International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://theaspd.com/index.php

Obstructive Sleep Apnea In Commercial Drivers: A Review

Madhu Bala Bhardwaj[1*], Hrudananda Mallick[2], Nimarpreet Kaur[3], Mohit Agarwal[4]
[1]PhD Scholar, Department of Physiology, Faculty of Medicine & Health Sciences, SGT University, Gurugram, India. ORCID ID- 0009-0000-7563-6896, madhuombhardwaj@gmail.com
[2]Professor& Head Department of Physiology, Faculty of Medicine & Health Sciences, SGT University, Gurugram, India. ORCID ID- 0000-0002-4301-6198
[3]Professor, Department of Physiology, Faculty of Medicine & Health Sciences, SGT University, Gurugram, India.ORCID ID- 0000-0002-7208-8844
[4]Associate Professor, Department of Pulmonary Medicine and critical care medicine, National institute of Medical Sciences and Research, Jaipur. ORCID ID- 0000-0002-9566-551X

Abstract
Introduction-*Obstructive sleep apnea (OSA) is a chronic sleep-related breathing disorder characterized by repetitive collapse of the upper airway, leading to oxygen desaturation, disturbed sleep and excessive daytime sleepiness. It involves partial or complete pharyngeal obstruction, which can cause multiple episodes of sleep fragmentation, hypoxia, snoring, apnea, and daytime sleepiness. Undiagnosed obstructive sleep apnea is independently linked to higher risks of hypertension, cardiovascular disease, stroke, motor vehicle accidents, and reduced quality of life, thereby placing a strain on healthcare resources. Truck drivers often face long working hours and numerous challenges, including inadequate sanitation, safety concerns, and poor sleep hygiene. Commercial drivers primarily drive at night, disturbing their circadian rhythm, apart from prolonged immobility during working hours, making them prone to obesity and hypertension, which are risk factors for OSA. The Epworth Sleepiness Score (ESS), PSQI (Pittsburgh Sleep Quality Index), and STOP-BANG questionnaire are used to assess daytime sleepiness, quality of sleep, and as a screening tool for OSA, respectively. Studies have shown that high ESS and PSQI scores predict a high chance of OSA in commercial drivers.*
Methods - *A comprehensive literature search was conducted in major academic databases, including PubMed, Scopus, DOAJ, and Google Scholar. PSQI, ESS, STOP BANG, Commercial drivers, sleep apnea, and snoring were used as keywords.*
Result: *A total of 110 articles were identified. Literature with only abstracts was excluded. A total of 60 articles were studied.*
Conclusion- *Timely detection and treatment with a continuous positive airway pressure (CPAP) device can significantly reduce morbidity and lower the incidence of vehicle collisions.*
Keywords: *obstructive sleep apnea(OSA), Snoring, drivers*

INTRODUCTION:

Obstructive sleep apnea (OSA) is a chronic sleep-related breathing disorder characterised by repetitive collapse of the upper airway during sleep, leading to disturbed sleep, oxygen desaturation, and excessive daytime sleepiness. There is an occurrence of partial or complete pharyngeal obstruction, which can result in multiple episodes of apnea, sleep fragmentation, and decreased oxygen levels, causing snoring, disrupted sleep, and daytime sleepiness.

Evidence from various cohort studies indicates that undiagnosed OSA, is associated with increased chances of hypertension, cardiovascular disease, stroke, daytime sleepiness, motor vehicle accidents, and diminished quality of life thereby causing a burden in healthcare infrastructure and expenditure and if it is diagnosed and treated optimally with continuous positive airway pressure (CPAP) can significantly mitigate that burden and decrease in the vehicle collision cases respectively. [1,2]

In middle-aged adults in the United States, the estimated prevalence of OSA is 10% for mild OSA, 3.8%, and 6.5% for moderate and severe OSA, respectively. In Taiwan, the average prevalence of OSA is 2.6% among adults (3.4% in males and 1.9% in females). The five countries with the highest OSA prevalence estimates with an AHI ≥15/hour are China (estimated at 66 million patients, a prevalence estimate of 8.8% among the population aged 30–69), India (29 million, 5.4%), Brazil (25 million, 26%), followed by the USA (24 million, 14.5%) and Russia (20 million, 25.6%).[3] In a recent meta-analysis by Suri et al. (2023), the overall prevalence of OSA was 11%, with rates of 13% in men and 5% in women in India.[4]However, due to low awareness of OSA among the general public and health professionals, an estimated 80% to 90% of people with OSA remain undiagnosed.[5] Untreated OSA is a risk factor for all-cause mortality, and the risk appears to increase with the severity of OSA.

A study of commercial drivers estimates that between 17% and 28% of commercial motor vehicle drivers have OSA.[6] OSA is a significant concern among commercial drivers due to its potential impact on road safety. Because of the nonspecific symptoms of OSA, when left untreated, it may lead to decreased cognitive function, psychomotor impairment, a decrement in driving skills, including increased off-road deviations in driving simulators, and an increased risk of vehicular accidents. Therefore, commercial drivers with OSA are at a high risk of road accidents.

OSA causes a 2-7-fold increase in the risk of motor vehicle crashes and significantly raises the likelihood of developing hypertension, stroke, ischemic heart disease, and mood disorders if left undiagnosed and untreated.[7] Commercial drivers often work long hours due to job commitments, insufficient rest periods, shift work, and other factors, which can result in poor sleep quality. This can lead to daytime sleepiness and fatigue. Kales et al. state that excessive daytime sleepiness is the most common cause of OSA.[6] Commercial drivers are particularly susceptible to OSA since they are usually male, obese (due to sedentary lifestyles, poor eating habits, and inadequate sleep), and, when combined with excessive daytime sleepiness, may increase the risk of road traffic accidents. Several studies suggest that commercial motor vehicle (CMV) operators have a higher prevalence of OSA than the general population.[8] Furthermore, OSA is common among commercial drivers, with a prevalence in Indian males as high as 13% to 19%.[9]

METHOD- A comprehensive literature search was conducted in major academic databases, including PubMed, Scopus, DOAJ, and Google Scholar. PSQI, ESS, STOP BANG, Commercial drivers, sleep apnea, and snoring were used as keywords. A total of 110 articles were identified. Literature with only abstracts was excluded. A total of 60 articles were studied.

RESULTS AND DISCUSSION

With industrialisation, there is an exponential growth of the transport industry. Commercial drivers play a crucial role in transporting passengers and goods. They are at a high risk of OSA due to non-adherence to working hours, addiction, and improper sleep hygiene. Early detection and adherence to treatment may prevent a fatal outcome.

Classification of sleep disorders

The International Classification of Sleep Disorders (ICSD) serves as the primary reference for diagnosing sleep disorders, categorising them into seven main categories: insomnia disorders, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, sleep-related movement disorders, parasomnias, and other sleep conditions.[10] Scientific advances have enabled us to establish a clear link between the pathophysiology of obstructive sleep apnea, which involves temporary upper airway blockage leading to breathing pauses, frequent nocturnal awakenings, and a choking sensation.

Risk factors

The most common risk factors for OSA among commercial drivers and the general population are obesity, age, and male gender.[11] Additionally, alterations in craniofacial structure may contribute to the high prevalence of OSA, including variations in OSA prevalence among different ethnic groups in response to increasing adiposity.[12]

1. Obesity

OSA and obesity are closely linked and influence each other. Excess weight, particularly in the fat deposition around the upper airway, increases the likelihood of airway obstruction during sleep. Several studies have demonstrated that even a modest weight reduction of 5-10% can reduce the severity of OSA.[13] According to the American Academy of Sleep Medicine, a 10% increase in weight is associated with a sixfold increase in the risk of OSA.[14] The mechanism causing weight gain in OSA can be attributed to sleep fragmentation and daytime fatigue, which may reduce physical activity and alter appetite-regulating hormones, ultimately leading to increased caloric intake. OSA often goes unrecognised, especially in women, and shares overlapping mechanisms with obesity that increase the risk of developing comorbid chronic disorders and impair quality of life.

Obesity is the most common risk factor among commercial drivers as well as in the general population. Inadequate sleep, poor nutrition, lack of exercise, and the sedentary nature of driving all contribute to the risk of obesity. A Japanese study on 5,320 truck drivers aged 30-69 years concluded that drivers with a BMI of 25.0– 29.9 and >30.0 had an approximately 2-4-fold higher prevalence of sleep-disordered breathing (SDB) compared to those with a normal BMI.[15] Furthermore, men with a weight gain of more than 10.0 kg since the age of 20 showed approximately twice the prevalence of SDB.[16] According to Young T et al., an increase in body weight has been hypothesised to affect breathing in numerous ways that include changes in upper airway structure (e.g., altered geometry) or function (e.g., increased collapsibility), disturbance of the relationship between respiratory drive and load compensation, and by exacerbating OSA events via obesity-related reductions in functional residual capacity and increased whole-body oxygen demand. It also identified a strong relationship between the risk of OSA and a BMI greater than 26 kg/m2.[1]

2. Age

Philip et al. gathered epidemiological data through a telephonic survey of 685 people, including 329 men and 356 women, with a mean age of 50 years. They found that OSA symptoms were more common in respondents over 50. As age increases, slow-wave sleep (deep sleep), which helps prevent sleep-disordered breathing and airway collapse, decreases.[17,18]

3. Gender

Men and women are at higher risk for OSA than premenopausal women, although once women reach menopause, their risk becomes similar to that of men. The ventilatory drive in females increases due to the effects of progesterone and estrogen, thereby reducing the risk of OSA compared to men. Also, Postmenopausal women on hormone replacement therapy were found to have lower rates of OSA, suggesting that hormonal loss elevates risk.[19]Several studies indicate that most men experience OSA during sleep in the supine position more than women do in the same position. Conversely, women also tend to have more OSA during rapid eye movement (REM) sleep.[20]OSA tends to be less severe in women compared to men of similar body mass index (BMI). Symptom differences are notable: snoring and witnessed apneas are more common in men, whereas insomnia and excessive daytime sleepiness are more typical in women.

Obstructive sleep apnea and related comorbidities

OSA is associated with increased mortality and other adverse health outcomes, such as cardiovascular disease, cerebrovascular events, diabetes, and cognitive impairment if left untreated.[21] Additionally, OSA negatively impacts the quality of life and increases the risk of motor vehicle accidents. Marin et al. reported that severe OSA correlates with a higher incidence of fatal and non-fatal cardiovascular events compared to mild-moderate cases.[22] Ismail K. et al. noted that intermittent hypoxic apneas associated with OSA affect pulmonary circulation.[23] Elevated levels of circulating free fatty acids promote lipid storage by increasing adipocyte number and size, leading to pathological changes in adipose tissue through stress pathways, such as endoplasmic reticulum stress, oxidative stress, and inflammation, all of which are triggered by intermittent hypoxia and sleep fragmentation in individuals with OSA.[24] Dyslipidaemia contributes to endothelial dysfunction and atherosclerosis, raising cardiovascular morbidity and mortality. According to a recent review by Amna B et al. on the relationship between OSA and hypertension (HTN), factors involved in the pathophysiology of both conditions include hypoxemia, nocturnal fluid shift, increased sympathetic tone coupled with decreased parasympathetic tone, impaired sleep quality, and activation of the renin-angiotensin-aldosterone system. Additional factors involve peripheral vasoconstriction and altered baroreceptor reflexes.[25] Due to OSA, there is an increased risk of systemic inflammation and elevated levels of high-sensitivity C-reactive protein (hs-CRP), interleukin (IL)-1, IL-8, IL-6, tumour necrosis factor-alpha (TNF-α), Rantes, and sICAM, leading to oxidative stress similar to ischemic reperfusion injury. This results in the release of reactive oxygen species, consequently causing hypertension.[26] Nocturnal fluid shift occurs as lower limb fluid reaches the neck during sleep, exacerbating obstruction, raising blood pressure, and causing episodes of partial or complete cessation of breathing in individuals with HTN and OSA. An additional contributing factor to fluid retention is increased aldosterone levels, which further obstruct the upper airway.

Role of the autonomic nervous system

Due to episodes of apnea in OSA, there is an increase in carbon dioxide (CO_2). In contrast, a decrease in O_2 leads to the activation of the sympathetic nervous system and the deactivation of the parasympathetic nervous system, resulting in increased levels of catecholamines and, consequently, hypertension during the daytime.

Impaired sleep quality

Sleep deprivation due to sleep fragmentation in OSA leads to poor sleep quality, therefore contributing to HTN. According to various studies, there is a positive correlation between sleep deprivation and various adverse cardiovascular risk factors: arterial stiffness, endothelial dysfunction, sympathetic activity, non-dipping nocturnal BP pattern, and insulin insensitivity.[27]

Renin-angiotensin-aldosterone system

Renin-angiotensin-aldosterone is a hormonal system that regulates blood pressure, fluid, and electrolyte balance in the body. Renin is produced from the kidneys, along with enzymes that cause the conversion of angiotensinogen to angiotensin I, and then to angiotensin II (a potent vasoconstrictive peptide), causing vasoconstriction and hence increasing the BP. Hypoxia occurs due to recurrent episodes of upper airway obstruction, which causes increased renin activation. A meta-analysis of 13 studies (2016) revealed that patients with OSA have higher levels of angiotensin II and aldosterone, especially in cases with co-existing HTN.[28] Increased aldosterone levels cause oedema of nasopharyngeal tissues and upper airways, causing airway obstruction and further progression of OSA.

Screening tool

Despite being aware of the OSA risks and prevalence among commercial drivers, it remains underdiagnosed in many countries. Implementing routine screening protocols, such as the STOP-Bang questionnaire, during medical examinations can aid in early identification. The Indian Council of Medical Research (ICMR) has developed consensus guidelines that emphasise the need for increased awareness and screening for OSA, particularly among high-risk groups like commercial drivers (INOSA guidelines, 2014). However, its legal implications are still pending.[29]

STOP-Bang questionnaire

The STOP-Bang questionnaire is a simple and quick screening tool for detecting high-risk OSA subjects. It consists of four simple yes/no questions, i.e., snoring, tiredness, observed apneas, and high blood pressure, along with four additional demographic questions that include body mass index (BMI), age, neck circumference, and sex. It is extensively utilised in research to screen for Obstructive Sleep Apnea (OSA) across various populations. Due to its ease of use, it has been validated in multiple patient populations, mostly in preoperative and sleep clinic settings.

According to a study, the sensitivity for the STOP-Bang score ≥3 to predict any OSA (apnea-hypopnea index (AHI) >5), moderate-to-severe OSA (AHI >15), and severe OSA (AHI >30) was 83.9%, 92.9% and 100% respectively.[30]

In a study by Adeline Tan et al., a sample of 242 subjects was selected, and subjects were asked to complete the STOP-Bang questionnaire. A score of 3 or higher on the questionnaire indicated a high risk of OSA. Hence, they concluded that the STOP-Bang questionnaire can be used as a screening tool in the general population, given its moderate sensitivity and high negative predictive value for subjects with moderate-to-severe and severe OSA.[31]

The study by Frances Chung et al. tested the modified STOP-Bang Questionnaire to increase its specificity in identifying undiagnosed OSA. This study explores various combinations of the questionnaire's components to improve its specificity without compromising sensitivity, where a cross-sectional study involving preoperative patients who completed the STOP-Bang questionnaire and underwent polysomnography to diagnose OSA. Hence, it concludes that specific combinations within the STOP-Bang questionnaire, particularly focusing on a STOP score of ≥2 combined with male gender and elevated BMI, can substantially enhance its specificity in detecting undiagnosed OSA and thereby may reduce unnecessary referrals for sleep studies by minimising false-positive results.[32]

In another study conducted by Hideto et al., they retrospectively evaluated the correlation between the STOP-Bang score and the apnea-hypopnea index (AHI) in patients who underwent polysomnography, concluding that the STOP-Bang score correlates with AHI and helps predict OSA severity. The STOP-Bang score was significantly higher in the patients with severe OSA.[33]

In another study involving patients with cardiovascular risk factors, the STOP-Bang questionnaire showed high sensitivity (89.1% for any OSA (AHI ≥5)) but lower specificity (32.3% for any OSA (AHI ≥5)), suggesting that this tool effectively identifies individuals at risk but may also produce more false positives in this population.[34] Therefore, the high sensitivity of the STOP-Bang questionnaire makes it a valuable initial screening tool for OSA, especially in settings where undiagnosed OSA is common. However, due to its lower specificity, particularly at lower cutoff scores, positive screening results should be confirmed with definitive diagnostic procedures, such as polysomnography, to ensure an accurate diagnosis and prevent unnecessary treatments.

In a study by Pawarangkul et al., which included an Asian population, clinical features were compared between subjects with OSA-induced hypertension (42 subjects) and healthy control subjects (82 subjects) using the STOP-BANG questionnaire. The OSA-induced hypertension patients were significantly older, had a higher number of males, were more obese, and showed a higher incidence of Mallampati class 3 or higher, along with larger neck circumferences. They also had a higher incidence of torus palatinus and torus mandibularis. In statistical analysis, BMI and neck circumference were significantly associated with OSA-induced hypertension, with the best cut-off points being 24.5 kg/m2 for BMI and 36 cm for neck circumference in the Asian population.[35]

According to various studies, a STOP-Bang score of greater than 3 (i.e., ≥4) indicates a higher risk for OSA, while a score of 3 or less suggests a lower risk. [36] A score of ≥3 offers high sensitivity (approximately 83.9% for any OSA (AHI ≥5), 92.9% for moderate-to-severe OSA (AHI ≥15), and 100% for severe OSA (AHI ≥30) but moderate specificity in detecting OSA, thereby indicating a higher rate of false positives. Therefore, a STOP-Bang score of >3 (i.e., four or higher) suggests a higher probability of moderate to severe OSA, and further diagnostic evaluation, such as polysomnography, is recommended to confirm the diagnosis. Conversely, a score of ≤3 Indicates a lower risk, but it does not entirely rule out the possibility of OSA.

Epworth Sleepiness Scale (ESS)

The Epworth Sleepiness Scale (ESS) is a widely used self-assessment tool designed to measure an individual's level of daytime sleepiness, which is a common symptom of Obstructive Sleep Apnea (OSA). It was developed by Dr Murray Johns in 1991 at Epworth Hospital in Melbourne, Australia. The ESS consists of eight questions that ask respondents to rate their chances of dozing off or falling asleep in various everyday situations (e.g., watching television or sitting and talking to someone). A score greater than 10 indicates probable excessive daytime sleepiness. ESS assessment, if done accurately, can provide valuable screening information. A study on drivers in North Carolina has shown an association between ESS and an increased risk of accidents.[37] Kales et al. state that most OSA-affected commercial drivers report very low ESS scores (range 2-4).[6]

Wish Banhiran et al. aimed to evaluate the reliability and validity of the Thai-translated Epworth Sleepiness Scale (ESS) in assessing excessive daytime sleepiness among individuals with obstructive sleep-disordered breathing (OSDB). It was concluded that ESS is a reliable and valid tool for assessing daytime sleepiness in OSA patients. However, due to its weak association with OSA severity, it should be used in conjunction with comprehensive clinical evaluations.[38]

Pittsburgh Sleep Quality Index (PSQI)

The PSQI is a self-report questionnaire designed to assess sleep quality and disturbances over a one-month period. It was developed by researchers at the University of Pittsburgh, who evaluated various aspects of sleep to provide a comprehensive measure of an individual's sleep patterns. It is a brief and straightforward questionnaire that takes approximately 5–10 minutes to complete, and is widely used in both clinical and research settings to assess sleep quality in various populations, including older adults and individuals with medical or psychiatric conditions. Its comprehensive nature enables the evaluation of multiple dimensions of sleep, making it a valuable tool for identifying sleep disturbances and guiding effective interventions. It has good reliability and validity across diverse populations and has been translated into multiple languages, facilitating its use in international research and clinical practice. Its ability to differentiate between "good" and "poor" sleepers makes it a standard instrument in sleep research. In the context of OSA, the PSQI serves as a valuable tool for evaluating the impact of OSA on patients' sleep quality.[39]

OSA leads to disrupted sleep patterns and reduced sleep quality, which can be quantified using the PSQI. The PSQI evaluates various components of sleep, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction, all of which are assessed over the last month.

According to a study by Čović et al, individuals with OSA often report higher PSQI global scores, indicating poorer sleep quality compared to those without OSA.[40] This study assessed sleep quality in patients with mild and severe OSA and found that the PSQI effectively differentiated between varying degrees of sleep disturbance associated with OSA severity. While the PSQI is effective in assessing sleep quality, it is a subjective measure and may not help in evaluating all aspects of sleep disturbances caused by OSA. Therefore, it is often used along with other diagnostic tools, such as polysomnography, to provide a comprehensive evaluation of sleep disorders.

Polysomnography (PSG)

Polysomnography (PSG) is the gold standard for diagnosing OSA, providing comprehensive data on sleep stages, respiratory events, and other physiological and pathological parameters such as the apnea-hypopnea index, oxygen desaturation index, snoring, and more. Type 1 PSGs are overnight, in-laboratory, fully attended sleep studies that record physiological events using 14-16 channels and are regarded as the reference standard among PSGs. Type 2 PSG records the same information as Type 1 but lacks technician attendance and may be conducted either in a laboratory or outside of one. Despite being the gold standard, this method can encounter various errors such as artefacts, data loss, and differences in scoring events. Furthermore, different sleep laboratories utilise multiple types of monitoring equipment, which can affect the sensitivity of event detection. Commonly used montages for baseline PSG include electroencephalogram (EEG) leads, electrooculographic (EOG) leads, electromyography (EMG) leads, electrocardiogram (ECG) leads, nasal thermistors, and/or nasal cannula pressure transducers for airflow signals, respiratory inductance plethysmography to measure respiratory effort, and pulse oximeters to monitor oxygen saturation.[41] The American Association of Sleep Medicine (AASM) appointed a task force (TF) comprising content experts to develop an updated clinical practice guideline (CPG). This guideline aims to consolidate and revise earlier recommendations regarding the diagnosis of OSA, including the optimal circumstances for performing attended in-laboratory polysomnography (hereafter referred to as "polysomnography" or "PSG") or home sleep apnea testing (HSAT). They advise that clinical tools, questionnaires, and prediction algorithms should not be used to diagnose OSA in adults without conducting polysomnography or home sleep apnea testing.[42]

Diagnostic evaluation of OSA

For the diagnosis of OSA, there should be signs and symptoms or an associated medical or psychiatric condition along with five or more apnea-hypopnea events per hour of sleep in PSG. Additionally, respiratory events of 15 or more per hour of sleep, without any associated medical symptoms, satisfy the criteria, indicating that OSA can be present in subjects even without any symptoms.[42]

Commercial drivers and road traffic accidents

Commercial drivers are professional drivers who work long hours away from their homes, carrying passengers and transporting essential goods from one place to another. As industrialisation expands, the goods transport industry is growing rapidly and is projected to reach $330 billion by 2025, with a compound annual growth rate of 8%.[43] In India, over 25 million people are employed in the logistics sector, and according to a report by the non-governmental organisation (NGO) Sightsavers, around 8 million truck drivers operate on Indian roads.[44] OSA can cause excessive daytime sleepiness, fatigue, and impaired cognitive function, significantly increasing the risk of road traffic accidents. Truck drivers face numerous challenges, including inadequate sanitation, long working hours, safety issues, and poor sleep hygiene. They mainly drive at night, which disrupts their circadian rhythm, and prolonged immobility during work hours further increases the risk of obesity and hypertension, both of which are risk factors for OSA. In 2018, road traffic accidents (RTA) claimed 15 million lives in India, with 15,000 of these fatalities involving truck and lorry drivers. Lack of sleep, overwork, and overloading trucks may all contribute to fatal road accidents.

A study by American Academy of Sleep Medicine (AASM) in the Swiss population aged 40–85 years found that 83.8% of men and 60.8% of women have an AHI of >5 events per hour (at least mild OSA), and 49.7% of men and 23.4% of women have an AHI of >15 (at least moderate OSA).[45]According to The World Health Organization 2018 Global Status report on road safety reports that the number of deaths on the world's roads remains unacceptably high with an estimated 1.35 million people dying due to motor vehicle accidents every year and road traffic injuries are the eighth leading cause of death for all age groups, which is greater than those from HIV/AIDS, tuberculosis, and diarrheal diseases.[46] A systematic review by Tregear et al. found that individuals with OSA have a higher chance of being involved in MVAs compared to those without OSA. The study reported that the mean crash-rate ratio associated with OSA likely falls within the range of 1.21 to 4.89. Factors such as higher body mass index (BMI) and daytime sleepiness, lower oxygen saturation, and severity of apnea-hypopnea index were identified as predictors of crash risk in drivers with OSA.[47]

OSA among commercial drivers

A Joint Task Force was established by representatives of the American College of Occupational and Environmental Medicine, the American College of Chest Physicians, and the National Sleep Foundation in 2009 to screen and evaluate obstructive sleep apnea among commercial motor vehicle drivers, outlining six consensus criteria. Drivers fulfilling one or more of the six criteria were considered to have obstructive sleep apnea and referred for polysomnography to confirm the diagnosis.[48]

A study by Parks et al. employed the consensus criteria during commercial drivers' medical examinations (CDME), involving 456 drivers from 50 companies. Of these drivers, 17% screened positive for obstructive sleep apnoea. Among them, only 15% (n = 12) would have tested positive based solely on the CDME history question. Of those who screened positive, 68% were referred for PSG, but only 20 adhered to the referral, and all of them were confirmed to have obstructive sleep apnoea.[49] In another study by Xie et al, which evaluated 1,890 commercial drivers, 51 of them tested positive for obstructive sleep apnoea through polysomnography following initial screenings using the Joint Task Force criteria. Based on multivariate logistic regression, a BMI of 30 kg/m2 or higher, hypertension, and diabetes were independently linked with OSA.[50] In a nested control study from Egypt, 150 commercial drivers suspected of having OSA were enrolled. Sleep questionnaires (ESS, FOSQ-10, Berlin questionnaire, and STOP BANG questionnaire) were completed by all participants. The prevalence of accidents was 46.0% among the studied drivers. The prevalence of OSA was statistically significantly higher among individuals who had experienced accidents compared to those who had not.[51]

In a retrospective study by Masaka U. et al., 1309 Japanese drivers aged 40-69 years were evaluated using type IV portable sleep monitors (PMs) and the Epworth Sleepiness Scale (ESS). The variables related to AHI were analysed according to the American Academy of Sleep Medicine criteria. Questions also included whether they had gained ≥ 10 kg in weight since the age of 20 years. They concluded that the prevalence of moderate and severe OSA (AHI ≥ 15) among drivers aged 40–69 years was 23.9%. Haemoglobin A1c also had a significant association with AHI scores, which was independent of age and obesity. Although only 9.17% of drivers had ESS > 11, this was because the drivers were unable to describe sleepiness subjectively, as self-reporting can be less reliable in an occupational setting.[52]

In a study by Wahida et al, two separate analyses were conducted: a cross-sectional survey among truck drivers (130 cases) and a second study among express bus drivers (292 cases). To identify the high-risk group for OSA, the Berlin questionnaire was used. Express bus drivers were subjected to a polysomnography test; however, truck drivers were not subjected to a polysomnography. While screening the risk group of OSA among truck drivers, 14.6% (19 cases) of drivers were categorised as having a high risk of OSA, while 85.4% (111) had a low risk of OSA. While in another study, polysomnography test among express bus drivers showed that 83 (28.7%) had mild OSA, 26 (9.0%) had moderate OSA, and 19 drivers (6.6%) had severe OSA.[53]

In a study by Huhta et al, 2021, in professional truck drivers, 1095 drivers were included, where the prevalence of OSA in professional truck drivers using various criteria were AHI≥5: 40.1%, AHI≥15:16.2% and AHI ≥ 30:7.2%. The study concluded that sleep apnea is common among professional truck drivers with significant inability to stay awake.[54] In a study by Gurubhagavatula et al, 4,286 commercial drivers were randomly enrolled in a questionnaire-based study. Multivariable prediction was used, combining symptoms with BMI, rather than using BMI alone, because this approach could potentially prevent more subjects from undergoing polysomnography. The proportion of OSA in the weighted sample was 28.1% with AHI of five or more episodes per hour to define any apnea, and 4.7%, using an AHI of 30 or more episodes per hour to defines severe apnea.[55]

In a study by Otoghile et al., the risk of sleep obstructive apnea among commercial car drivers was examined, with data collected on random blood sugar, age, and blood pressure. One hundred and five male drivers participated in the study. The prevalence of sleep apnea was 15.20%, and 50.5% of the drivers were at high risk of developing sleep apnea. To identify sleep apnea, the study used predisposing factors such as the Mallampati score, neck circumference above 43.35cm, and BMI.[56] In a cross-sectional study conducted in Lusaka, Zambia, involving 130 commercial drivers to determine the prevalence of excessive daytime sleepiness and OSA among them, and to evaluate the impact of OSA on high RTA rates, the researchers employed the STOP BANG questionnaire and the Epworth Sleepiness Scale. The prevalence of high-risk OSA was 22.8%, of whom 67.7% also experienced EDS, while only 9.6% of all participants had EDS without high-risk OSA. Snoring and EDS were significantly associated with RTAs, respectively.[57]

Howard et al. compared the risk of motor vehicle crashes among drivers with OSA (symptom diagnosis) and drivers not diagnosed with OSA (controls). The author presented the odds ratio (OR) for road accidents over the past three years in drivers with OSA, adjusted for age, hours of driving, and alcohol intake. OSA among commercial drivers was identified based on a Multivariable Apnea Prediction Score (MAPS) ≥ 0.5 and an Epworth Sleepiness Scale (ESS) score ≥ 11, both of which were associated with an increased risk of motor vehicle crashes. The study's limitation was that only questionnaires were used to detect sleep apnoea, and no sleep study, which is the gold standard for OSA diagnosis, was conducted.[58]

In a community-based study by Dubey et al (2018, the risk of OSA was assessed in male permanent driving licence recipients of Lucknow, India. This cross-sectional study evaluated 542 male applicants at two Regional Transport Office centres. Demographic information, anthropometric indices, smoking history, blood pressure, and data from the STOP BANG questionnaire were collected from these 542 males. It was found that 23% of participants were at high risk for OSA. Among the assessed factors, high blood pressure (≥140/90 mm Hg) was most prevalent, affecting 40.5% of participants, followed by neck circumference greater than 40 cm (17.1%), age over 50 years (15.3%), snoring (12.3%), and feelings of tiredness or sleepiness (10.5%). Notably, the risk of OSA increased with age, and the study concluded that a significant proportion of male driving licence applicants are at risk for OSA, emphasising the need for national screening guidelines or protocols to assess OSA risk among driving licence applicants in India.[59]

In another study by Kamlesh et al, the study was conducted to estimate the risk of OSA in commercial drivers and to see their relationship with reaction times. Visual and auditory reactions were assessed. In this study, 35% of drivers were at risk of OSA. and showed reduced auditory reaction time. There was no significant correlation between OSA and collisions.[60]

CONCLUSION

In developed countries, such as the US, guidelines for OSA screening are available for commercial drivers. However, in developing countries, there are no such guidelines for OSA, and as a result, it often remains undiagnosed and untreated. OSA should be considered a serious condition that can threaten safe driving. Cost and access barriers for obtaining an OSA diagnosis and treatment must be addressed through innovative and easily accessible solutions. This can be achieved by considering various screening strategies, including wide-scale awareness among drivers, mandatory screening of prospective drivers with screening questionnaires, and polysomnography for those at risk. This will not only help in the early diagnosis of OSA among commercial drivers but also prevent possible crash-related fatalities and injuries.

Perspective for further research –

A multicenter cohort study should be done to ascertain the prevalence of OSA among commercial drivers using polysomnography.

Contributions of authors :

Development of the concept and design of the study: Madhu Bala Bhardwaj, Hrudananda Mallick, Nimarpreet Kaur, Mohit Agarwal

Data collection, analysis and interpretation: Madhu Bala Bhardwaj, Hrudananda Mallick, Nimarpreet Kaur, Mohit Agarwal

Preparation and editing of the text: Hrudananda Mallick, Nimarpreet Kaur, Mohit Agarwal

Statistical analysis:

Ethical standards - human research has been conducted in accordance with the ethical standards set out in the Declaration of Helsinki of the World Medical Association "Ethical Principles of Medical Research with Human Participation" revised in 2013.

Funding: Nil

Author contributions: The authors made an equivalent contribution to the publication.

Conflict of interest statement: The authors declare no conflict of interest

Ethics approval— Not needed

Acknowledgements— None

Consent for publication— All the authors have consented

Artificial intelligence - No artificial intelligence software was used

REFERENCE

1. Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. Am J Respir Crit Care Med. 2002;165(9):1217-1239.
2. Berger M, Varvarigou V, Rielly A et al. Employer-mandated sleep apnea screening and diagnosis in commercial drivers. J Occup Environ Med. 2012;54(8):1017-1025. doi:10.1097/JOM.0b013e3182572e16.
3. Benjafield AV, Ayas NT, Eastwood PR et al. Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis. Lancet Respir Med. 2019;7(8):687-698. doi:10.1016/S2213-2600(19)30198-5
4. Suri TM, Ghosh T, Mittal S et al. Systematic review and meta-analysis of the prevalence of obstructive sleep apnea in Indian adults. Sleep Med Rev. 2023;71:101829. doi:10.1016/j.smrv.2023.101829
5. Singh M, Liao P, Kobah S. et al.Proportion of surgical patients with undiagnosed obstructive sleep apnoea. Br J Anaesth. 2013 ;110(4):629-36. doi: 10.1093/bja/aes465.
6. Kales SN, Straubel MG. Obstructive sleep apnea in North American commercial drivers. Ind Health. 2014;52(1):13-24. doi: 10.2486/indhealth.2013-0206.

7. Bonsignore MR, Lombardi C, Lombardo S, Fanfulla F. Epidemiology, Physiology and Clinical Approach to Sleepiness at the Wheel in OSA Patients: A Narrative Review. J Clin Med. 2022 Jun 27;11(13):3691. doi: 10.3390/jcm11133691.
8. Schiza SE, Bouloukaki I.Screening for obstructive sleep apnoea in professional drivers. Breathe(Sheff).2020;16(1):29364. doi: 10.1183/20734735.0364-2019.
9. Suri TM, Ghosh T, Mittal S et al.Systematic review and meta-analysis of the prevalence of obstructive sleep apnea in Indian adults. Sleep Med Rev. 2023;71:101829. doi: 10.1016/j.smrv.2023.101829.
10. Michael JS. International Classification of Sleep Disorders-Third edition. Chest. 2014 Nov. doi: https: //doi.org/10.1378/ chest.14-0970.
11. Slowik JM, Sankari A, Collen JF. Obstructive Sleep Apnea. [Updated 2025 Mar 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459252/
12. Sharma SK, Kumpawat S, Banga A, Goel A. Prevalence and risk factors of obstructive sleep apnea syndrome in a population of Delhi, India. Chest. 2006;130(1):149-156. doi:10.1378/chest.130.1.149
13. Coaker MA, Hudgel DW, Patel SR.American Thoracic Society Patient Education Information Series.Am J Respir Crit Care Med. 2020;201:P5-P6.
14. Peppard PE, Young T, Palta M et al.Longitudinal study of moderate weight change and sleep-disordered breathing. JAMA. 2000;284(23):3015–3021. doi: 10.1001/jama.284.23.3015.
15. Cui R, Tanigawa T, Nakano H et al.Associations between weight change since 20 years of age and sleep-disordered breathing among male truck drivers. Int J Obes (Lond).2009;33(12):1396-401. doi: 10.1038/ijo.2009.192.
16. Leinum CJ, Dopp JM, Morgan BJ. Sleep-disordered breathing and obesity: pathophysiology, complications, and treatment. Nutr Clin Pract. 2009;24(6):675-87. doi: 10.1177/0884533609351532.
17. Phillips B, Cook Y, Schmitt F, Berry D. Sleep apnea: prevalence of risk factors in a general population. Southern Medical Journal. 1989 Sep;82(9):1090-1092.
18. Chinoy ED, Frey DJ, Kaslovsky DN et al.Age-related changes in slow wave activity rise time and NREM sleep EEG with and without zolpidem in healthy young and older adults. Sleep Med. 2014;15(9):1037-45. doi: 10.1016/j.sleep.2014.05.007.
19. D'Ambrosio C, Stachenfeld NS, Pisani M, Mohsenin V. Sleep, breathing, and menopause: the effect of fluctuating estrogen and progesterone on sleep and breathing in women. Gend Med. 2005 Dec;2(4):238-45. doi: 10.1016/s1550-8579(05)80053-1.
20. O'Connor C, Thornley KS, Hanly PJ. Gender differences in the polysomnographic features of obstructive sleep apnea. Am J Respir Crit Care Med. 2000 May;161(5):1465-72. doi: 10.1164/ajrccm.161.5.9904121.
21. Knauert M, Naik S, Gillespie MB, Kryger M. Clinical consequences and economic costs of untreated obstructive sleep apnea syndrome. World J Otorhinolaryngol Head Neck Surg. 2015;1(1):17-27. doi: 10.1016/j.wjorl.2015.08.001.
22. Marin JM, Carrizo SJ, Vicente E, Agusti AG. Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study. Lancet. 2005;365(9464):1046-53. doi: 10.1016/S0140-6736(05)71141-7.

23. Ismail K, Roberts K, Manning P et al.OSA and pulmonary hypertension: time for a new look. Chest. 2015;147(3):847-861. doi: 10.1378/chest.14-0614.
24. Ran L, Wei C, Wang X et al.SPHK2 inhibition alleviates chronic intermittent hypoxia-induced inflammation in adipose tissue by decreasing endoplasmic reticulum stress. Eur J Pharmacol. 2025;1002:177841. doi: 10.1016/j.ejphar.2025.177841.
25. Bangash A, Wajid F, Poolacherla R et al.Obstructive Sleep Apnea and Hypertension: A Review of the Relationship and Pathogenic Association. Cureus. 2020 May 22;12(5):e8241. doi: 10.7759/cureus.8241.
26. Zhao X, Niu Y, Zhao XL et al. Associations Between Serum TNF-α, IL-6, hs-CRP and GLMD in Obese Children and Adolescents: A Cross-Sectional Study. Diabetes Metab Syndr Obes. 2023 Dec 2;16:3915-3923. doi: 10.2147/DMSO.S434482.
27. Evbayekha EO, Aiwuyo HO, Dilibe A et al.Sleep Deprivation Is Associated With Increased Risk for Hypertensive Heart Disease: A Nationwide Population-Based Cohort Study. Cureus. 2022 Dec 27;14(12):e33005. doi: 10.7759/cureus.33005.
28. Patel AR, Patel AR, Singh S et al.The Association of Obstructive Sleep Apnea and Hypertension. Cureus. 2019;11(6):e4858. doi: 10.7759/cureus.4858.
29. Sharma SK, Katoch VM, Mohan A et al.Indian Initiative on Obstructive Sleep Apnoea (INOSA) Guidelines Working Group. Consensus & evidence-based INOSA Guidelines 2014 (first edition). Indian J Med Res. 2014 Sep;140(3):451-68.
30. Singh M, Gavidia R, Dunietz GL et al.Validation of an obstructive sleep apnea symptom inventory in persons with multiple sclerosis. Mult Scler. 2022;28(2):280-288. doi: 10.1177/13524585211013014.
31. Tan A, Yin JD, Tan LW et al.Using the Berlin questionnaire to predict obstructive sleep apnea in the general population. J Clin Sleep Med. 2017;13(3):427–432.
32. Chung F, Yang Y, Brown R, Liao P. Alternative scoring models of STOP-Bang questionnaire improve specificity to detect undiagnosed obstructive sleep apnea. J Clin Sleep Med 2014;10(9):951-958.
33. Oshita H, Ito N, Senoo M et al. The STOP BANG test is useful for predicting the severity of obstructive sleep apnea. JMA J.2020;3(4):347-352.
34. Chung F, Subramanyam R, Liao P et al.High STOP-Bang score indicates a high probability of obstructive sleep apnoea. Br J Anaesth. 2012 May;108(5):768-75. doi: 10.1093/bja/aes022.
35. Pavarangkul T, Jungtrakul T, Chaobangprom P et al.The Stop-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea-Induced Hypertension in Asian Population. Neurol Int. 2016 Apr 1;8(1):6104. doi: 10.4081/ni.2016.6104.
36. Kang J, Koo HK, Kang HK et al.Prevalence of high-risk group for obstructive sleep apnea using the STOP-Bang questionnaire and its association with cardiovascular morbidity. Front Neurol. 2024;15:1394345. doi: 10.3389/fneur.2024.1394345.
37. Stutts JC, Wilkins JW, Scott OJ, Vaughn BV. Driver risk factors for sleep-related crashes. Accid Anal Prev. 2003;35(3):321-31. doi: 10.1016/s0001-4575(02)00007-6.

38. Banhiran W, Assanasen P, Nopmaneejumruslers C et al.Epworth sleepiness scale in obstructive sleep disordered breathing: the reliability and validity of the Thai version. Sleep Breath. 2011;15(3):571-7. doi: 10.1007/s11325-010-0405-9.
39. Zhong QY, Gelaye B, Sánchez SE, Williams MA. Psychometric Properties of the Pittsburgh Sleep Quality Index (PSQI) in a Cohort of Peruvian Pregnant Women. J Clin Sleep Med. 2015 Aug 15;11(8):869-77. doi: 10.5664/jcsm.4936.
40. Čović F, Leventić M, Lesko J. The quality of sleep estimated by the Pittsburgh Sleep Quality Index in patients with mild and severe obstructive sleep apnea. ABCR [Internet]. 2023 Jul. 9 [cited 2025 Jul. 15];2(1):8-13. Available from: https://abcr-mefmo.org/index.php/abcr/article/view/20.
41. Rundo JV, Downey R 3rd. Polysomnography. Handb Clin Neurol. 2019;160:381-392. doi: 10.1016/B978-0-444-64032-1.00025-4.
42. Morgenthaler TI, Deriy L, Heald JL, Thomas SM. The Evolution of the AASM Clinical Practice Guidelines: Another Step Forward. J Clin Sleep Med. 2016 ;12(1):129-35. doi: 10.5664/jcsm.5412
43. Gupta D, Dhar S.Exploring the freight transportation transitions for mitigation and development pathways of India," Transport Policy.Elsevier. 2022;129(C);156-175.
44. Government of India. Ministry of road transport and highways. Road accidents in India, 2018. Available from morth.nic.in/sites/default/files/Road_Accidednt.pdf
45. Ruehland WR,Rochford PD,O'Donoghue FJ et al.The New Aasm Criteria for Scoring Hypopneas: Impact on the Apnea Hypopnea Index. Sleep.2009;32(2):150–157, https://doi.org/10.5665/sleep/32.2.150.
46. World Health Organisation. The Global Health Observatory. Road traffic mortality. Available from https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/road-traffic-mortality.
47. Tregear S, Reston J, Schoelles K, Phillips B. Obstructive sleep apnea and risk of motor vehicle crash: systematic review and meta-analysis. J Clin Sleep Med. 2009;5(6):573-81.
48. Schiza SE, Bouloukaki I. Screening of obstructive apnea in sleep apnea in professional drivers.Breathe 2020 16(1): 29364; DOI: https://doi.org/10.1183/20734735.0364-2019.
49. Parks PD,Gerardo D,Antonios JT et al.Screening for Obstructive Sleep Apnea During Commercial Driver Medical Examinations. J Occu Environ Med.2009; 51(3): 275-282. DOI: 10.1097/JOM.0b013e31819eaaa4.
50. Xie W, Chakrabarty S, Levine R et al.Factors associated with obstructive sleep apnea among commercial motor vehicle drivers. J Occup Environ Med. 2011;53(2):169-73. doi: 10.1097/JOM.0b013e3182068ceb.
51. El-Morsy N, El-Hadidy S , El-Gilany A.Accidents related to obstructive sleep apnea among commercial drivers: a clinic-based study. Egyptian Journal of Occupational Medicine. 2019; 43 (2) : 283-296.
52. Masako U,Hiroyuki K,Oikawa H et al.Investigation of Obstructive Sleep Apnea Using Portable Monitors and Health Check Data in Japanese Drivers. J Atheroscler Thromb. 2018:25(11):1118-1127.
53. Wahida, A. Ilhamah O. Suffian A et al.Obstructive sleep apnea among commercial vehicle drivers in Malaysia: Issues and initiatives. Health. 2013;5:80-86. doi: 10.4236/health.2013.58A2012.
54. Huhta R,Hirvonen K,Partinen M.Prevalence of sleep apnea and daytime sleepiness in professional truck drivers.Sleep Medicine.2021;81:136-143. https://doi.org/10.1016/j.sleep.2021.02.023.
55. Gurubhagavatula I, Maislin G, Nkwuo JE, Pack AI. Occupational screening for obstructive sleep apnea in commercial drivers. Am J Respir Crit Care Med. 2004;170(4):371-6. doi: 10.1164/rccm.200307-968OC.
56. Otoghile B, Amusa YB, Lasisi AO et al. Risk of Obstructive sleep apnea among commercial car drivers in a Nigerian City.Nig Del Med J. 2018; 2(2): 42-8.
57. Simpamba K, May JL, Waghat A et al.Obstructive sleep apnea and excessive daytime sleepiness among commercial motor vehicle drivers in Lusaka, Zambia. J Clin Sleep Med. 2023;19(7):1191-1198. doi: 10.5664/jcsm.10538.
58. Howard ME, Desai AV, Grunstein RR, et al. Sleepiness, sleep-disordered breathing, and accident risk factors in commercial vehicle drivers. Am J Respir Crit Care Med. 2004;170:1014–21.
59. Dubey A, Bajaj DK, Mishra A et al.Obstructive sleep apnea risk for driving license applicants in India - A community based study. Int J Occup Med Environ Health. 2018 Jan 1;31(1):25-36. doi: 10.13075/ijomeh.1896.01021.
60. Kamlesh R, Krishnakumar M, Mathangi DC. Obstrructive sleep apnea and reaction time in commercial vehicle drivers-an explorary study. J Trans Health. 2021;20: 101028.