Risk of obstructive sleep apnea among taxi–motorbike drivers in Parakou city in West Africa and associated factors with road traffic accidents

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Abstract

Objectives: Obstructive sleep apnea (OSA) is an underdiagnosed chronic respiratory disease, causing excessive daytime sleepiness (EDS) and road traffic accidents (RTA). This study aimed to determine the risk of OSA among taxi–motorbike drivers (TMD) and factors associated with RTA in Parakou, Benin.

Methods: A cross-sectional comparative study was carried out between July and September 2020, including 225 TMD and 450 motorbike drivers other than TMD (non-TMD). A multiple logistic regression was then performed to determine factors associated with RTA.

Results: The mean age of participants was 38.2 ± 10.2 and 36.6 ±10.9 years, respectively, for TMD and non-TMD (p = .048). The average daily working time was 10.7 ± 2.3H and 9.1±3.5H, respectively, for TMD and non-TMD (p < .001). Average sleeping time was comparable in both groups (7.5±1.4H vs 7.4±1.4H; p = .415). TMD significantly more complained of non-restorative sleep (38.7% vs 18.4%; p < .001) but less of EDS (20.0% vs 28.7%; p = .015). Abdominal obesity predominated in TMD (13.8% vs 4.4%; p < .001). An increased risk of OSA (NoSAS score ≥8) was diagnosed in 25.8% TMD and 26.7% non-TMD (p = .805). Overall, 25.8% of TMD and 18.4% of non-TMD (p = .027) reported at least one RTA in the last 12 months. After adjusted analysis, the unique factor associated with RTA was a daily sleeping pills consumption (aOR=2.2; 95%CI = 1.2–3.8; p = .006).

Conclusion: There is need to improve systematic screening and diagnosis of OSA in both TMD and non-TMD and reinforce the regulation and consumption of sleeping pills.

Keywords

Motorbike, commercial driver, sleep apnea, road traffic accident, sleeping pills, Benin

Introduction

Road traffic accidents (RTA) have become a huge global public health threat. According to the World Health Organization (WHO), approximately 1.35 million people die annually in RTA, and an additional 20 to 50 million suffer

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from related-disabilities that considerably impair their quality of life.[1] Globally, over a 15-year follow-up period, from 2000 to 2016, death rates due to RTA did not reduce but remained constant at around 18 deaths per 100,000 population.[1] Low- and middle-income countries are those most affected by these accidents, accounting for approximately 93% of these deaths.[1] No low-income country has recorded a decrease in the number of deaths due to RTA since 2013.[1] The WHO African region ranks first in the world, with high mortality rates that ranged from 26.1 to 26.6 deaths per 100,000 inhabitants between 2013 and 2016.[1] Of road users, motor-cyclists are those most involved in accidents.[1]

There are several situations leading to RTA, including for instance, poor road conditions, alcohol abuse, ignorance or negligence of traffic regulations, and use of mobile phones during driving.[1] However, another important factor is diminished reactivity due to excessive daytime sleepiness (EDS), a possible manifestation of obstructive sleep apnea (OSA).[2] This disease is also a major public health problem in the world, with an estimated prevalence ranging between 3% and 7% in the general population, and with variation also occurring between certain subgroups.[3] OSA is responsible for several vascular and metabolic disorders. The obstruction of the pharynx due to several mechanisms leads to chronic intermittent tissue hypoxia, micro-awakenings, sleep fragmentation and non-restorative sleep. One of the consequences is EDS and an increased risk of road traffic and occupational accidents. In previous reports, the odds of having an occupational accident is nearly two times higher in workers with OSA, with the highest rate found in occupational drivers with the disease,[4] namely for instance truck, bus or train drivers, airplane pilots, air traffic controllers, and heavy or dangerous machinery operators.

Benin is a developing country in West Africa and like others suffers from an RTA scourge. In 2015, according to official statistics, 5992 road accidents were recorded in the country. Among the victims, 2220 were seriously injured and 637 were killed.[5] The situation is likely to be more worrying, since in real life many accidents or RTA victims are not officially reported.

In the early 1990s, increasing unemployment and difficulties in paying workers' salaries in the public and private sectors prompted the emergence of a new kind of professional in the country, the taxi–motorbike driver (TMD), commonly called "zemidjan." Usually, these drivers do not receive any training about traffic regulations or best driving practices prior to the commencement of their activity. Over the years, their number has increased in Benin as well as in other countries in West Africa.

Although TMD provide enormous services to the population in terms of intra-urban mobility, they are also often involved in numerous traffic accidents.[6] Apart from their lack of knowledge about traffic regulations that undoubtedly contributes to RTA, whether this high rate of RTA is associated with OSA compared with other motorbike drivers is not known. Unfortunately, OSA symptoms are not systematically recorded at hospitals among victims of RTA, potentially exposing them to an unavoidable risk of recurrence.

The present study therefore aimed to investigate (1) whether there were any differences in the frequency of an increased risk of OSA between TMD and the other non-commercial motorbike drivers (non-TMD) and (2) whether there were associations of OSA and other factors with RTA in Parakou city in Benin.

Methods

Study type

This was a cross-sectional comparative study carried out between July and September 2020.

Setting

Parakou is the third major city in Benin, with a population of 255,478 inhabitants according to the last general census of the population in 2013.[7] In terms of road infrastructure, since 2014, there has been significant progress, with the building of new roads or the rehabilitation of old roads. Multiple parking areas have been created as well as rehabilitation of all types of vehicles. TMD were recruited from the eight most frequented taxi–motorbike parking areas, and non-TMD were recruited after home visits to districts.

Study population

Study inclusion criteria were being aged ≥18 years and giving formal verbal consent. Registration in the TMD or the non-TMD group then depended on whether or not the participant was officially registered as a TMD. The sample size of each group was determined using Epi Info Software v.7.2.3.1. For two-sided 95% confidence level, a power of 90%, a ratio of non-TMD to TMD equal to 2, a prevalence of 14.4% found in one study from Nigeria (a neighboring city)[8] and a desired odds ratio of 2, the calculated total sample size was 675, and consisted of 225 TMD and 450 non-TMD respectively.

Due to challenges in obtaining a complete list of TMD and their high mobility, the 225 TMD were selected from the parking areas. Each TMD was then matched with two non-TMD, based on their gender and their age (±5 years), giving a total of 450 non-TMD who were recruited. The selection and sampling of these non-TMD were carried out through a three-stage cluster.

Data collection and variables

Over two days, six public health students were briefed on the different items of the study questionnaire, on how to

measure the different parameters and the best way of completing the form. Height of participants was measured with a gauge, heels placed against the wall, and corresponding to the distance between the top of the head and the soles of the feet. Weight was measured without shoes and without anything in the pockets. Neck circumference was measured with the head being in a neutral position, at a point halfway between the tip of the chin and the supra-sternal notch. Waist circumference was measured in an upright position and in a gentle exhalation, halfway between the lower costal rim and the iliac crest. Three teams of two pairs of students each were formed. During data collection, the study participants were questioned during a face-to-face interview that lasted 20 min.

Data variables included: demographic characteristics, comorbidities, lifestyles, sleep-related information, OSA-related symptoms, anthropometric and vital parameters, neck and waist circumferences, and the occurrence of at least one RTA in the last 12 months. They were questioned on any daily consumption of hypnotics such as zopiclone, zolpidem or diazepam in order to fall asleep during the last 4 weeks. They were also asked whether they have been using daily kola nuts seeds to keep awake in the last 4 weeks. Populations in the region usually consume kola nuts seeds for its medicinal virtues and also to stay awake, due to its caffeine content.[9] The different nutritional status categories were derived from the WHO classification based on the Body Mass Index (BMI in kg/m^2) and comprised: underweight (BMI <18.50), normal status (BMI= 18.50–24.99), overweight (BMI= 25.00–29.99) and obesity (BMI ≥30).[10] Abdominal obesity was defined as waist circumference ≥94 cm in men or ≥80 cm in women.[11] EDS was defined by an Epworth score ≥ 11.[12] The participant was recorded as having nocturia if he declared urinating more than one time per night.[13] The neck circumference, obesity, snoring, age, sex (NoSAS) score (a novel tool) was used to screen for OSA. The score is based on these five items with defined end-points: neck size >40 cm (4 points); body mass index (BMI in kg/m^2) ranging between 25 and 29.9 (3 points) or ≥30 Kg/m^2 (5 points); Snoring (2 points); Age >55 years-old (4 points); and male gender (2 points). An increased risk of OSA was defined by a NoSAS score ≥ 8.[14]

Data analysis

Data were collected and entered into the EpiData Entry software v4.6.0.0 and were analyzed using Rx64 3.6.0. Continuous variables were described using means (±standard deviation). Qualitative variables were described using percentages. The prevalence of patients with an increased risk of OSA was compared in both groups using Pearson chi-square test. Factors associated with an RTA in the last 12 months were sought by univariate analysis. For multiple logistic regression, we included in the model factors with a p value < .20 on univariate analysis as well as factors with a p value (p)

Table 1. Demographic characteristics and comorbidities of study participants in Parakou city, Benin between July and September 2020 (N = 675).

	Taxi–motorbike drivers		Non taxi–motorbike drivers		
	n	(%)	n	(%)	p Value
Marital status					
Married	179	(79.6)	299	(66.4)	.058
Single	45	(20.0)	131	(29.1)	.027
Divorced	1	(0.4)	13	(2.9)	.055
Widowed	0	(0.0)	7	(1.6)	.117
Educational status					
No education	48	(21.3)	66	(14.7)	.051
Primary level	87	(38.7)	142	(31.6)	.138
Secondary level	63	(28.0)	161	(35.8)	.096
University level	27	(12.0)	81	(18.0)	.063
Comorbidities					
Primary hypertension	3	(1.3)	15	(3.3)	.128
Type 2 diabetes mellitus	1	(0.4)	3	(0.7)	.723
Lifestyles					
Regular active smoking[a]	37	(16.4)	64	(14.2)	.481
Harmful alcoholism[b]	37	(16.4)	79	(17.6)	.751
kola	31	(13.8)	75	(16.7)	.331
Total	225		450		

[a]Patient smoking every day in the last month.
[b]Daily consumption of ≥40 g (for women) or ≥60 g (for men) of alcohol.

≥ .20 demonstrated to have a strong link with RTA in the literature. Odds ratios (OR), 95% confidence intervals and the p values were determined. Levels of significance were set at 5%.

Ethical considerations

Approval of the Local Ethics Committee for Biomedical Research of the University of Parakou (REF: 0339/CLERB-UP/P/SP/R/SA) was obtained. Informed consent of all participants was obtained.

Results

Characteristics of the study participants

The mean age of participants was 38.2 ± 10.2 and 36.6 ±10.9 years, respectively, for TMD and non-TMD (p = .048). TMD were less likely to be single (20.0% vs. 29.1%; p = .027). The prevalence of reported primary hypertension (1.3% vs. 3.3%; p = .128) and type 2 diabetes mellitus (0.4% vs. 0.7%; p = .723) were low and comparable between both groups (Table 1). Regarding work habits, TMD reported a significantly longer duration at work each day than non-TMD, 10.7 ± 2.3 h and 9.1 ± 3.5 h (p < .001), respectively.

Table 2. Obstructive sleep apnea suggestive symptoms, neck and waist circumferences of study participants in Parakou city, Benin between July and September 2020 (N = 675).

	Taxi–motorbike drivers		Non taxi–motorbike drivers		
	n	(%)	n	(%)	p Value
Symptoms of OSA					
Severe snoring	97	(43.1)	177	(39.3)	.346
Excessive daytime sleepiness	45	(20.0)	129	(28.7)	.015
Apnea	32	(14.2)	47	(10.4)	.150
Tiredness	11	(4.9)	27	(6.0)	.555
Lack of concentration	10	(4.0)	23	(5.1)	.705
Nocturia	9	(4.0)	6	(1.3)	.027
Nutritional status					
Underweight	5	(2.2)	12	(2.7)	.759
Normal status	125	(55.6)	284	(63.1)	.234
Overweight and obesity	95	(42.2)	154	(34.2)	.110
Increased neck circumference	73	(32.4)	136	(30.2)	.556
Increased waist circumference	31	(13.8)	20	(4.4)	< .001
Total	225		450		

Sleep-related characteristics

The mean reported sleep duration was comparable between TMD and non-TMD, 7.5 ± 1.4 and 7.4 ± 1.4 h (p = .415), respectively. However, TMD reported more frequently the symptom of restless leg syndrome (25.8% vs. 14.4%; p < .001) and an impression of having non-restorative sleep (38.7% vs. 18.4%; p < .001).

OSA-related findings

Among OSA-related symptoms, severe snoring was the one most frequently reported in TMD and non-TMD groups in similar proportions, 43.1% and 39.3% (p = .346), respectively. TMD complained less of EDS (20.0% vs. 28.7%; p = .015) than non-TMD, but had more frequent nocturia (4.0% vs. 1.3%, p = .027). The proportion of other daytime symptoms such as tiredness (4.9% vs. 6.0%; p = .555) and lack of concentration (4.0% vs. 5.1%; p = .705) was comparable in both groups. Abdominal obesity was more common in TMD than non-TMD (13.8% vs. 4.4%; p < .001) (Table 2).

Overall, based on NoSAS score, the prevalence of an increased risk of OSA was comparable in TMD and non-TMD, respectively 25.8% and 26.7% (p = .805). There were no differences between TMD and non-TMD with an increased risk of OSA in relation to comorbidities, lifestyles, and sleep events apart from a higher frequency of non-restorative sleep among TMD compared with non-TMD (46.6% vs. 20.8%, p < .001) (other data not shown).

Prevalence of RTA in the last 12 months and associated factors

Overall, 141 (20.8%) motorbike drivers declared having had at least one RTA in the last 12 months. After univariate analysis, factors associated with RTA were being a TMD (cOR=1.5; p = .027), daily consumption of sleeping pills (cOR=2.3; p = .002) and a report of non-restorative sleeping (cOR=1.7; p = .006). After multivariate analysis, only a daily consumption of sleeping pills was associated with a high risk of RTA (aOR=2.2; 95%CI=1.2–3.8; p = .006). TMD (aOR=1.4; 95%CI=0.9–2.0; p = .131) or having an increased risk of OSA (aOR=1.0; 95%CI=0.6–1.6; p = .917) were not associated with a significant risk of RTA (Table 3).

Discussion

This study is one of the few to assess the burden of OSA among people living in sub-Saharan Africa, where there is huge dearth information regarding this important disease. The overall objective of the study was to estimate the risk of OSA among TMD as well as to determine what important risk factors might be associated with RTA among motorbike drivers in Parakou city.

There were several strengths to this study. These included the large sample size, the prospective comparative nature of the study, with enrollment of two non-TMD for one TMD, thereby increasing the power of the study. The international and validated clinical scores that were used, namely the NoSAS and the Epworth scale scores, refer to items or situations that are common and easy to investigate in Parakou.[12,14] Compare to other OSA screening scores, we

Table 3. Factors associated with road traffic accidents (RTA) in the last 12 months in Parakou city, Benin (N = 675).

	RTA		Univariate analysis		Multivariate analysis		
	n/N	(%)	Cor	p-value	aOR	95%CI	p-value
Motorbike driver							
Non-TMD	83/450	(18.4)		.029			.131
TMD	58/225	(25.8)	1.5		1.4	0.9–2.0	
Age (years)							
30–54	94/434	(21.7)	1.0	.435			
<30	40/194	(20.6)	0.9				
≥30	07/47	(14.9)	0.6				
Marital status							
Single	37/176	(21.0)	1	.373			
Married	102/447	(21.4)	1.02×10				
Divorced	02/14	(14.3)	6.26×10^{-1}				
Widowed	00/07	(00.0)	6.52×10^{-7}				
Sleeping pills							
No	118/611	(19.3)	1	.002			.006
Yes	23/64	(35.9)	2.3		2.2	1.2–3.8	
Non-restorative sleep							
No	93/505	(18.4)	1	.007			.051
Yes	48/170	(28.2)	1.7		1.5	0.9–2.3	
Restless leg syndrome							
No	114/552	(20.6)		.756			
Yes	27/123	(21.9)	1.1				
Increased risk of OSA							
No	99/497	(19.9)	1	.285			.917
Yes	42/178	(23.6)	1.3		1.0	0.6–1.6	
Alcohol							
No	112/559	(20.0)	1	.236			.320
Yes	29/116	(25.0)	1.3		1.3	0.8–2.0	
Kola nuts intake							
No	121/569	(21.3)	1	.608			
Yes	20/106	(18.9)	0.9				
Nutritional status							
Normal	74/409	(18.1)	1	.150			
Underweight	04/17	(23.5)	1.4		1.5	0.4–4.4	.524
Overweight/Obesity	63/249	(25.3)	1.5		1.4	0.9–2.2	.107

RTA = road traffic accident; TMD = taxi–motorbike drivers; non-TMD = non taxi-motorbike drivers; OSA = obstructive sleep apnea; cOR = crude odds ratio; aOR = adjusted odds ratio.

preferred the NoSAS because of its simplicity and because all the components, except snoring, require objective measurements, leaving little chance for subjectivity. Furthermore, this score has performed better in other studies compared to other measurements such as the STOP-BANG and the Berlin questionnaires.[14,15] The investigators had also been well trained on the most suitable way of completing the collection forms. The main limitation related to the lack of polygraphic or polysomnographic recording to confirm OSA, due to the unavailability of these diagnostic tools in Parakou. Furthermore, we cannot exclude the fact that some TMD who declined to participate, despite the anonymous nature of the survey, may have done so out of concern about sleepiness,

thus underestimating the burden of this problem in their group. Unfortunately, there was no way of compelling these drivers to participate. Some constraints were also faced during data collection, especially the reluctance of some motorbike drivers to participate for various reasons that included their high daily workload and/or the ongoing COVID-19 pandemic despite study investigators respecting physical distancing and so on. For the same reasons, carrying out a physical examination, especially of the nose and throat to look for any morphological abnormalities linked with OSA, was challenging. A further constraint was the need to trust participants' statements about work and sleep habits, and we had no way to crosscheck the information provided. Despite

these constraints and limitations, the study led to interesting findings, some of which deserve consideration.

Overall, the study included motorbike drivers who were in the prime of their life, with a mean age of 36–38 years in both groups. TMD tended to work a longer day than non-TMD, with an average difference of 1 h 35 min additional work time. However, recovery sleeping time was comparable in the two groups, just below 7 h 30 min. Coupled with the fact that driving a taxi–motorbike is perceived as a difficult job in the community, the longer working time may explain to some extent the reasons why TMD were more likely to report an overall impression of non-restorative sleep compared with non-TMD. An expected consequence would have been a higher rate of EDS among TMD, but that was not observed in our study for reasons which are unclear. The prevalence of EDS amongst motorbike drivers in our study, however, was higher than that found in the general population in Parakou city at 14.6% according to a previous study.[16] With respect to other studies, in South Korea there was a lower prevalence of EDS reported in commercial motor vehicle drivers and the general population, at 19.1% and 16.8%, respectively.[17] In Lagos, Nigeria, Ozoh and colleagues reported that 14.4% of commercial drivers who were interviewed had EDS based on the Epworth scale score.[8]

With regards to risk factors for OSA, it was of concern that abdominal obesity was three times more common among TMD than the other motorbike drivers. In other reports, the prevalence of abdominal obesity among bus drivers has been investigated and varied between 19.9% and 26.3%.[18,19] Long-duration of sitting during driving, eating late at night or during stressful periods, high caloric intake, and physical inactivity were some of the important factors associated with this disorder.[19] The same reasons would likely prevail in our population, with regard to lifestyle habits. This calls for awareness and actions to change lifestyles among TMD, to prevent the occurrence or worsening of non-communicable diseases.

Based on the NoSAS score, more than one fourth of participants in each group (TMD and non-TMD) were diagnosed with an increased risk of OSA. This comparable proportion with OSA in each group refutes our original hypothesis of a higher prevalence of OSA among TMD. Other studies using different scoring mechanisms have published a high prevalence of OSA varying between one fifth and one fourth of occupational drivers.[20–24] This high prevalence strongly suggests the need to improve the availability of OSA confirmation tools as well as treatment for this disease in developing countries like Benin. Routine consultation could be an opportunity to search for OSA suggestive symptoms in all drivers, irrespective of their professional activities, to prevent possible accidents, which we found to be common in our study. During data collection, there were attempts to obtain additional useful information related to accidents, such as the number of motorbike drivers who recognized that fatigue or drowsiness may have been responsible for the accident.

Unfortunately, the hesitations noted in the different responses provided to the study investigators were not convincing and therefore they were removed from the analysis.

Despite the high prevalence of reported RTA, there are good grounds for hope. Several years ago, the medical emergency services were inundated with RTA victims. Head injuries were very common, and often led to death. Since the decisions by government to make the wearing of helmets mandatory during driving, the numbers presenting to emergency services with RTA has significantly decreased. In one study from Cotonou, the economic capital city, published by Madougou and colleagues[6] in 2014, the incidence of RTA in which at least one TMD was involved decreased considerably to 1.77%: the authors linked this improvement to the use of helmets. For greater impact, we would advocate extending this decision about helmets to the passenger, which to date has not yet happened.

With respect to frequency of RTA, we expected a significantly higher risk of accidents with TMD. However, this was not confirmed after adjustment with other confounders. The unique factor linked to a RTA in the previous 12 months was a daily use of hypnotics. The role of these drugs in RTA is often mentioned in the literature. For instance, in a multicenter European study, hypnotics were one of several factors associated with RTA. Gustaven and colleagues from Norway also reported an increased risk of RTA after benzodiazepine and hypnotic consumption.[25] In Parakou city, according to regulations, such drugs can only be sold in the pharmacies upon presentation of a duly signed medical prescription. However, the drugs can be clandestinely obtained in the black market, despite awareness and monitoring from the Ministry of Health. This calls for urgent action to prevent the dispensing of such medications in these places. This type of decision will require close collaboration of several ministries, including that of health or of internal affairs. Although we did not investigate this in the present study, compliance to traffic regulations should also remain a priority for reducing the burden of RTA.

Conclusion

An increased risk of OSA was diagnosed in one motorbike driver out of four, and was common among TMD as well as non-TMD. RTAs in the last 12 months were reported by about one quarter of TMD and by almost one fifth of non-TMD. The use of daily sleeping pills was associated with RTA among motorbike drivers, regardless of whether they were TMD or non-TMD, thus emphasizing the importance of better regulation of the consumption of these drugs.

Declaration of conflicting interests

Availability of data and materials

Data used in this study are available from the corresponding author upon reasonable request.

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Supplementary material

Supplementary material for this article is available online.

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