increase the risk of developing OSAS. We confirm a high incidence of falling asleep while driving and a high rate of road traffic accidents in OSAS patients. Our findings suggest that OSAS with frequent brief arousal and severe oxygen desaturation occurring at night associated with sleep disordered breathing may contribute to daytime sleepiness leading to increased risk of road traffic accidents. These data indicates to the need that top managers of the public transportation companies have to be informed about the characteristics of driver population because they may be at a higher risk for having accidents and health problems due to obesity and training programs must be done about life style changes.

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