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ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ
ORIGINAL RESEARCH

Obstructive sleep apnea among commercial drivers in North India

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Abstract. Relevance. Obstructive sleep apnea (OSA) is the most common medical cause of excessive daytime sleepiness and is recognised worldwide as a significant risk factor for road traffic accidents when undiagnosed or untreated. OSA presents a critical occupational health concern in the transportation industry, affecting a substantial proportion of today's transport operators, especially in the trucking sector. *Aim of the study* was to estimate the risk of OSA among commercial drivers in North India and investigate its association with vehicle accidents. *Materials and methods.* A cross-sectional study was conducted involving 153 commercial drivers aged between 24 and 65 years, each with at least 5 years of driving experience. Participants were selected through simple random sampling after giving their consent. The collected data included demographic information, driving history (total years of driving, vehicular collisions due to sleepiness, and vehicular incidents), anthropometric measurements (height, weight, and neck circumference), and health history. Sleep quality, particularly difficulty in falling asleep or maintaining restful sleep, was assessed using the Pittsburgh Sleep Quality Index (PSQI). The risk of OSA and excessive daytime sleepiness was evaluated using the STOP-BANG questionnaire and the Epworth Sleepiness Scale, respectively. *Results and discussion.* Among participants, 21.56% were at risk of OSA, while 28.10% exhibited poor sleep quality as per the PSQI, and 15.16% of high-risk OSA drivers experienced excessive daytime sleepiness. A significant association was observed between the high-risk OSA group and vehicle collisions ($p < 0.05$). *Conclusion.* The prevalence of OSA risk is notably high among commercial drivers, who also display poor sleep quality. In a country with a population of 1.4 billion, studies on OSA among commercial drivers are limited. Currently, there are no guidelines for OSA detection in Indian commercial drivers, despite its recognised prevalence in studies from other countries and related hazards such as an increased risk of motor vehicle collisions.

Keywords: obstructive sleep apnea, commercial drivers, STOP-BANG, Epworth sleepiness scale, PSQI, road traffic accidents, neck circumference

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Consent for publication. All participants of the investigation provided informed voluntary consent to participate in the study according to the Helsinki Declaration of the World Medical Association (WMA Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects, 2013) and personal data processing.

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Introduction

Obstructive sleep apnea (OSA) is a common sleep disorder characterized by excessive daytime sleepiness, loud snoring, witnessed breathing pauses, or frequent arousals in the presence of at least five obstructive respiratory events per hour of sleep [1]. There is a partial or complete cessation of breathing during sleep. OSA is a critical occupational health concern in the transportation industry that is underdiagnosed, which affects a substantial percentage of today's transportation operators, mainly in the trucking sector. Excessive daytime sleepiness (EDS) is the most common symptom and is considered the most critical medical cause of OSA. Lack of sleep usually leads to impairment in a person's judgment and hampers their abilities, which is of utmost importance for driving and hence can cause motor vehicle crashes [2]. According to Parks et al, there are 2–7-fold increased chances of vehicular crashes in drivers with OSA, with an estimated prevalence of as high as 17% to 28% [3]. According to a systematic review, subjects having OSA on average have an increased risk of motor vehicle accidents (MVA) by 1.2 to 4.9-fold [4]. The International Road Federation World Road Statistics 2022 suggested that India has one

of the highest numbers of total deaths due to road traffic accidents [5]. In one of the studies, the prevalence of OSA in the Indian male population is estimated to range between 13% and 19% [6]. Although the prevalence in Indian drivers is mainly unknown. This study aimed to assess the risk of OSA in commercial drivers in North India and to find its correlation with vehicle accidents or near-miss incidents.

Materials and methods

One hundred fifty-three commercial drivers were enrolled after their consent by a simple random sampling technique. The study design was cross-sectional. The study was conducted after institutional approval from the ethical committee. Inclusion criteria consist of male, commercial drivers (truck, bus, interstate taxi service) with a minimum 5 years of driving experience, age group (25–65 years) who gave informed consent to participate in the study whereas participants already being diagnosed as OSA or any known sleep disorders, psychiatric disorders, drivers who didn't give consent for the study were being excluded. All the Demographic, anthropometric, and historical data were obtained. Sleep

quality, i.e., whether the subject is having difficulty in falling asleep or maintaining a sound sleep, was assessed using PSQI. The risk of OSA and excessive daytime sleepiness (EDS) was assessed using the STOP-BANG questionnaire and Epworth Sleepiness Scale (ESS), respectively.

Anthropometric measurements, such as height, weight, and neck circumference, were measured. Study questionnaires consisting of demographic characteristics, clinical history (if any), sleep habits and quality, driving history including total years of driving and average hours of driving per day, vehicular collisions occurred due to sleepiness, near-miss accidents due to sleep, etc., were obtained. The STOP BANG questionnaire was used to assess the risk of OSA, and a score >3 was taken as the cut-off for high risk.

Excessive Daytime Sleepiness was assessed using the ESS, a self-administered questionnaire with eight questions about the likelihood of dozing or falling asleep during eight different activities. Commercial drivers were asked to rate, on a 4-point scale (0–3), their usual chances of dozing while engaged in these activities. An ESS score above 10, i.e., 11–24, indicates a high risk of EDS. Sleep quality among commercial drivers was evaluated using the PSQI questionnaire, which measures aspects such as sleep latency, sleep duration, and habitual sleep efficiency. It also considers other factors related to sleep disturbances, including the use of sleeping medication and daytime dysfunction. The scores from seven components in PSQI are combined

to produce a single global score that reflects both sleep quality and quantity. A global score exceeding 5 suggests poor sleep quality. The association of high-risk OSA with accidents were evaluated. All participants of the investigation provided informed voluntary consent to participate in the study according to the Helsinki Declaration of the World Medical Association (WMA Declaration of Helsinki—Ethical Principles for Medical Research Involving Human Subjects, 2013) and personal data processing.

The data obtained were analysed using SPSS statistical software (version 24). Quantitative data are presented as mean $\pm$ SD or median and compared with a Fisher t-test, while qualitative data are expressed as frequencies and percentages and compared using a chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results and discussion

Among 153 commercial drivers, the average age of the participants was 39.9 ± 9.10 years, ranging from 25 to 65 years. Hypertension was observed in 19 (12.2%), Diabetes mellitus in 7 (4.6%), and hypothyroidism in 3 (2%) participants. Normal Body mass index (BMI) was identified in 93 (60.78%) participants; 12 (7.8%) were underweight, 42 (27.4%) were overweight, and 6 (3.9%) were obese as per World Health Organisation (WHO) classification. Among drivers, 11 reported accidents, whereas 15 reported near-missed accidents (Table 1).

Table 1

Descriptive characteristics of participants enrolled in the study

Variables	Frequency (n)	Percentage, %	Median	IR
Age			38 years	15 years
≤50 years	128	83.7	—	—
≥51 years	25	16.3	—	—
Observed apnea				
No	149	97.4	—	—
Yes	4	2.6	—	—

Ending tabl. 1

Variables	Frequency (n)	Percentage, %	Median	IR
Age			38 years	15 years
Snoring				
No	113	72.4	—	—
Yes	40	25.6	—	—
Daytime tiredness				
No	40	25.6	—	—
Yes	113	72.4	—	—
Accident / NMA				
No	131	85.6	—	—
Yes	11/15	7.1/9.8	—	—
Alcohol consumption				
No	58	37.9	—	—
Yes	95	62.1	—	—
OSA risk				
Low risk	120	78.5	—	—
High risk	33	21.5	—	—
Smoking				
No	61	39.9	—	—
Yes	92	60.1	—	—
Comorbidities				
HTN	19	12.2	—	—
DM	7	4.6	—	—
Hypothyroidism	3	2	—	—
BMI				
< 18.5	12	7.8	—	—
18.5–24.9	93	60.7	—	—
25–29.99	42	27.4	—	—
>30	6	3.9	—	—
Neck circumference				
31–40 cm	89	58.2	—	—
>41 cm	64	41.8	—	—
STOP BANG				
≤3	120	78.4	—	—
≥4	33	21.6	—	—
ESS				
0–7	108	70.6	—	—
8–9	30	19.6	—	—
10–15	15	9.8	—	—
16–24	0	0	—	—
PSQI				
0–5	110	71.9	—	—
6–21	43	28.1	—	—

33 among 153 commercial drivers were at high-risk of OSA whereas 120 drivers were at low-risk based on STOP BANG score >3. The bivariate analysis indicates that larger neck circumference, BMI, blood pressure, alcohol consumption, incidents or missed incidents, tiredness, hypertension (HTN), and snoring were significantly more common in the high-risk OSA group compared to the low-risk group. No significant difference was observed among

subjects with diabetes mellitus and hypothyroidism (Table 2).

Association of OSA risk with accidents

Among participants with a high risk of OSA, 30.30% were involved in motor vehicle crashes compared to 13.13% in the low-risk OSA group ($p<0.05$). An ESS score (>10) was seen in 15.15% of the high-risk group ($p<0.05$) (Table 2).

Bivariate analysis between OSA risk (dependent factor) and independent factors

Table 2

Variables	OSA Risk		Total	p value
	Low riskN=120 (%)	High riskN=33 (%)		
Age median (Range)	35(24–65)	49 (32–62)	—	—
≤50 years	112 (93.33)	16 (48.48)	128	—
≥ 51 years	8 (6.66)	17 (51.51)	25	—
Observed apnea	1 (0.83)	3 (9.09)	4	0.05
Snoring	13 (10.83)	27 (81.81)	40	<0.001*
Tiredness	81 (67.5)	32 (96.96)	113	<0.001*
Accident or near miss accidents	16 (13.33)	10 (30.30)	26	<0.001*
Alcohol consumption	72 (60)	23 (69.69)	95	<0.001*
Hypertension	6 (5)	13 (39.39)	19	<0.001*
Diabetes Mellitus	2 (1.66)	5 (15.15)	7	0.02
Hypothyroidism	2 (1.66)	1 (3.03)	3	0.001
Epworth Sleepiness Scale				
≤ 10	118 (98.33)	28 (84.84)	146	—
> 10	2 (1.66)	5 (15.15)	7	<0.001*
Neck circumferenceMean (SD)	38.53 (1.9)	41.12 (1.34)	—	—
≤ 40 cm	110 (91.66)	10 (30.30)	120	—
≥ 41 cm	10 (8.33)	23 (69.69)	33	<0.001*
Body mass indexMean (SD)	22.7 (3.3)	25.3 (2.5)	—	—
< 18.5	12 (10)	-	12	—
18.5–24.9	78 (65)	15 (45.45)	93	—
25–29.9	26 (21.66)	16 (48.48)	42	—
> 30	4 (3.33)	2 (6.06)	6	<0.001*

This study revealed that 33 (21.5%) of commercial drivers were in a high-risk group for OSA based on the STOP-BANG questionnaire, which is an internationally validated tool having high sensitivity and specificity for OSA screening [7]. Obstructive sleep apnea is a significant health concern in the transportation sector, which affects a considerable number of commercial drivers, causing significant morbidity. According to a previous study in North America, 17–28% of commercial drivers were expected to have OSA [8]. In a recent survey done in Lusaka, Zambia, 22.8% of commercial drivers were found to have a high risk for OSA [9]. The estimated prevalence of OSA in the Indian population, based on a meta-analysis by Suri TM et al, was 11% [10]. In another study, commercial drivers were found to have 2–7 times higher prevalence of OSA compared to the general population [11]. In our study, a significant number of commercial drivers were overweight and obese and had a neck circumference of more than 40 cm. This can be due to the sedentary lifestyle, long working hours, and eating habits of commercial drivers, exposing them to many non-communicable diseases [12]. The average working hours in our study were 10.30 hours per day. These long working hours make drivers vulnerable to prolonged immobility and morbidity. A study among Australian drivers discovered that 44% of drivers in the study were obese and 24% were diagnosed with OSA [13]. In our study, 45% of the participants from the high-risk group for OSA were under the normal BMI range; the same findings were also seen in a Japanese study, where most drivers with OSA were not obese per WHO international criteria ($BMI \geq 30 \text{ kg/m}^2$) [14]. Villaneuva et al reviewed the existing literature, which shows that the Asian population is at a higher risk of having OSA at the lower level of obesity as compared to the Caucasian population, showing a high propensity of OSA in the Asian population [15]. In another study, weight gain as an anatomical factor plays a vital role in OSA pathogenesis, along with the contribution of non-anatomical traits such as low arousal threshold or poor sleep-related upper airway muscle tone/low pharyngeal muscle responsiveness [16]. Among the studied commercial drivers, snoring, BMI and neck

circumference were significantly higher among high-risk groups of OSA. These findings are comparable to the study done by Wahida et al [17].

It has been reported that ~50% of OSA patients have hypertension and that ~30% of hypertensive patients suffer from OSA [18]. In our study, a significant number of respondents in the high-risk OSA (39.39%) category were hypertensive. A cohort study from Brazil included 10,101 truck drivers and determined that factors such as obesity and hypertension that were associated with OSA were common among drivers [19].

Excessive daytime sleepiness (EDS) is the most crucial consequence of OSA in the context of occupational health. It is also a significant cause of motor vehicle collisions (MVCs) among commercial drivers. In this study, the Epworth sleepiness scale (ESS) was used to determine EDS among commercial drivers, where an ESS score >10 was significantly associated with high-risk OSA respondents as compared to the low-risk group. Long-haul truck drivers are a high-risk population due to their high driving distance/year, i.e., increased exposure, frequent sleep debt, and a high prevalence of OSA [20]. The study by Burks and co-workers in truck drivers in the United States showed that drivers with OSA who were non-adherent to CPAP treatment had a fivefold risk of serious preventable crashes. In contrast, those adherent to CPAP treatment showed a crash rate similar to the controls [21]. Between 10–30% of all vehicle crashes are estimated to have sleepy drivers as a root cause [22]. However, in this study, almost 85% of high-risk OSA drivers had an ESS score of less than 10.

In trying to associate OSA with RTAs, we discovered that out of the 33 drivers that were classified with a high risk for OSA, 10 had experienced at least one MVC. These findings show us that the possibility of accidents happening because of the dozing of commercial drivers at the wheel and not being able to concentrate fully on the road could very likely be because of OSA and EDS. Consistent with the reported literature, we found a statistically significant association ($p < 0.05$) between the STOP-Bang score and the number of accidents and near accidents. However, several studies depict that the vast majority of OSA patients

without complaints of EDS were also found to exhibit attention defects that may potentially expose them to specific risks of accidents while driving [22, 23].

Our study found that 28.1% of commercial drivers experienced poor sleep quality, with a PSQI score above 5, including 12 (36.36%) in the high-risk group and 31 (25.83%) in the low-risk group. This aligns with the study by Kalcina et al., where Obstructive sleep apnoea patients had higher overall PSQI scores, indicating poorer sleep compared to a healthy control group [24]. Commercial drivers often work long hours, perform shift work, lack proper resting facilities during work, and do not adhere to their permitted daily working hours.

Road traffic accidents impose a significant burden on the nation's economy and healthcare systems. Obstructive sleep apnea and EDS are major risk factors for RTA. Therefore, there should be appropriate screening and awareness programs, and strict rules should be followed while issuing or renewing driving licenses by local transport organizations. Polysomnography is a gold standard test for diagnosing OSA, and may be included in the case of individuals with high-risk factors for OSA before issuing a vehicular licence.

Limitations

The study is entirely based on self-reporting and not on any documentary evidence or driving simulation-based assessments. In addition, the entire data has been collected at a single time point and not a longitudinal analysis. The data regarding accidents and near accidents were collected retrospectively from participants, which may have led to recall bias.

Conclusion

The prevalence of OSA among commercial drivers is high in India. Also, the sleep quality is poor among them. Therefore, there are high chances of road traffic accidents. There should be guidelines for OSA screening among commercial drivers for early detection and treatment of OSA, thereby decreasing fatal events.

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Обструктивное апноэ сна среди водителей коммерческого транспорта в Северной Индии

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Аннотация. *Актуальность.* Обструктивное апноэ сна (ОАС) является наиболее распространенной медицинской причиной чрезмерной дневной сонливости и признано во всем мире как значительный фактор риска дорожно-транспортных происшествий, если оно не диагностировано или не лечится. ОАС представляет собой серьезную проблему для здоровья работников транспортной отрасли, затрагивая значительную часть современных транспортных операторов, особенно в секторе грузоперевозок. Цель исследования состояла в том, чтобы оценить риск ОАС среди водителей коммерческого транспорта в Северной Индии и изучить его связь с дорожно-транспортными происшествиями. *Материалы и методы.* Было проведено поперечное исследование с участием 153 водителей коммерческого транспорта в возрасте от 24 до 65 лет, каждый со стажем вождения не менее 5 лет. Участники были отобраны методом простой случайной выборки после получения их согласия. Собранные данные включали демографическую информацию, историю вождения (общее количество лет вождения, дорожно-транспортные происшествия из-за сонливости и другие ДТП), антропометрические измерения (рост, вес и окружность шеи) и историю болезни. Качество сна, в частности трудности с засыпанием или поддержанием спокойного сна, оценивалось с помощью Питтсбургского индекса качества сна (PSQI). Риск синдрома обструктивного апноэ сна (СОАС) и чрезмерной дневной сонливости оценивался с помощью опросника STOP-BANG и шкалы сонливости Эпворта соответственно. *Результаты и обсуждение.* Среди участников 21,56 % находились в группе риска СОАС, в то время как 28,10 % демонстрировали плохое качество сна по данным PSQI, а 15,16 % водителей с высоким риском СОАС испытывали чрезмерную дневную сонливость. Была выявлена значительная связь между группой высокого риска обструктивного апноэ сна (ОАС) и дорожно-транспортными происшествиями ($p < 0,05$). *Выводы.* Распространенность риска ОАС особенно высока среди водителей коммерческого транспорта, которые также демонстрируют плохое качество сна. В стране с населением 1,4 миллиарда человек исследования ОАС среди водителей коммерческого транспорта ограничены. В настоящее время отсутствуют рекомендации по выявлению ОАС у индийских водителей коммерческого транспорта, несмотря на признанную распространенность этого заболевания в исследованиях из других стран и связанные с ним риски, такие как повышенный риск дорожно-транспортных происшествий.

Ключевые слова: обструктивное апноэ сна, водители коммерческого транспорта, STOP-BANG, шкала сонливости Эпворта, PSQI, дорожно-транспортные происшествия, окружность шеи

Информация о финансировании. Данная работа была профинансирована.

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Заявление о конфликте интересов. Авторы заявляют об отсутствии конфликта интересов.

Информация о конфликте интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией данной статьи.

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