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Obstructive Sleep Apnea and Excessive Daytime Sleepiness Among Long-Distance Bus Drivers in Iloilo Province: A Cross Sectional Study

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ABSTRACT

Objective: To determine the prevalence of risks for obstructive sleep apnea among professional long-distance bus drivers in Iloilo City and their correlation with excessive daytime sleepiness.

Methods:

Design: Cross-sectional study

Setting: Commercial bus company in Iloilo City, January to August 2022

Participants: Two hundred forty-eight (248) male professional long-distance bus drivers completed validated Filipino versions of the Berlin Questionnaire, STOP-BANG Questionnaire and Epworth Sleepiness Scale (ESS). Demographic data, clinical profiles, and anthropometric measurements were analyzed to identify factors significantly associated with the risk of obstructive sleep apnea (OSA) and excessive daytime sleepiness (EDS).

Results: Median participant age was 44 years with 78.2% classified as overweight or obese. Majority were smokers, alcoholic beverage drinkers, had large tongues, modified Mallampati grades 3-4, and tonsil grades of 2. OSA risk prevalence varied by screening tool: the Berlin Scale identified 35.9% high-risk while STOP-BANG identified 56.0% and the ESS identified 95.6%. EDS affected 95.6% of drivers with 35.5% experiencing severe sleepiness. Weak positive correlations existed between OSA risk and EDS (Berlin vs ESS: r=0.373, p<.001; STOP-BANG vs ESS: r=0.399, p<.001). Risk of OSA (based on Berlin scale) was significantly associated with obesity (63.2% vs 27.1% overweight, p<.001) and hypertension (69.1% vs 27.7% without comorbidities, p<.001). Risk of OSA (based on STOP-BANG Scale) was significantly associated with older age (76.1% in 50-59 years vs 51.6% in 40-49 years, p=.019) and macroglossia (65.1% vs 41.1% normal tongue, p<.001). All anthropometric measurements showed significant positive correlations using both OSA screening tools.

Conclusion: Professional bus drivers in Iloilo province demonstrate a high prevalence of OSA risk and near-universal EDS, with specific anthropometric and comorbidity patterns identifying highest-risk individuals. These findings support mandatory OSA screening in commercial driver licensing using validated tools and population-specific thresholds.

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Obstructive sleep apnea (OSA) is a common disorder involving upper airway obstruction during sleep, resulting in frequent arousals and oxyhemoglobin desaturation.[1] This condition frequently manifests as excessive daytime sleepiness (EDS), creating significant safety concerns for commercial drivers due to increased risk of vehicular accidents.[2,3] Population-based studies report OSA prevalence of 22% in males and 17% in females, with OSA-associated EDS affecting 6% of males and 4% of females globally.[4]

Commercial bus drivers represent a particularly vulnerable population given their occupational demands involving long hours of operation and responsibility for passenger safety. Findley *et al.* established the critical link between OSA and automobile accidents, demonstrating that untreated OSA patients have significantly higher crash rates.[2] International studies estimate that one in four commercial drivers have OSA,[5] with STOP-BANG screening often revealing considerable risk in this population.[6] Recent research from Ecuador reflects similar findings, highlighting a high prevalence of OSA risk among South American bus drivers.[7] The occupational hazards extend beyond individual drivers to passengers, pedestrians, and other road users, making this a critical public health concern.

In the Philippines, limited research exists on OSA among commercial drivers. A single study by Albay *et al.* reported OSA prevalence of 86%, EDS at 53%, and combined OSA and EDS at 46% among long-distance drivers, which are significantly higher than general population rates.[8] However, this study was conducted nearly a decade ago, and additional validation using standardized screening tools is needed to establish current baseline data for policy development.

Despite OSA being a preventable and treatable condition, screening protocols are notably absent from current driver licensing and renewal procedures in the Philippines. Effective policy frameworks for OSA screening in commercial drivers have been developed in other countries,[9] but implementation remains limited in developing nations. With over 200 bus operators and approximately 26,000 commercial buses operating nationwide, many on long-distance and inter-island routes, systematic screening has become a public health imperative.

We investigate the prevalence of risks for OSA and their correlation with EDS among professional long-distance drivers of a commercial bus company based in Iloilo City to provide a comprehensive understanding of sleep-related health risks in this occupational group.

METHODS

With Western Visayas Medical Center Research Ethics Review Committee approval (WVMC-RERC-2021-14), this cross-sectional study was conducted at the CERES bus liner of Vallacar Transit, Inc., located in Dungon B, Jaro, Iloilo City, Philippines. This major private transportation company operates throughout Panay Island with long-distance routes exceeding 100 km from base terminals. Data collection was performed at the company's main terminal facility from January 1 to August 31, 2022.

Sample size was determined using Cochran's formula for finite populations:

$$n = [z^2p(1-p)/e^2] / [1 + [z^2p(1-p)/e^2N]]$$

Where z = 1.96 (95% confidence interval), p = 0.50 (response distribution), e = 0.05 (margin of error), and N = 590 (total bus drivers employed by CERES in 2019). The calculated minimum sample size was 233 participants.

Considered for inclusion were professional driver's license holders aged 18 years and above, with a minimum of six months driving experience with the company, who were assigned to routes greater than 100 km from the base terminal, who voluntarily agreed to participate in the study by granting informed written consent.

Exclusion criteria included gross craniofacial deformities affecting upper airway assessment, visual impairments preventing questionnaire completion, nasal deformities, masses, or polyps, laryngeal masses or current pulmonary conditions, known sleep pathology other than OSA, mental health conditions affecting questionnaire validity, current use of medications causing sleep disturbance, and previously diagnosed OSA with ongoing or completed therapy.

Following IRB approval, institutional permission to conduct the study was obtained from officials of CERES Bus Liner. An orientation session was conducted with the bus drivers using a recruitment speech to explain the study purpose, procedures, voluntary participation, and employment protection regardless of participation decision.

A complete list of bus drivers employed by CERES Bus Liner was obtained from company records. Drivers who met the inclusion criteria and expressed willingness to participate had their names included in the sampling frame. Potential participants underwent the informed consent process with adequate time provided for questions before signing consent forms. Simple random sampling was performed using computer-generated random numbers to select participants. A total of 250 drivers were initially enrolled, exceeding the calculated minimum sample size by 7.3% to account for potential data incompleteness and enhance statistical power.

Each participant answered a questionnaire regarding their clinical and demographic profile, along with validated Filipino versions of standardized questionnaires (Epworth Sleepiness Scale, Berlin, STOP-BANG) with researcher assistance as needed. The demographic and clinical profile questionnaire collected comprehensive data including age, sex, education, years of driving experience, total distance driven per week, family history of OSA, smoking status, and alcohol consumption patterns. The Filipino version Berlin questionnaire was a 10-item validated tool assessing snoring patterns, daytime sleepiness, and BMI/hypertension history. High OSA risk was defined as positive responses in ≥2 of 3 categories.[10] The Filipino version STOP-BANG Questionnaire was an eight-item screening tool evaluating snoring, tiredness, observed apnea, high blood pressure, BMI >35 kg/m^2, age >50 years, neck circumference >40 cm, and male gender. High OSA risk was defined as ≥3 positive responses.[10] The Filipino Epworth Sleepiness Scale (ESS) was an eight-scenario questionnaire measuring propensity to doze in daily situations. Scores >10 indicated excessive daytime sleepiness, with severity classification: normal (0-10), mild (11-12), moderate (13-15), severe (16-24).[10]

Standardized physical examinations were performed by the principal investigator, focusing on upper airway anatomy. Of the 250 initial participants, two were excluded – one due to bilateral nasal polyps and another one taking medications causing sleep disturbance. Height was measured with participants shoeless, recorded to the nearest 0.1 cm using a tape measure (Medida, Philippines) affixed to a wall. Weight was measured with participants in light clothing, recorded to the nearest 0.1 kg, using a portable weighing scale (Panasonic EW-FA13-W, Japan). Body Mass Index was calculated as weight (kg)/height (m)^2 while neck circumference was measured at cricothyroid membrane level using flexible measuring tape (Medida, Philippines), recorded to the nearest 0.1 cm. Waist circumference was measured at umbilical level during normal expiration, recorded to nearest 0.1 cm using the same flexible measuring tape, that was also used to measure hip circumference at maximum protrusion of the buttocks, recorded to nearest 0.1 cm. The waist-hip ratio was calculated as waist circumference/hip circumference. Modified Mallampati classification was assessed with mouth maximally open, tongue protruded, without phonation and graded 1-4 based on visible structures (Class 1: complete uvula/pillars visible; Class 4: only hard palate visible). Friedman tonsil grading was evaluated based on tonsil size relative to the oropharyngeal space (Grade 0: absent; Grade 4: touching midline) without gagging. Tongue size assessment was a subjective clinical evaluation for macroglossia relative to oral cavity size.

Data Analysis

The data gathered from the data collection tool and validated questionnaires, as well as results of the physical examination was encoded in Microsoft Excel for Mac version 16.98 (Microsoft Corp., Redmond WA, USA) and analyzed using SPSS version 20 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to characterize the study population. Categorical variables (age groups, education level, BMI categories, smoking status, comorbidity types, tongue size, palate grade, tonsil grade) were presented as frequencies and percentages. Continuous variables were assessed for normality and expressed as means ± standard deviations for normally distributed data (BMI, anthropometric measurements, ESS scores) or medians with ranges for non-normally distributed data (age, years of driving experience). The Pearson correlation coefficient (r) was used to determine linear relationships between OSA risk scores, EDS scores, and anthropometric measurements. Chi-square tests and Fisher exact tests were employed to assess associations between categorical variables and OSA risk or EDS status. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 250 male professional long-distance bus drivers initially participated in this cross-sectional study. Two participants were excluded based on the exclusion criteria, leaving 248 participants completing the study. The median age was 44 years (range 24-59, IQR: 37-48), with 49.2% (122) aged 40-49 years. Educational attainment was predominantly high school level with 48.4% (120) graduates, while 9.7% (24) completed college degrees. Driving experience varied widely: 26.6% (66) had 3-4 years' experience, while 21.0% (52) had >10 years, with a median of 6 years. Overall, 60.1% (149) had ≥5 years of professional driving experience. All participants operated routes exceeding 150 km weekly.

Clinical and Anthropometric Profiles

The mean BMI of participants was 25.7±3.5 kg/m^2, with 78.2% (194) classified as overweight (47.6%; 118) or obese (30.6%; 76). Comorbidities affected 107 (43.1%) of drivers: hypertension alone (22.2%; 55), diabetes mellitus alone (3.2%; 8), and combined hypertension-diabetes (17.7%; 44).

Lifestyle factors showed high prevalence of risky behaviors: current smoking in 73.8% (183) and alcohol consumption in 84.3% (209), with patterns ranging from occasional binge drinking (31.5%; 78) to frequent binge drinking (50.8%; 126) and heavy drinking (2%; 5).

Upper airway examination revealed high-risk anatomical features: macroglossia in 61.3% (152), Modified Mallampati Grades 3-4 in 62.9% (156), indicating compromised airways. Friedman tonsil grading was predominantly Grade 2 (60.9%; 151) with Grade 3 in 12.1% (30).

Anthropometric measurements approached or exceeded established OSA risk thresholds: mean neck circumference 38.9±3.0 cm with 41.9% (104) exceeding 40 cm cutoff, mean waist circumference 92.4±8.6 cm with 44.4% (110) exceeding 94 cm, and mean waist-hip ratio 0.94±0.05 with 73.8% (183) exceeding 0.90 risk threshold.

OSA risk prevalence varied substantially between screening tools, while EDS prevalence was consistently high across the study population. *(Table 1)* The EDS Severity Distribution follow: normal range (ESS 0-10), 23 (9.3%); mild sleepiness (ESS 11-12), 68 (27.4%); moderate sleepiness (ESS 13-15), 69 (27.8%); and severe sleepiness (ESS 16-24), 88 (35.5%).

The mean ESS score was 16.2±4.3 indicating widespread excessive daytime sleepiness.

Correlations Between OSA Risk and EDS

Significant weak positive correlations were observed between OSA risk assessments and EDS: Berlin Scale vs ESS ($r=0.373$, $R^2=0.14$, $p<.001$) and STOP-BANG vs ESS ($r=0.399$, $R^2=0.16$, $p<.001$), indicating that approximately 14-16% of EDS variability could be explained by OSA risk scores.

Risk Factor Associations

Berlin Scale Associations

Berlin Scale high-risk classification was significantly associated with BMI categories (p<.001), showing a clear gradient: 63.2% of obese drivers were high-risk compared to 27.1% overweight, 16.3% of normal weight, and 20.0% of underweight drivers. The presence of comorbidity doubled the risk (46.7% vs 27.7%, p=.002), with hypertension showing the strongest association – 69.1% of hypertensive-only drivers were high-risk compared to 27.7% without comorbidities (p<.001).

Non-significant associations included age (p=.086), educational attainment (p=.271), years of driving experience (p=.208), smoking status (p=.159), alcohol consumption (p=.591), tongue size (p=.145), palate grade (p=.677), and tonsil grade (p=.623).

STOP-BANG Scale Associations

STOP-BANG high-risk classification showed significant age-related patterns (p=.019): 76.1% of drivers aged 50-59 were high-risk vs 51.6% aged 40-49, 51.4% aged 30-39, and 50.0% aged 18-29. Driving experience demonstrated a non-linear association (p=.025), with highest risk among those with 7-8 years (69.7%) and >10 years (71.2%) experience.

Hypertension alone showed the strongest association (83.6% high-risk, p<.001) while diabetes alone or combined with hypertension showed lower risk profiles. Tongue size was significantly associated (p<.001): 65.1% with large tongues were high-risk vs 41.1% with normal tongue size.

Non-significant factors included educational attainment (p=.488), BMI categories (p=.192), smoking status (p=.648), overall comorbidity status (p=.194), alcohol consumption (p=.527), palate grade (p=.539), and tonsil grade (p=.254).

ESS Associations

Notably, ESS showed no significant associations with any categorical clinical-demographic variables: age (p=.466), education (p=.790), driving experience (p=.234), BMI categories (p=.345), smoking status (p=.485), comorbidity status (p=1.000), type of comorbidity (p=.547), alcohol consumption (p=.160), tongue size (p=1.000), palate grade (p=.164), or tonsil grade (p=.821).

Anthropometric Correlations

All anthropometric measurements showed significant positive correlations with both OSA screening tools, with the Berlin Scale showing slightly stronger associations than STOP-BANG. ESS correlated significantly with neck, waist, and hip circumferences but not waist-hip ratio. *(Table 2)*

Table 1. Prevalence of OSA Risk and Excessive Daytime Sleepiness Among Professional Bus Drivers (N=248)

Assessment Tool	Low Risk n (%)	High Risk n (%)
Berlin Scale	159 (64.1)	89 (35.9)
STOP-BANG Scale	109 (44.0)	139 (56.0)
Epworth Sleepiness Scale	11 (4.4)	237 (95.6)

Table 2. Anthropometric Correlations with OSA Risk and EDS

Assessment Tool	Berlin Scale	STOP-BANG Scale	ESS
	r (p-value)	r (p-value)	r (p-value)
Neck circumference	0.329 (<.001)	0.274 (<.001)	0.190 (.003)
Waist circumference	0.342 (<.001)	0.244 (<.001)	0.156 (.014)
Hip circumference	0.312 (<.001)	0.214 (<.001)	0.133 (.036)
Waist-hip ratio	0.216 (.001)	0.166 (.009)	0.104 (.102)*

*Not statistically significant based on Pearson r

DISCUSSION

This cross-sectional study of 248 professional bus drivers reveals concerning prevalence rates of OSA risk (35.9-56.0%) and excessive daytime sleepiness (95.6%) in Iloilo Province, establishing critical baseline data for occupational health policy development. The near-universal presence of EDS, with 35.5% experiencing severe sleepiness (ESS 16-24), represents a significant public safety concern consistent with foundational research linking untreated OSA to a 2-7 fold increase in vehicular accident risk.[2]

Our OSA risk prevalence aligns with international commercial driver studies, supporting global patterns of elevated risk in this occupational group. Felix *et al.* recently reported comparable high-risk prevalence among Ecuadorian bus drivers using STOP-BANG,[7] while systematic reviews demonstrate OSA rates of 28-36% among commercial drivers worldwide, substantially exceeding general population prevalence of 22% in males.[4] However, our EDS prevalence (95.6%) markedly surpasses international reports (typically 20-40%), suggesting either heightened occupational stressors in the Philippine transport sector or potential cultural differences in ESS interpretation requiring validation studies.

The discrepancy with previous Philippine data warrants careful consideration. Albay *et al.* reported 86% OSA prevalence using different criteria nearly a decade ago,[8] while our study found 35.9% (Berlin) to 56.0% (STOP-BANG) high-risk prevalence. This apparent decrease may reflect methodological differences rather than true prevalence reduction, as our screening tools employed validated cutoffs while their study used modified criteria. The persistence of high prevalence across both studies, however, underscores ongoing systemic challenges in occupational health management.

Our study identifies critical anthropometric thresholds for OSA risk in Filipino bus drivers: BMI >27.5 kg/m^2, neck circumference >40 cm, and waist-hip ratio >0.90. These findings support international literature demonstrating obesity as a major OSA contributor[11,12] while providing population-specific cutoff values. The mean BMI (25.68 kg/m^2) approaches Asian obesity thresholds, with 78.2% classified as overweight or obese, reflecting broader obesity trends among transportation workers documented in multiple countries.[13,14]

Neck circumference emerged as a particularly strong OSA predictor (r=0.329-0.342, p<.001), consistent with studies identifying it as an independent risk factor with metabolic syndrome associations.[15] The 41.9% of drivers exceeding 40 cm neck circumference thresholds substantially surpasses rates reported in other commercial driver populations,[16] potentially reflecting dietary patterns, genetic factors, or measurement technique variations. These findings align with mechanistic studies demonstrating upper airway fat deposition's role in OSA pathogenesis.[15]

The discordance between the Berlin Scale (35.9% high risk) and STOP-BANG (56.0% high risk) reflects known differences in tool sensitivity and specificity documented in meta-analysis evidence.[17] The STOP-BANG's higher sensitivity for detecting potential OSA cases supports its utility for initial screening in occupational settings, particularly given its validation in commercial driver populations.[6] The Berlin Scale's lower false-positive rate may be preferable for definitive assessment, consistent with comparative studies across different populations.[18]

The weak correlations between OSA screening tools and EDS (r=0.373-0.399) align with previous studies showing limited predictive value of sleepiness scales for OSA diagnosis.[19,20] This finding emphasizes that EDS and OSA, while related, represent distinct clinical entities requiring separate assessment in commercial driver screening protocols.

The association between extended driving experience (>10 years) and elevated OSA risk (71.2% high-risk, p=.025) reveals concerning occupational health trajectories. This relationship likely reflects cumulative effects of sedentary work, irregular schedules, limited healthy food access during routes, and stress-related behaviors. The high prevalence of modifiable risk factors—smoking (73.8%), alcohol consumption (84.3%), and obesity (78.2%) indicates substantial intervention potential through workplace wellness programs. These findings mirror health trends observed in commercial driver populations worldwide[14,16]

Hypertension's strong association with OSA risk, particularly using STOP-BANG (83.6% of hypertensive drivers high-risk, p<.001), has immediate clinical relevance. Given established bidirectional relationships between OSA and cardiovascular disease,[19,20] hypertensive drivers represent a priority screening population where OSA treatment could provide cardiovascular benefits while enhancing driving safety.

Our findings support mandatory OSA screening during commercial driver medical examinations, especially for those with anthropometric risk factors identified in this study. International policy frameworks[9] advocate for targeted screening using validated tools among drivers with BMI >27.5 kg/m^2, neck circumference >40 cm, or relevant comorbidities, aligning with our population-specific thresholds.

The high EDS prevalence necessitates immediate attention to driver fatigue management, including regulated driving hours, mandatory rest periods, and fatigue awareness training. Bus companies should

implement wellness programs targeting modifiable risk factors, particularly obesity, smoking cessation, and alcohol reduction, as demonstrated effective in other transportation worker populations.[13]

Healthcare providers in occupational medicine should utilize the anthropometric thresholds identified in this study for risk stratification and referral decisions. The weak correlation between OSA screening and sleepiness measures emphasizes the need for comprehensive assessment rather than relying on single screening tools, consistent with meta-analysis evidence.[18]

Several limitations merit consideration. The cross-sectional design precludes causal inferences about OSA development. The study's restriction to a single bus company may limit generalizability across diverse transportation operators. Additionally, questionnaire-based screening, while validated through meta-analysis,[18] cannot definitively diagnose OSA without polysomnography confirmation.

The exclusively male sample reflects industry demographics but limits applicability to female commercial drivers. Cultural factors influencing questionnaire responses and sleep hygiene practices may affect comparative interpretations with international studies. However, the consistency with other developing country findings[12,14] supports the broader applicability of our results. The implementation of systematic screening programs, coupled with workplace interventions targeting modifiable risk factors, represents a critical opportunity to enhance road safety while improving driver health outcomes. Future research may explore the correlation of prevalence of risk of OSA and EDS with the number of accidents in Iloilo Province or in the locality where the study shall be conducted.

In conclusion, our study revealed that professional bus drivers in Iloilo Province demonstrate high prevalence of OSA risk and near-universal excessive daytime sleepiness, with specific anthropometric and comorbidity patterns identifying highest-risk individuals. Our findings provide essential evidence supporting mandatory OSA screening in commercial driver licensing, using validated tools and population-specific thresholds.

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