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Original Article

Risk factors of sleep-disordered breathing among Public Transport Drivers of Kochi, India

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ABSTRACT

Introduction: Sleep-disordered breathing (SDB) appears to be a major occupational health concern among transport drivers as it increases the chance of road traffic crashes. The study aimed to determine the prevalent risk factors of sleep-disordered breathing in public transport drivers of Kochi, India.

Methods: A descriptive cross-sectional study was performed among 50 public transport drivers who satisfied the inclusion criteria and were categorized as high and low-risk groups using the STOP-BANG questionnaire. Physical examination recorded neck circumference, waist-hip ratio, body mass index, blood pressure, and facial profile. Excessive daytime sleepiness was evaluated using the Epworth sleepiness scale. Mann Whitney and Chi-square tests were used to test for significance. Logistic regression was also done by including the significant variables.

Results: The high risk (n= 27) and low-risk groups (n=23) were identified. Among the high-risk group; age, body mass index, neck circumference, blood pressure, snoring, and tiredness showed statistically significant results ($p<0.05$) when compared to the low-risk group. Excessive daytime sleepiness was present among 29.6% of high-risk subjects. Logistic regression confirmed that age (OR=1.176; p=0.001) and body mass index (OR=1.348; p=0.050) were independent predictors of developing a high risk of SDB.

Conclusion: Among public transport drivers in Kochi, India; older age and increased body mass index were significant contributing factors for developing sleep-disordered breathing. Obstructive sleep apnea (OSA), whether diagnosed or undiagnosed, is a major public health concern and a proven risk factor for vehicle crashes. Applicants for public transport driver's licenses should be thoroughly examined for the risk of OSA/SDB. A standardized screening protocol for OSA risk assessment should be advisable for public transport drivers to ensure road safety.

Keywords: Obstructive sleep apnea, Public transport drivers, Sleep-disordered breathing, STOP-BANG questionnaire.

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Introduction

Obstructive sleep apnoea (OSA) is a disease characterized by collapsed upper airway with restricted or full cessation of airflow. Characteristic features of OSA include disruptive snoring, nocturnal hypoxemia, and excessive daytime sleepiness due to recurrent episodes of full/partial pharyngeal blockage during sleep.[1] OSA could be due to sleep-disordered breathing (SDB) and has been correlated with negative cardiovascular health outcomes, risk of vehicle crashes, and impaired quality of life and social living.[2]

Obesity and associated factors like high body mass index (BMI), altered neck circumference (NC), and waist-to-hip ratio (WHR) are all considered risk factors for OSA.[3] Polysomnography which is the gold standard in diagnosing OSA is an expensive, time-consuming test which cannot be routinely done among the public which necessitates the need for screening tests like the STOP-BANG questionnaire and Epworth Sleepiness scale for evaluating the risk factors for OSA.[4]

Driving is a complex process that requires constant interaction with the road and the environment.[5] Excessive daytime sleepiness (EDS) may be described as a situation wherein the subject is unable to keep themselves fully awake during the wakeful period of the sleep-wake cycle. Recent years have seen a gradual increase in the number of fatal and non-fatal motor vehicle crashes in the country. Tregear et al and Huhta et al reported persons with undiagnosed OSA have an increased risk of falling asleep during driving and may cause crashes when compared to healthy individuals.[6,7] This warrants the need to identify the high-risk factors for developing SDB among drivers. Thus, the study aimed to determine the prevalent risk factors of SDB among public transport drivers of Kochi, India.

Methods

A descriptive cross-sectional study was conducted among 50 male public transport drivers in Kochi, Kerala, India from June to August 2021. Based on the results of percentage predicted neck circumference and BMI among OSA by Agrawal et al and with 10% relative precision and 95% confidence, the minimum sample size came to 17 and 2 respectively.[8] Since the highest value was 17, the minimum sample size would be 50 subjects, which would give an estimated 99% confidence.

Male public transport drivers in the age group of 18-60 years with professional driver's licenses and enrolment at any local transportation enterprise in Kochi, Kerala were selected for the study. Of the 68 individuals approached for the study, 50 consented to participate (response rate of 73.5%). Subjects who denied voluntary participation, and who had any recent upper airway surgery, respiratory malignancy, congestive heart failure and renal failure were excluded from the study.

The Institutional ethical committee at Amrita Institute of Medical Sciences, Kochi (IRB-AIMS-2020-161) approved the study protocol. Participants who gave consent and satisfied the inclusion criteria were selected for the study. Their demographic details, medical history, and years of working as professional drivers were recorded.

A previously validated Modified STOP-BANG questionnaire[4,9] was used as a screening tool for assessing the risk factors of SDB. Physical examination was done to record neck circumference (NC), waist-hip ratio (WHR), Body mass index (BMI), blood pressure and facial profile.

The STOP-Bang questionnaire is a simple, reliable screening tool, which can be effectively used for identifying the risk factors for OSA in a cost-effective manner. This questionnaire includes eight screening criteria such as a history of snoring, daytime tiredness, observed apnea, high blood pressure, body mass index $>30\,kg/m^2$, Age > 50, Neck circumference > 40 cm, and male Gender. Patients with a score of <3 were categorized as the low-risk group and patients with scores ≥ 3 were classified as a high-risk group.[9]

Excessive daytime sleepiness was assessed using the Epworth Sleepiness scale (ESS).[4] ESS is a self-administered questionnaire that measures daytime sleepiness based on the chances of falling asleep in eight different situations. The final score of 11 or more indicates excessive and severe daytime sleepiness.

Using standardized processes and equipment, anthropometric data were collected. The height was measured to the closest half-centimeter. The weight was measured in barefooted subjects to the nearest 0.1 kilograms. BMI calculation was done with the equation: BMI = weight in Kg / (height in meters)^2

Based on BMI categorization, participants were classified into: normal weight ($\leq 24.99\ kg/m^2$), overweight (25 - 29.99 kg/m^2), and obese (≥30 kg/m^2).[10] Measurement of circumferences to the closest 0.5 cm was done with a non-stretch measuring tape. NC was measured between the mid-cervical spine and the mid-anterior neck, with the individual standing erect, face in the Frankfort horizontal plane, and shoulders relaxed.[11] The midpoint between the highest point of the iliac crest and the last floating rib was used to calculate the WC. The circumference of the hips was measured at their widest point. The WHR was computed (cm) by dividing the waist circumference (cm) by the hip circumference (cm).[12] According to the World Health Organization, a WHR of 1.0 or above increases heart diseases risk and other illnesses connected to obesity in both men and women, so they were categorized into two groups; the no-risk group with a WHR of less than 1 and a risk group with WHR >/= 1. The participant's blood pressure (BP) was measured while the patient was seated in a comfortable position with proper back support. Standardized mercury sphygmomanometers were used. The systolic and diastolic BP (SBP and DBP respectively) above 140 mm Hg and 95 mm Hg respectively were classified as risk categories. The facial profile was recorded clinically. Glabella, subnasale and soft tissue pogonion were evaluated. Based on the facial profile participants were categorized as convex, straight and concave.

Statistical analysis was done with IBM SPSS version 20.0 software. Frequency and percentage were used to express categorical variables. The mean and SD as well as the median and interquartile range were used to depict numerical variables. The statistical significance of the mean value difference of all continuous variables between groups in terms of risk was tested using the Mann-Whitney test. Chi-Square with continuity correction was used to examine the statistical significance of the relationship between Profile, Snoring, Tiredness and risk. To find the significant predictors of SDB, logistic regression analysis was applied. Statistically significant values had a p-value of less than 0.05.

Results

In the study, 50 participants were screened using the modified STOP-BANG questionnaire. Then they were categorized as high-risk and low-risk groups based on their score. A score of more than >3 indicates high risk and <3 as low-risk subjects.

Out of the 50 participants, 23 subjects (46%) were grouped as high-risk and 27 subjects (54%) in a low-risk group. The mean age and BMI of the high-risk group were 48.96±7.01 and 24.91±3.77 respectively; whereas for the low-risk group the mean age and BMI were 39.96±7.40 and 23.15±1.44. EDS was identified in 29.6% of high-risk subjects using ESS. By comparing the two groups (low and high risk) age, BMI, neck circumference, and Systolic and diastolic blood pressure showed statistically significant results (p<0.05). (Table 1 & figure1)

Table 1: Comparison between high and low-risk groups

Variable	Risk	Median (Q1, Q3)	p-value
Age	Low Risk	40(34,45)	0.001*
	High Risk	52(46,54)	
Body Mass Index	Low risk	23.5(23.07,24.02)	0.006*
	High risk	24.5(23.5,26.06)	
Neck circumference	Low risk	39(38,40)	0.003*
	High risk	40(39,41)	
Waist hip ratio	Low risk	0.98(0.98,0.99)	0.224
	High risk	0.98(0.97,0.99)	
Systolic BP	Low Risk	125(122,127)	0.004*
	High risk	131(128,145)	
Diastolic BP	Low risk	82(81,84)	0.045*
	High risk	85(82,87)	

*p<0.05 statistically significant

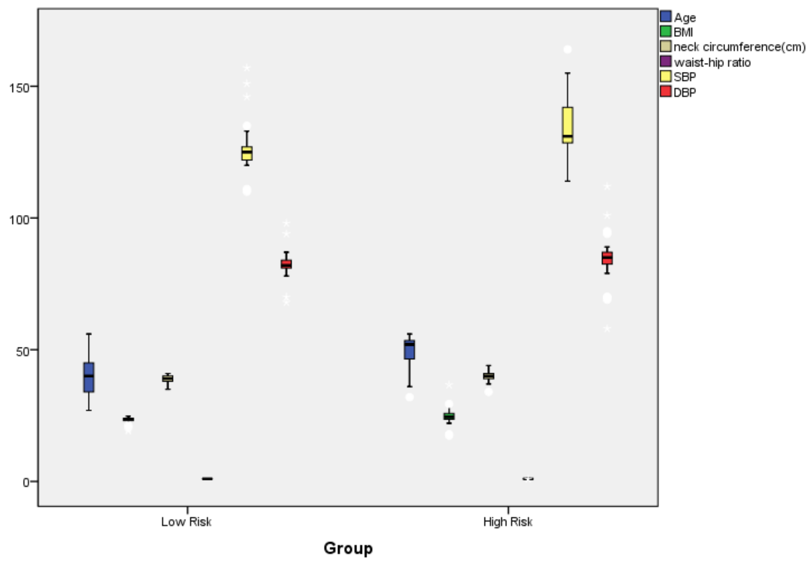

Fig.1: Risk factors in low and high-risk groups

Out of the 50 participants, snoring was present in 10 subjects and 40 were non-snorers. All the 10 snorers identified were grouped into the high-risk group based on the scores. Among the 40 non-snorers,13 were high-risk subjects and 27 were low-risk subjects.

Tiredness was also reported among 10 participants who were grouped as high-risk subjects and among 40 participants who reported an absence of tiredness, 16 were grouped into high risk and 24 were grouped into low-risk. The comparison showed that both snoring and tiredness were statistically significant parameters ($p<0.05$) (Table 2). The comparison of facial profile and Waist Hip ratio among the two groups did not show a statistically significant difference.

Table 2: Association of the profile, snoring and tiredness among low and high-risk groups.

Risk factor		Low-risk n (%)	High risk n (%)	p-value
Profile	**Convex**	16 (51.6)	15 (48.4)	0.665
	Straight	11(57.9)	8 (42.1)	
Snoring	**Absent**	27 (67.5)	13 (32.5)	0.001*
	Present	0 (0)	10 (100)	
Tiredness	**Absent**	24 (60)	16 (40)	0.037*
	Present	0(0)	10 (100)	

*p<0.05 statistically significant

The variables showing significant differences were included in the logistic regression model and the odds ratio was obtained (Table 3). Older age and increased BMI were associated with OSA. The risk of being in the high-risk group of OSA was 1.17 times more in participants with >50 years of age ($p=0.001$) and 1.35 times more when BMI was >30kg/m^2 ($p=0.05$). Other variables were NC (OR 1.65), systolic BP (OR 1.06), and diastolic BP (OR 1.03) were not independent risk factors.

Table 3: Univariate analysis of risk factors of OSA

Variable	Odds Ratio (OR)	95% of CI of OR	p-value
Age	1.176	1.070-1.292	0.001*
Body Mass Index	1.348	0.994-1.827	0.050*
Neck Circumference	1.650	1.121-2.428	0.011
Systolic BP	1.066	1.007-1.129	0.028
Diastolic BP	1.030	0.962-1.103	0.397

*$p<0.05$ statistically significant

Discussion

In this study, the predictive risk factors for OSA identified among the high-risk group of public transport drivers were age and BMI.

Road traffic crashes have become a significant public health issue since they are a preventable cause of mortality.[13] Among the various factors causing motor vehicle crashes, excessive sleepiness as a result of OSA has a significant position.[14] It is often characterized by a partial or complete collapse of the upper airway during sleep leading to hypoxemia and sleep fragmentation. Thus, these patients with OSA have abnormal neurocognitive and psychomotor abilities, excessive drowsiness and fatigue, which all affect their driving skills.[14,15] Previous studies have shown that drivers with untreated OSA have a 1.2 to 4.9 times higher risk for road crashes and adequate treatment using CPAP therapy reduces this risk.[16] Hence, to ensure the safety of drivers there exists an increased need to identify and screen the possible risk factors of OSA.

The study was performed among male public transport drivers as previous literature on the Indian population has shown three times higher prevalence of OSA among males when compared to females and the majority of the public transport drivers were male. According to Reddy et al and Dubey et alprevalence of high-risk OSA increases with age.[17,18] This was in accordance with our study in which the median age was 52 years ($p<0.05$) in the high-risk group as opposed to the low-risk group, which had a median age of 40 years. The odds of developing OSA were higher as age increases (OR 1.17) and has emerged as a strong risk factor.

The results of the present study also showed increased BMI (OR 1.348) causing obesity as another important independent risk factor for developing OSA. Neck circumference even though was increased in the high-risk group when compared to the low-risk group and was not found to be an independent risk factor (OR 1.65) for OSA. A previous study by Basoglu et al. identified a proportional relationship in OSA patients with increased neck circumference to greater daytime sleepiness leading to more chances of road traffic crashes.[19] The increased NC has also been reported as a predictor of severe OSA severity, with marked central fat deposition.[11] Many theories have been proposed to explain how fat accumulation increases the risk of OSA. As fat deposits around the pharyngeal region (neck region) it leads to an increased risk for upper airway collapsibility and central obesity (abdominal fat) also causes a decrease in lung volume and residual functional capacity leading to weakened caudal traction causing pharyngeal collapse.[20]

Blood pressure records of the study population revealed a significantly higher value ($p<0.05$) for systolic and diastolic BP among high-risk subjects but were not found to be an independent risk factor. Phillips et al also have previously reported elevated blood pressure as an important risk factor for OSA, and that OSA can be an important secondary cause of hypertension.[21] Elevated systolic and diastolic pressure caused by apnea-hypopnea episodes keeps the mean blood pressure levels high at night and also during the daytime even when the breathing is normal.

A facial profile also could be an important component in diagnosing risk factors of OSA. Banabihl et al postulated in their study that a convex profile was more common in patients with OSA.[22] Convex profile because of mandibular retrognathism has an increased chance of upper airway collapse. The subjects in the high-risk group in our study also predominantly demonstrated a convex profile (48.4%) but were not statistically significant. Also, all those participants who reported snoring and tiredness were identified to be in the high-risk category. Berger et al found that patients with snoring had an increase in the apnoea/hypopnoea index over time which led to OSA.[23] Conversely, Chotinaiwattarakul et al reported a substantial reduction in patients' complaints of tiredness with good adherence to Continuous positive air pressure (CPAP) for OSA.[24]

There is a higher prevalence rate of crashes among SDB patients and they have an increased risk of morbidity and mortality, particularly due to excessive daytime sleepiness and cardiovascular diseases. EDS assessed subjectively by the Epworth sleepiness scale showed 29.6% among high-risk individuals. The results of the study indicate a marked overall association of SDB with high-risk factors for OSA. OSA patients are often tired and sleepy during the daytime and also contribute to neurocognitive deficits which can further impair their driving performance leading to road traffic crashes.[25] Additionally, a drowsy driver fails to assess the hazardous situations while driving due to impaired decision-making. The alarming higher percentage of high-risk group subjects in a smaller study sample of public transport drivers of the Kochi population necessitates screening of larger samples of public transport drivers. Proper awareness and screening of public transport drivers in coordination with transport authorities and health agencies regarding SDB may ensure the safety of both drivers and passengers. Thus, it is important to conduct systematic screening procedures among public transport drivers for identifying sleep-disordered breathing while driving license is being issued or renewed for ensuring road safety.

Conclusion

Sleep disorders are highly prevalent among public transport drivers leading to poor quality of sleep and motor vehicle crashes. In this study, older age and increased BMI indicating obesity were shown to be significant independent risk factors for developing OSA. Thus, the study findings emphasize the need to conduct screening protocols and awareness programs for identifying sleep disorders among public transport drivers for improving their general and psychological well-being and thus reducing road traffic crashes.

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