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Original Article

Sleep Disordered Breathing in Professional Drivers in Damietta Governorate

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ABSTRACT

Background: The term of "sleep-related breathing disorders" describes a collection of different conditions, where there was an aberration of the respiratory function partially or completely. The aim of this study was to estimate the prevalence of sleep disordered breathing among professional drivers in Damietta Governorate

Patients and Methods: This research included two parts: First part was descriptive longitudinal study contained two phases: Phase-I: diagnosis of the symptomatized patients as SDB patients and Phase-II: treatment and follow up of the diagnosed patients. Second part: cross sectional study. Phase-I: 110 male commercial drivers with license belong to Damietta Governorate Traffic Unit who were self-referred or referred by a physician to SDB Unit Clinic with symptoms suggesting sleep disordered breathing. Phase-II: The diagnosed drivers with SDB 100 from 110 drivers were offered treatment options according to clinical practice guidelines. The second part of the study included 510 male commercial drivers.

Results: Multivariate analysis of statistically significant predictors of OHS in bivariate analysis and we found three independent predictors (with percentage for accuracy of this model= 99%): AHI (OR=2.3), sleep efficiency (OR=0.98) and arousal index (OR= 1.89). where each unit increase in both AHI, sleep efficiency results in increase in the risk of OHS by 2.3 and 0.98 respectively. Each unit increase in arousal index decrease the risk of OHS (1.89). There was a higher percentage of accidents in the group of OHS in comparison to OSA group and this difference was statistically significant.

Conclusion: There was a high prevalence of SDB among commercial drivers in Damietta governorate. Neck circumference (≥ 38.5) is the most useful independent predictor for SDB and cut of point of AHI and arousal index are the most useful independent predictors of OHS. Higher prevalence of accidents and near accidents in those with SDB versus those without SDB and more prevalent in OHS vs OSA.

Keywords: Sleep Disordered Breathing; Professional Drivers; Obstructive sleep apneas.

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INTRODUCTION

The term sleep-related breathing disorders (SRBDs) includes collection of respiratory aberrations- related to sleep partially or completely. These includes several categories or classifications. For example, the primary classification includes sleep-related hypoventilation, sleep-related hypoxemia, central sleep apnea and obstructive sleep apneas. Sleep disordered breathing (SDB) been considered as a worldwide health problem, as it affects as many as 2% to 9% of middle-aged adults, and increased to up to 15% or more in older adults [(1)].

Obstructive sleep apnea (OSA) defines asleep-related breathing disorder due to repeated upper airway collapse. This leads to intermittent episodes of hypoxia and ventilation impairment during sleep. About 900 million adults or more, between the age of 30 to 69 years overall the world are affected by OSA [(2,3)]. Obstructive events are widely different and includes hypopneas, apneas, and respiratory effort-related arousals). Obstructive hypopneas (OHs) consist of an incomplete reduction of airflow. However, the complete airflow obstruction best described as obstructive apneas (OAs). In addition, the respiratory effort-related arousals (RERAs) are incidents of inspiratory flattening of the inspiratory signal/or amplified effort of respiration leading to airway obstruction. The flattening of inspiratory signal is followed by an arousal, provided that, it does not fulfil the definitions of hypopnea or apneas [(4,5)].

The risk factors for OSA are diverse and include obesity, regional fat distribution, patient's age, thickness of the skin-fat fold, male gender and neck circumference more than 43 cm for males and 41 cm for females. NC predictive value in middle aged patients with OSA is the highest. It is better predictor for OSA than waist circumference, waist hip ratio or body mass index (BMI). The predictive power of NC is significantly lower for OSA in younger and older people [(6)].

OSA adversely affects every organ system leading to adverse health outcomes. The neurocognition effects include impairments in alertness, attention/vigilance through the day, delayed long-term memory especially visual and verbal memory, visuospatial/ constructional abilities. In addition, adverse effects include accident-related effects (e.g., motor vehicle crashes and injuries during the work) [(7)]. The cardiovascular effects of OSA include chronic heart failure (CHF), hypertension, ischemic heart disease (IHD), atrial fibrillation, arrhythmia and stroke. Respiratory consequences include poor control of asthma symptoms, worse respiratory functions in chronic obstructive pulmonary disease (COPD), increased the incidence of pulmonary embolism. Finally, diabetes mellitus, metabolic syndrome, and sexual dysfunction represented the endocrine consequences of OSA [(8)].

Gastrointestinal (GIT) consequences include gastro-esophageal reflux disease (GERD) and non-alcoholic fatty liver disease (NAFLD). Otherwise, pregnancy-related hypertension and gestational diabetes, maternal cardiovascular, pulmonary, and surgical complications are the main obstetric consequences of OSA. Perioperative effects include postoperative intensive care unit (ICU) admission, and respiratory complications. Oncologic effects include the increased incidence of cancer (e.g., breast and colorectal cancer). Furthermore, OSA is associated with increased mortality due to cardiovascular, non-cardiovascular, and COPD related causes [(9,10)]. However, the prevalence of sleep disordered breathing seems to be underestimated due to lack of sufficient studies among many countries including Egypt.

The current work was designed to estimate the prevalence of sleep disordered breathing among professional drivers in Damietta Governorate.

PATIENTS AND METHODS

This research was divided into two parts. The first part was descriptive study conducted at sleep disordered breathing (SDB) unit of the Chest Diseases Department, Al-Azhar Faculty of Medicine (Damietta). This part contained two phases: ***Phase- I*** was the diagnosis of the symptomatized patients as SDB patients and ***Phase-II*** described the treatment and follow up of the diagnosed patients. The second part was a cross sectional study conducted at the General Medical Council of Damietta governorate in Damietta city. The overall study was conducted and completed in the period from July 2022 to the March 2024.

Ethics approval has been obtained from the Institution Review Borad (Medical Research Ethics Committee), Faculty of Medicine Al-Azhar University Damietta. A written informed consent was obtained from the participants in both parts of the study.

First part (clinic-based study):

Phase-I: One hundred and ten (110) male commercial drivers with license belong to Damietta Governorate Traffic Unit who were self-referred or referred by a physician to the clinic of the SDB Unit with symptoms suggesting sleep disordered breathing. All tools used for assessment were previously validated.

The drivers were subjected to history taking (Name, age, sex, education level, special habits (e.g., smoking), license class, vehicle type, usual work road, mean years of driving, mean daily sleep hours, total daily sleep time, presence or absence of shift work, driving after main meal, tea or coffee use during driving, naps (when feel tiredness or sleepiness during driving), history of accidents or near accidents), anthropometric measurement, NC, full medical examination, pulse oximetry using (Granzia pulse oximetry, Granzia, Italy), laboratory work-up (e.g., CBC, lipid profile, thyroid profile, fasting and post-prandial blood glucose), Chest x-ray posterior-anterior view, tonsillar size score, Modified Malampati classification, Friedman tongue position (FTP), Friedman OSAHS score, Epworth sleepiness scale (ESS), Functional outcome of sleep questionnaire (FOSQ-10), Berlin questionnaire, STOP BANG questionnaire, arterial blood gases (ABGs), full night polysomnography and respiratory events scoring.

Tonsillar size score: Tonsil size was classified into five classes (grades) from 0 to 4. The zero grade describes the surgically removed tonsil, while grade 1 indicates hidden tonsils within the pillars and tonsil size grade 2 is assigned when the tonsil extending to the pillars. Grade 3 is assigned when the tonsils are beyond the pillars but not reach the midline. Tonsil size grade 4 is recognized by extended tonsils to the midline [11].

Modified Malampati classification: It was used for palatal examination. It depends on the tonsils, uvula and palates (soft and hard). Four grades are defined. The first indicating complete vision of tonsils, uvula and soft palate. The second defined by the vision of hard and soft palates, upper tonsils and uvula. The third for visible hard and soft palates, while uvula is somewhat obscured. The last class was assigned if the hard palate only was visible [12].

Friedman OSAHS (Obstructive sleep apnea/ hypopnea syndrome) **score:** it was used as a screening system for OSAHS. It is also based on palate position (as explained in Friedman Tongue Position), tonsil size and body mass index. The BMI was graded from 0 to 4. Grade 0 (BMI< 20 kg/m^2), grade 1 (BMI from 20–25 kg/m^2) grade 2 (BMI from 25–30 kg/m^2), grade 3 (BMI from 30–40 kg/m^2), and grade 4 (BMI > 40 kg/m^2). Then, the score was calculated from the following equation: "OSAHS score = (FTP (0-IV) + Tonsil size (0-4) + BMI grade (0 -4) [13].

Epworth sleepiness scale (ESS): it was used to reflect the daytime **sleepiness**. It was measured on the basis of probability for dozing and graded from eight different active and passive situations. Each of was scored (from 0 to 3) according to likelihood of dozing, where 0 = would never doze, 1 = Slight chance of dozing**,** 2 = Moderate chance of dozing, and 3 = High chance of dozing [14].

Functional outcome of sleep questionnaire (FOSQ-10)*:* It was used after a written permission of the author to measure the effect of excessive daytime sleepiness on multiple activities of everyday living. It is consisted of 30 questions related to the potential effects of fatigue on everyday activities. It was designed to assess the respondent's quality of life as it is affected by the disorders of excessive sleepiness. Five domains of day-to-day life are examined "activity, vigilance, intimacy and sexual relationships, productivity, and social outcomes" [15].

Berlin questionnaire: It was used for detection of patients with different grades of risk to develop OSA (high, low, or no risk). It contains 3 categories, each of which either positive or negative. When it was position, it was scored by one point, while negative grade assigned zero. The total of points for the three categories indicates the score [16].

STOP BANG questionnaire: It was used for the screening for OSA. It consisted of 8 items: S = snoring, T= tiredness, O= observed apnea during sleep, P= high blood pressure, B= body mass index ≥ 35kg/m^2, A= age ≥ 50 years, N= neck circumference ≥ 40 cm, G= gender (male gender is positive). Each positive item scored by one point and the sum was calculated. Patients with values ≥3 indicated high risk for OSA [17].

Full night polysomnography (PSG): All drivers had in lab attended full night polysomnography using (SOMNO HD eco version 3.0.0.1). PSG (EEG (Extended electroencephalography), EOG (Electro-oculogram), ECG (Electrocardiography), chin EMG (electromyo-graphy), airflow sensor, RIP (Respiratory inductance plethysmography) belts, PLM (Periodic limb movements) in sleep, with online screen). The interpretation of the sleep study (staging and scoring) was performed on the basis of the 2023 manual of the American academy of sleep medicine for scoring of sleep and associated events [18] with 2012 updates of Rules for Scoring Respiratory Events in Sleep in wiring, scoring of the sleep studies [19].

Phase-II: The diagnosed drivers with SDB (100) were offered treatment options according to clinical practice guidelines of American academy of sleep medicine guidelines [18]. Only (75) patients accept to start the treatment. Patients who received treatment were followed up by BMI, ESS, and FOSQ after 3 months of treatment. They were categorized according to the type designed therapy into: Positive airway pressure treatment (either continuous positive airway pressure or bi-level positive airway pressure) plus weight loss; upper airway surgery plus weight loss, and weight loss only

Second part (general medical council-based study)

The second part of the study included five hundred and ten (510) male commercial drivers with license belong to Damietta governorate traffic unit who came to the general medical council at Damietta city for periodic medical check-up necessary for renewal of their commercial licenses in the period of July 2022 till March 2024.

Methods: The same methods used in the first part of the study except arterial blood gases, polysomnography, serological tests, and chest x-ray.

Statistical analysis: For analysis of data, results were coded and fed to personal computer and the statistical package for social sciences (SPSS) version 16 for Windows® (SPSS Inc, Chicago, IL, USA) was used to perform all analyses. Qualitative variables were presented by the relative frequency (number) and percent. Chi-square test was to test associations between groups. On the other side, mean and standard deviations (SD) were calculated for quantitative variables. They were tested for normal distribution by Kolomogrov-Sironov test and unpaired *t*-test (*t*) was used for comparison. For detection of independent factors, we used the binary logistic regression model. For detection of cut off points, the receiver operation characteristic (ROC) curve was plotted. $P \leq 0.05$ was considered statistically significant.

RESULTS

First part:

Phase –I: Of the studied subjects 81.0% were under the age of fifty years and all were men and 72.7% of them were smokers. There were drivers of heavy-duty truck (13.7%), light and medium duty truck (20.0%), cab drivers (27.3%), tricycle (16.3%) and mini- or micro-bus (22.7%). In addition, 52.7% had shift work, 47.3% nodding during driving and total sleep ours/day was 6.78±1.176. The license class was first among 13.7%, second for 31.8%, third for 38.2% and only 16.3% had a license to tricycle. One hundred subjects had SDB and 10 had no SDB. When compared, no significant differences were found as regard (smoking or BMI). However, patients with SDB were significantly older in age and had significant increase of neck circumference, Berlin questionnaire, STOP Bang score, modified Malampati score, Friedman OSAS diagnostic score, ESS and significant reduction of FOSQ. Furthermore, SDB was significantly associated with significant increase of $PaCO^2$ and significant decrease of PaO_2 (Table 1).

The cut off points of STOP BANG score was (4) sensitivity (87%), specificity (80%), positive predictive value (97.75%), negative predictive value (38.1%). Berlin Questionnaire cut off point was (2) with sensitivity 78% and 90% specificity and positive predictive value (98.73%), negative predictive value (29.73%). OSAS score cut off point was (7) with sensitivity 68% and 90% specificity. Positive predictive value was (98.55%), negative predictive value (29.73%). cut off points of ESS was (7) with sensitivity 77% and 100% specificity and positive predictive value (100%), negative predictive value (30.3%). The neck circumference cut off point was 38 with sensitivity (88%), specificity (100%), positive predictive value (100%), and negative predictive value (45.45%) (Figure 1).

Multivariate analysis of statistically significant predictors of SDB in bivariate analysis revealed that, two independent predictors (with percentage for accuracy of this model= 93.6%) NC (OR=2.8) and ESS (OR= 1.3).

There was significantly higher percentage of hypertension, diabetes mellitus, dyslipidaemia and the presence of one or more comorbid condition in group of SDB. However, no significant difference was recorded for hypo- and hyperthyroidism. In addition, OHS was reported for 25 subjects and OSA for 75 subjects. There were significant differences in the comparison between OHS and OSA as regard erect awake pulse oximetry (SPO_2), AHI, minimal oxygen saturation, oxygen desaturation index, sleep efficiency, REM sleep percentage, and arousal index. No significant differences were found regarding BMI, basal oxygen saturation, deep sleep percentage (Table 2).

Multivariate analysis of statistically significant predictors of OHS in bivariate analysis showed that, three independent predictors (with percentage for accuracy of this model= 99%), AHI (OR=2.3), sleep efficiency (OR=0.98) and arousal index (OR= 1.89). There was a higher percentage of accidents in the OHS than OSA group. The risk significantly increased in SDB than patients without SDB and in OHS than OSA (Table 3).

Cut off points of AHI was (70) with sensitivity 100% and 96% specificity, positive predictive value was (86.21%), and negative predictive value was (100%). Arousal index cut off point was (51) with sensitivity 100% and 98.67% specificity. The positive predictive value (PPV) was (96%), negative predictive value was (98.68%). Area under the curve of Sleep efficiency was below the 0.31 so it cannot be reliable for obtaining of cutoff point (Figure 2).

In drivers with SDB, there were 47 subjects with accidents or near accidents and 53 reported no accidents. When both groups compared, we found significant differences as regard AHI, ESS, FOSQ, basal oxygen saturation, minimal oxygen saturation, oxygen desaturation index, deep sleep percentage, REM sleep percentage, sleep efficiency, and arousal index. In addition, there was a higher percentage of shift work in group with accidents. The multivariate analysis of statistically significant predictors of accidents in bivariate analysis revealed that, three independent predictors (with percentage of accuracy of this model= 74%) were found. These were sleeping efficiency (OR=0.8), REM percentage (OR= 0.8) and deep sleep percentage (OR= 0.7). Area under the curve of Sleep efficiency, REM sleep percentage and deep sleep percentage was below the 0.50 (0.24, 0.23, 0.12 respectively) so it cannot be reliable for obtaining of cutoff point (Table 4).

Phase –II: There was significant decrease in ESS, BMI, and significant increase in FOSQ (P=0.009). For upper airway surgery (5 patients). In addition, there were reduction of pre vs post results of ESS, increase in FOSQ and decrease in BMI results. For diet, weight loss was reported for (3 patients). In addition, there were decrease in pre vs post results of ESS, increase in FOSQ and decrease in BMI results (Table 5).

Second part:

The range of high-risk group for SDB percentages range from (23% to 50.9%) according to different variables calculated cut off points in our study (STOP Bang, berlin, OSAS score, NC and ESS). There was statistically significant higher percentage of accidents among High risk for SDB in comparison to Low risk for SDB. In comparison of the two groups of drivers (with accidents or near accidents vs without accidents) among high-risk group of SDB depending on neck circumference, we found significant differences as regard age, ESS, FOSQ. No significant differences as regard (driving hours, total sleep time, shift work) (p= 0.4, 0.1, 0.9respectively). significantly higher percentage of hypertension in group of high risk of SDB in comparison to without SDB group, significantly higher percentage of diabetes mellitus in group of SDB in comparison to without SDB group (p=0.005), significantly higher percentage of one or more comorbidities in group of SDB in comparison to those without SDB group. However, no significant difference as regard hypothyroidism and CAD (p=0.2 and 0.833; respectively) (Table 6).

Table (1): Comparison between study groups regarding patient demographics, screening scores and results of investigation

		SDB (100)	without SDB (10)	P value
Smoking (n,%)	Smokers Non-smokers	70(70%) 30(30%)	6 (60%) 4 (40%)	0.495
Age (years)		44.04±6.43	41.7±8.66	***0.012****
BMI (kg/m^2)		38.5±2.41	36.7±3.7	0.519
Neck circumference (cm)		42.17±3.2	35.0±0.994	***<0.001****
Berlin questionnaire		2.39±1.1	1.1±0.316	***<0.001****
STOB Bang score		5.66±1.72	3.3±1.059	***<0.001****
Modified Malampati score		2.33±0.792	1.4±0.69	***<0.001****
Friedman OSAS score		7.7±1.71	5.5±0.85	***<0.001****
ESS		11.6±5.8	4.5±0.85	***<0.001****
FOSQ		24.65±4.7	30.8±2.7	***<0.001****
CBC	Hemoglobin (g/dl)	13.2±2.1	13.7±1.9	>0.05
	Hematocrit %	39.6±0.5	39.7±0.3	>0.05
	Basophils (x 10^9)	0.07±0.02	0.04±0.01	>0.05
ABGs	$PaCO_2$ (mm/Hg)	79.8±4.4	43.2±2.6	***<0.001****
	PaO_2 (mm/Hg)	72.6±8.3	80.2±8.9	***<0.001****
Chest X-ray	Hyperinflation	28 (28.0%)	2 (20.0%)	0.452

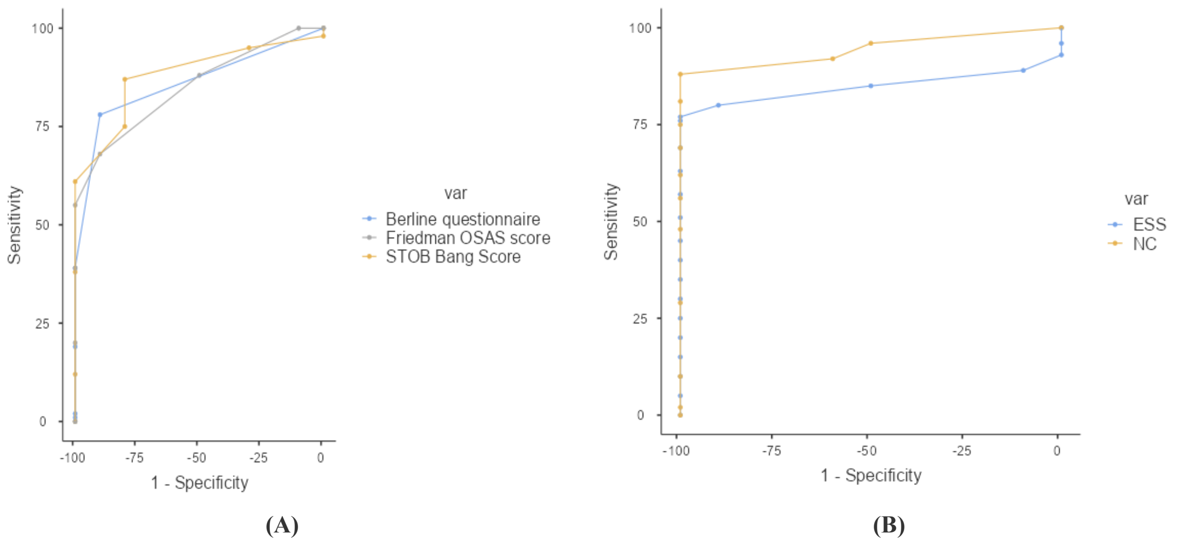


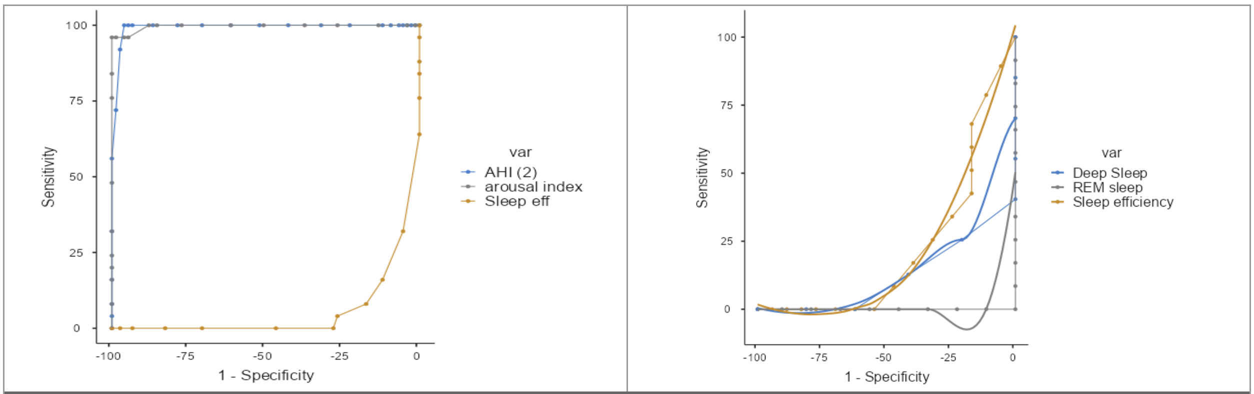
Figure (1): ROC curve of (A) STOP BANG score, Berlin Questionnaire, OSAS score and (B) independent predictors of SDB

Table (2): Comparison between OHS and OSA and prevalence of comorbidities in drivers with or without SDB

Variable	OHS (25)	OSA (75)	P Value	Variable	SDB (100)	without SDB(10)	P value
BMI	36.04±4.85	36.22±4.07	0.852	HTN	60(60%)	2(20.0%)	≤0.001*
SPO2 (erect, awake)	89.2±2.33	92.4±2.92	<0.001*	DM	48(48%)	1(10.0%)	0.004*
AHI	90.8±1.8	45.4±8.65	<0.001*	Dyslipidemia	42(42%)	1(10.0%)	0.009*
Basal SPO2	88.72±2.47	89.04±2.63	0.598	Hypothyroidism	27(27%)	3(30.0%)	0.839
minimal SPO2	65.24±2.05	78.33±3.26	<0.001*	Hyperthyroidism	20(20%)	1(10.0%)	0.13
O2 Desaturation index	78.33±3.62	43.23±3.26	<0.001*	Comorbidities (1 or more)	68(68%)	2(20.0%)	≤0.001*
Sleep eff.%	77.68±2.15	84.12±2.78	<0.001*				
Deep sleep%	4.44±2.26	5.94±1.85	0.072				
REM %	10.6±1.73	17±2.71	<0.001*				
Arousal index	84.68±8.01	43.65±2.85	<0.001*				

Table (3): Logistic regression analysis of independent predictors of OHS, Prevalence of accidents in those with or without SDB and those with OSA versus OHS

	B	P	OR (95%CI)
AHI (continuous)	-2.5	0.008	2.3 (2-3.97)
Sleep eff. (Continuous)	-0.129	0.898	0.98 (0.6-1.25)
Arousal index (Continous)	- 2.95	0.003	1.89 (1.3-2.9)
Constant ; Model χ^2 ; Percent correctly predicted	-53.8; χ^2=97.4, P≤0.001* ;99%		
	SDB (100)	**without SDB (10)**	**P value**
Accidents and near accidents	47(47%)	1(10%)	0.024*
No accidents	53(53%)	9(90%)	
	OSA (75)	**OHS (25)**	
Accident or near accidents	27 (36%)	20 (80%)	≤0.001*
No accidents	48 (64%)	5 (20%)	



(A) (B)

Figure (2): Receiver Operating Characteristic (ROC) curve of independent predictors of (A) OHS and (B) accident

Table (4): Comparison of clinical and polysomnographic parameters in accidents and non-accidents groups in commercial drivers with SDB

	Accidents and near accidents (47)	Non accidents (53)	P value
Mean daily Driving hours	7.2±3.3	7.6±2.2	0.5
Shift work (N, %)	22(61.1)	14(38.9)	0.03*
ESS	16.4±3.42	10.9±4.7	≤0.001*
FOSQ	22.4±7.7	30±7.9	≤0.001*
AHI	65.6±22.6	34.9±21.3	≤0.001*
Basal O_2 saturation	88.8±5.3	91.9±3.8	0.002*
minimal O_2 saturation	69.2±11.1	75.4±13.7	0.02*
Oxygen Desaturation index	63.9±24.4	38.9±26	≤0.001*
Deep sleep%	4.0±3.4	7.6±2.0	≤0.001*
REM sleep %	11.3±4.7	19.4±2.7	≤0.001*
Sleep efficiency	82.5±5.1	88.7±5.3	≤0.001*
Arousal index	65.5±22.7	34±21.9	≤0.001*
	B	**P**	**OR (95%CI)**
Sleep efficiency(continuous)	- 1.99	0.04	0.882(0.779-0.998)
REM sleep % (Continuous)	- 2.66	0.008	0.815 (0.701-0.947)
Deep sleep % (Continous)	- 1.95	0.05	0.768 (0.589-1.001)
Constant; Model χ^2 ; Percent correctly predicted	24.9; χ^2= 28.6, P≤0.001*; 74%		

Table (5): Comparison between follow up variables pre and post 3 months of positive airway pressure treatment with diet weight loss.

Follow up variable	PRE	POST	P value
ESS	14±4.9	9.4 ± 3.7	≤0.001*
FOSQ	25.5±8.3	27.2 ± 8.9	0.009*
BMI	40.1±6.7	36.9 ± 6.7	≤0.001*

Table (6): The results of the general medical commission group **(Part II).**

	Calculated Cut off points	Risk of SDB	
		Low	High
STOP BANG score	4	355 (69.6%)	155 (30.3%)
Berlin questionnaire	2	388 (76%)	122 (23.9%)
OSAS score	7	200 (39.2%)	310 (60.1%)
NC	40	250 (49%)	260 (50.9%)
ESS	7	390 (76.4%)	120 (23%)
	Low risk for SDB 235 (46.1)	High risk for SDB 275(53.9)	P value
Accident or near accidents	28 (5.5%)	100 (19.6%)	≤0.001*
No accident	207 (40.6%)	175 (34.3%)	
	Accidents or near accidents (128)	Without accidents (382)	
Age	43.9±9.2	39.1±9.6	≤0.001*
Driving hours	9.8±5	9.6±5.5	0.809
Total sleep time in work day	5.3±2.6	6.1±2.6	0.736
ESS	5.1±3.7	2.9 ± 2.8	≤0.001*
FOSQ	34.8±3.7	37.1±2.8	≤0.001*
Shift work N (%)	38 (29.6%)	84 (21.9%)	P=0.077
	High risk of SDB (128)	Low risk of SDB (382)	
HTN	76(58.5%)	60(15%)	≤0.001*
DM	45(35.1%)	50(13%)	0.005*
CAD	0(0%)	0(0%)	0.2
Hypothyroidism	0 (0%)	0 (0%)	0.831
Comorbidities (one or more)	85(66.4%)	70(18.3%)	≤0.001*

DISCUSSION

We found that the prevalence of SDB was 91% (100 out of 110), OSA was found in 75% of those with SDB and OHS was found in 25%, with no cases found with CSA. All OHS cases had OSA. Our results are in line with previous studies indicating a higher prevalence of SDB than has been previously believed. For example, El-Morsy *et al.* [20] conducted a nested case-control study for (150) commercial drivers in Mansoura governorate (Egypt) and reported SDB among 70% among the high-risk group of commercial drivers **[8]**.

In this study, the cut off points of STOP BANG score was (4) sensitivity (87%), specificity (80%), positive predictive value (97.75%), negative predictive value (38.1%). A recent meta-analysis had shown that STOP-Bang score ≥3 had excellent pooled sensitivity at 91% (95%CI: 82–97%) and pooled NPV at 89% (95%CI: 77–95%). The associated pooled specificity was 43% (95%CI: 34–53%) and PPV was 49% (95%CI: 40–58%) **[21]**.

In our study, Berlin Questionnaire cut off point was (2) (i.e. the same for the standard level) with sensitivity 78% and 90% specificity and positive predictive value (98.73%), negative predictive value (29.73%). This is in line with Netzer *et al.* [22] who reported that, the standard sensitivity is 89% and specificity is 71% **[10]**.

OSAS score cut off point was (7) with sensitivity 68% and 90% specificity. The positive predictive value (98.55%), negative predictive value (29.73%). The standard reference point is (8) with sensitivity 74% and 60% specificity and area under the curve was 0.77 **[23]**.

Our results show that the independent predictors for SDB were NC (cut off point 38 cm) (OR=2.8, p=0.005) and ESS cut off point (7) (OR=1.3, p=0.006) for each standard deviation (SD) increment and the regression model derived indicated a high probability of SDB of 93.6% if both factors were present. Both factors are applicable, so this model can be used as a screening tool for detection of SDB in commercial drivers. This comes in agreement with the results of Park *et al.* [24] studying 3432 Asian adult patients referred to a sleep clinic for investigation of sleep related breathing disorders and had a questionnaire and full PSG. They found that Neck circumference, obesity, BMI, and waist circumference were independent predictors of SDB. In addition, our results are in agree with Cizza *et al.* [25] and Park *et al.* [24] where they found that AUC of NC was ranging between (0.73-0.88). In addition, the results of the current work agree with Abdel Dayem *et al.* who included 160 Egyptian railway drivers in a prospective cross-sectional screening study to assess the prevalence and predictors of OSAS. The univariate analysis of risk factors showed that age ≤ 49 years was found to be associated with sleep apneas (p= 0.035 and OR was 11.364 and (95% CI) (1.184–109.020). Weight more than 95 was found to be associated with sleep apneas. Both $PaO_2 \leq 88$ and PaCO2 > 39, were associated with sleep apnea (p= 0.004 and OR (95% CI) of 31.0 (2.969–323.634) for both. furthermore, $SpO_2 \leq 88$ was significantly associated with sleep apneas (P = 0.002 and OR (95%CI) of 34.0 (3.704–312.092) **[26]**.

In the current work OHS was significantly different than OSA, regarding erect awake pulse oximetry (90.6 vs 93.3), AHI (80.5 vs 40.3), minimal oxygen saturation (67.1 vs 74), oxygen desaturation index (77.7 vs 42.9), sleep efficiency (81.9 vs 85.8), REM sleep percentage (12.1 vs 16.6), arousal index (79.6 vs 39.9). Multivariate analysis detected (AHI (OR=2.6) and arousal index (OR= 0.5) to be significant predictors of OHS. Another study in Egypt reported the following predictors can be used for early diagnosis of OHS (a wake SPO2 with a sensitivity of 97.1% and 100% specificity; serum HCO3 at a cutoff point of 28 mmol/dL with sensitivity of 85.7%, and specificity of 95.6%; and finally, AHI had and a sensitivity of 78.6%, specificity of 77.9 at a cutoff point of 46.40) **[27]**. In India, a previous study had found out that the most significant predictor of OHS were minimum nocturnal SpO_2 with 90% sensitivity and 84.9% specificity in detection of OHS. They also showed a nadir SpO_2 cutoff of <80% to predict OHS with a sensitivity of 82.8% and a specificity of 54.5% **(28)**.

In our study there are only 75% of those having SDB accepted to be treated for their disorders. This illustrated the decreased awareness of the problem in the community and highlighted he importance of acting active steps in this regard through seminars in the media and newspapers. In addition, the acceptance of the PAP (gold standard for treatment) was 87.3% (55 out of 63). This also highlighting the importance of good training for physician applying these devices for treating the possible limitation of use of these devices (e.g. existence of claustrophobia, use of different types of interfaces, use of new devices with advanced technology (flexible pressure, ramp pressure, humidifier and use of CPAP devices)). There were significant differences in comparison of ESS and FOSQ in pre and post treatment with CPAP and weight loss (14±4.9vs 9.4 ± 3.7) (P<0.001) and (25.5±8.3vs 27.2 ± 8.9) (P=0.009). This illustrates the efficiency of CPAP and weight loss in improvement of ESS and FOSQ with possible reduction in the rate of accidents in the future.

In Saudi Arabia, Alqurashi *et al.* [29] conducted a trial and included 32 obstructive sleep apnea (OSA) patients and 32 healthy participants who completed two visits, 1 month apart, during which they completed both ESS and VAS. Patients diagnosed with OSA were treated with Continuous positive airway pressure (CPAP) between visits. A reduction in sleepiness, following CPAP treatment occurred in patients with OSA, using the ESS (11.2 ± 5.5–4.7 ± 5.0 points, P < 0.001) and the VAS (50.2 ± 3.0–21.9 ± 26.5 mm, P < 0.001).

In this study, motor vehicle accidents or near accidents were significantly higher in those with SDB versus those without SDB (46.7 % vs 10 %). Also motor vehicle accidents or near accidents were significantly higher in those with OHS versus those with OSA (80 % vs 36 %, P<0.001). This illustrate that sleep disordered breathing is a significant risk factor for accidents and that OHS is more significant than OSA. Similarly, a close prevalence of OSA (47.1%) was detected by Badawy *et al.* [30]

Our results are much lower than the results found by El-Morsy *et al*. [20]**,** as they reported that the prevalence of OSA was statistically significantly higher among those with accidents (81.2%) than those without accidents (60.5%). Moreover, in Egypt, El-Morsy *et al.* [20] conducted a study to determine the prevalence of accidents among commercial drivers with suspected OSA and to identify the risk factors of road traffic accidents (RTA). They reported that 46.0% prevalence of accidents among drivers and the accidents were statistically increased with the first-, second- and third-class license than those with tricycle license (OR and 95% CI=15.5 (3.7-65.6), 5(1.3-19.4) and 5.5(1.5-20.7), respectively). In addition, the prevalence of RTA is significantly increased among drivers who had shift work and nodding while driving (OR: 2.4 times and 2.6 times, respectively). Longer total daily sleep hours were significantly higher among drivers without accidents (7.5 hrs. ±1.6) than who developed RTA (6.9 ±1.8). In addition, significant differences were reported for ESS, FOSQ, Oxygen desaturation index, deep sleep percent, sleep efficiency and Arousal index. The OSA prevalence was significantly higher among those with accidents (81.2%) vs 60.5% in subjects without accidents. Drivers who had OSA were 2.8 times more likely to experience accidents more than those who didn't have RTA. The logistic regression revealed that the independent predictors of RTA were having first class license, shift work, REM sleep percent and OSA with adjusted odds ratio.

Conclusion: We found high prevalence of SDB among commercial drivers in Damietta governorate, especially in symptomatized commercial drivers (91%). OSA constitute (75%) and OHS (25%). Neck circumference (≥ 38.5) is the most useful independent predictor for SDB. However, AHI and arousal index were the most useful independent predictors of OHS. SBD was associated with higher incidence of RTA and more prevalent in OHS vs OSA. Risk factors for SBD include comorbid medical conditions, especially hypertension and diabetes mellitus. Lower sleep efficiency%, REM sleep %, deep sleep% and mean daily sleep hours could be of predictive importance in detection of SDB related accidents among commercial drivers.

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None

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