ORIGINAL ARTICLE

Prevalence of fatigue while driving among two-wheeled vehicle drivers and associated factors: Exploratory approach from secondary analysis based on hospital data, Benin

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Abstract. Fatigue while driving is one of the risk factors of road crashes. It's still poorly considered in interventions because of insufficient literature. In addition, the literature on this issue doesn't focus on two-wheelers, the most frequent users in the Benin context. The study examined the prevalence of fatigue while driving among two-wheeled vehicle drivers and the related factors. It's a secondary baseline data analysis from a cohort of road crash victims recruited from five hospitals in Benin. Data were collected from July 2019 to January 2020. Patients who identified themselves as drivers during the accident were included. Data on individual characteristics, including fatigue status in the moments preceding the collision, and other risk factors and environmental settings, were extracted. We used multivariate logistic regression. Among the respondents, 12.20% (95% CI=10.20-14.53) reported fatigue in the moments preceding the collision. The odds of fatigue while driving were significantly higher in male drivers (aOR=3.60; 95% CI=1.08-11.98), during professional trips (aOR=2.09; 95% CI=1.30-3.37), in non-helmet wearers (aOR=1.85; 95% CI=1.09-3.13), in users of stimulants (aOR=3.13; 95% CI=1.50-6.54), in those with a history of chronic diseases (aOR=1.95; 95% CI=1.16-3.27), at dusk (aOR=4.22; 95% CI=2.22-8.02), at night (aOR=6.90; 95% CI=3.95-12.05), and on Inter-State National Roads (aOR=2.01; 95% CI=1.18-3.43). Fatigue is a risk factor for road crashes in Benin, associated with other risk factors that highlight particularly vulnerable profiles and groups. Integrating prevention policies based on these cumulative risk factors will result in efficiency improvements.

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Introduction

In 2019, 103.2 million people (1,299 per 100,000) were involved in road crashes worldwide vs. 63.2 million (1,193 per 100,000) in 1990 (1). Concurrently, each year from 2000 to 2016, it is estimated that 1.15-1.35 million (about 18 deaths per 100,000) individuals died as a result of road crashes, with regional disparities that disproportionately affect Sub-Saharan Africa (2). The latest estimates suggest that road crashes constitute the seventh leading cause of DALYs (Disability-Adjusted Life Years) for all age groups, ahead of malaria, HIV/AIDS, and tuberculosis, and the leading cause for young people aged 10 to 29 (3). Benin is a West African country characterized by a road transport system dominated by two-wheeled vehicles and a high involvement (68%) of these vehicles' users among the victims of road crashes (4). In 2018, 5,358 road crashes were recorded in Benin (5), with a road mortality rate of 27.5 per 100,000 in 2016, slightly higher than the African average (2).

In recent years, there has been an increase in literature on predictors of the occurrence and severity of road crashes, which has generated evidence needed to design and implement appropriate road safety strategies. Overall, these studies have highlighted the influence of factors related to the individual, the vehicle and the environment (6-9). However, it is considered that human factors are responsible for 95% of road crashes (10). Fatigue while driving is cited in the literature as one of the human factors contributing to the occurrence and severity of road crashes (7,9). It is a state of exhaustion in the driver on the road, and its principal sign may be drowsiness. It harms the driver's performance on the road by reducing their attention and reactivity and can be associated with falling

asleep while driving (11-13). In developed countries, fatigue while driving is responsible for 5-50% of road crashes, with median values of 15-25% (14,15). In a 2021 study in Benin, fatigue while driving among motorbike riders increased their risk of experiencing a traumatic brain injury by 1.90 times after an accident (16).

A range of studies has sought to understand the predictors of fatigue while driving. It is worth noting that a large part of the work on this issue has focused on professional drivers, such as truck drivers, taxi drivers, bus drivers, etc. (17-22). Indeed, this group of road users is considered vulnerable to fatigue because they travel long distances, both day and night, and are often responsible for several passengers (17,21,23,24). Among this group of users, an older age, excessive consumption of stimulants (caffeine), poor quality of sleep, trip-based payment type, long hours of driving, long distance trips, lack of rest time, additional employment (part-time), bad health status as well as social aspects such as loneliness are associated with fatigue on the road (18-20,22,25). Considering that the risk of fatigue applies to all drivers, including two-wheeled vehicle drivers, it is necessary to understand the extent of this phenomenon and the factors that promote its occurrence as the first step in implementing interventions to contribute to the reduction of road crashes and their consequences. In Benin, a literature review did not reveal any research on the determinants of fatigue during driving, among drivers of vehicles in general, or even among professionals. To address this gap, the present study aims to identify factors associated with fatigue during driving among two-wheeled vehicle drivers.

Materials and methods

Study setting. Benin is a country of 114,763 km^2 that administratively comprises 12 departments divided into 77 communes (26). The National Institute of Statistics and Demography (INSTaD) projected 12,535,929 inhabitants in 2021 (27). In a context marked by the high use of motorized two-wheeled vehicles, professional drivers using this type of vehicle have emerged, called motorcycle taxi drivers. Motorcycle taxis are an accessible, fast, and affordable public transportation service for people or goods using a motorcycle. Due to the low implementation of public transport services and their ease of movement in congested traffic and poorly maintained roads, this service has become the most widely used public transport mode (28).

Study type. We performed secondary analyses of a database established as part of the TraumAR prospective cohort of road crash victims in Benin in 2019 (4). The aim of establishing this cohort was to make reliable data available that could serve as a basis for conducting studies on the issue of road crashes in Benin. Individuals who were victims of road crashes between July 2019 and January 2020, residing in Benin and admitted alive to one of the five selected reference hospitals were eligible to be included in the cohort after obtaining their written, free and informed consent. The sites of enrolment were: the Hubert Koutoukou Maga National University Hospital Center, the Oueme-Plateau University Hospital Center, the Ménontin Zone Hospital, the Borgou-Alibori University Hospital Center, and the Boko Zone Hospital. For each patient enrolled in the cohort, initial data were collected at enrolment through the direct administration of a detailed questionnaire and the exploitation of their medical records. Investigators were asked to judge the opportune moment to approach the victims and their caregivers. The initial data were joined by follow-up data at six and twelve months after the crash. The present study used the initial data. Additional details on the TraumAR cohort are available elsewhere (4,16,29).

Population. The study population drawn from the TraumAR cohort consisted of patients who were victims of road crashes as drivers of motorized two-wheeled vehicles, living at admission and having complete data for all study variables.

Variables. The dependent variable was fatigue (yes vs. no), reported by the respondents. Participants were asked if they had signs of fatigue in the moments preceding the collision.

The independent variables were related to the driver and the accident environment. These included age in years (<30, 30-49, ≥50), sex (male, female), reason for the trip (professional, private), helmet use (yes, no), alcohol consumption (yes, no), tobacco use (yes, no), use of sleeping pills (yes, no), use of stimulants (yes, no), phone use in the moments preceding the collision (yes, no), history of chronic illness (yes, no), history of road crashes (yes, no), time of the collision (dawn, daytime, dusk, night-time), visibility at the collision site (poor, acceptable, good), and type of road at the collision site (Inter-State National Road, other).

Data analysis. Data analysis was conducted using Stata 15 in two steps. First, we described study variables based on their respective frequencies (n) and percentages (%). The prevalence of fatigue while driving was calculated with a 95% Confidence Interval (95% CI). The second step involved identifying factors associated to fatigue while driving. In simple logistic regression, each independent variable was cross-tabulated with the dependent variable. Variables with P<0.20 were entered into multivariate logistic regression. Following a stepwise downward strategy, we progressively eliminated the less significant variables to have only variables with P<0.05 in the final model. Results were presented as Odds Ratios (OR) with 95% CI. The Hosmer-Lemeshow test was used to check the goodness of fit of the final model.

Ethical considerations. The protocol of TraumAR study gets approbation by the University of Parakou (Benin) Ethics Committee under the number 0182/CLERB-UP/P/SP/R/SA. Before the interviews, eligible respondents provided free, written, and informed consent. In addition, the dataset used for analysis was anonymized so that survey respondents could not be identified in any way.

Results

Basic characteristics of the participants. The study included 885 motorized two-wheeler drivers involved in traffic crashes. Nearly half (49.04%) were 30 to 49 (Table I). About nine out of ten participants (89.94%) were male. For 30% of the respondents, the accident occurred during a professional trip. About 82% of the drivers were wearing a helmet.

Table I. Basic characteristics of the participants, Benin.

Variables	n	%
Age in years		
<30	311	35.14
30-49	434	49.04
≥50	140	15.82
Sex		
Male	796	89.94
Female	89	10.06
Reason for the trip		
Professional	269	30.40
Private	616	69.60
Helmet use		
Yes	729	82.37
No	156	17.63
Alcohol consumption		
Yes	589	66.55
No	296	33.45
Tobacco use		
Yes	102	11.53
No	783	88.47
Use of sleeping pills		
Yes	24	2.71
No	861	97.29
Use of stimulants		
Yes	49	5.54
No	836	94.46
Phone use		
Yes	14	1.58
No	871	98.42
History of chronic illness		
Yes	145	16.38
No	740	83.62
History of road crashes		
Yes	314	35.48
No	571	64.52
Time of the collision		
Dawn	59	6.67
Daytime	447	50.51
Dusk	143	16.16
Night-time	236	26.67
Visibility at the collision site		
Poor	138	15.59
Acceptable	112	12.66
Good	635	71.75
Type of road at the collision site		
Inter-State National Road	132	14.92
Other	753	85.08

The prevalence of alcohol and tobacco consumption was 66.55 and 11.53%, respectively. Besides, 2.71 and 5.54% of the respondents reported using sleeping pills and stimulants, respectively. Fourteen participants (1.58%) used their phones in the moments leading up to the collision. History of chronic diseases and road crashes were noted in 16.38 and 35.48% of the participants, respectively. The accident occurred during the day for a little over half (50.62%) of the drivers, in good lighting conditions for 71.77%, and in poor lighting conditions for 15.59%. The Inter-State National Roads were the location of the accident for 14.96% of respondents.

Prevalence of fatigue while driving. Among the participants, 12.20% (95% CI=10.20-14.53) were fatigued while driving. Table II shows the prevalence of fatigue while driving according to the characteristics of the study population with its 95% confidence interval. The prevalence of fatigue while driving was high among drivers aged 30 years and over, with a significant difference in the age group of 30-49 years (13.82% vs. 9.00%, P<0.05). The prevalence was also higher among men than women (13.19% vs. 3.37%, P=0.014). About 17% of those who travelled in a professional setting reported being fatigued, compared to 10.06% travelling in a private capacity (P=0.004). The frequency of fatigue while driving was higher among non-helmet wearers (17.95% vs. 10.97%, P=0.017), and alcohol (13.92% vs. 8.78%, P=0.029) and stimulant consumers (34.69% vs. 10.89%, P<0.001). On the other hand, the prevalence of fatigue while driving was lower among drivers without chronic diseases (10.54% vs. 20.69%, P=0.001) as well as those who travelled during the day (4.92% vs. 16.78% vs. 24.15%, P<0.001), in a setting with good visibility (7.40% vs. 24.11 vs. 24.64%, P<0.001), and on Inter-State National Roads (10.23% vs. 23.48%, P<0.001).

Factors associated with fatigue while driving. Table III shows the univariate and multivariate analysis of factors associated with fatigue while driving among the participants. During the univariate analysis, the following variables were significant at P<0.20 and were kept for the multivariate regression: age in years, sex, reason for the trip, helmet use, alcohol consumption, tobacco use, use of stimulants, history of chronic illness, time of the collision, visibility at the collision site, and type of road at the collision site. At the end of the multivariate analysis, sex, reason for the trip, helmet use, use of stimulants, history of chronic illness, time of the collision, visibility of the collision site, and the type of road were the factors associated with fatigue while driving. Males were 3.60 times (95% CI=1.08-11.98) more likely to report fatigue while driving than females. Drivers travelling for work (aOR=2.09; 95% CI=1.30-3.37) had higher odds of driving fatigue than those on private trips. Drivers who did not wear helmets (aOR=1.85; 95% CI=1.09-3.13) and those who reported using stimulants (aOR=3.13; 95% CI=1.50-6.54) were more at risk of fatigue while driving. Individuals with a history of chronic diseases were 1.95 times (95% CI=1.16-3.27) more likely to be fatigued while driving. The odds of driving fatigue were higher for those involved in crashes at dusk (aOR=4.22; 95% CI=2.22-8.02) and at night (aOR=6.90; 95% CI=3.95-12.05) than for those in daytime crashes. When respondents travelled on Inter-State National Road, they had twice the odds (aOR=2.01; 95%

Table II. Prevalence of driver fatigue by basic characteristics of two-wheeled drivers, Benin.

Variables	n	%	95% CI
Age in years			
<30	28	9.00	6.28-12.75
30-49	60	13.82	10.88-17.42
50 and over	20	14.29	9.36-21.21
Sex			
Male	105	13.19	11.01-15.73
Female	3	3.37	1.07-10.14
Reason for the trip			
Professional	46	17.10	13.03-22.11
Private	62	10.06	7.92-12.71
Helmet use			
Yes	80	10.97	8.90-13.46
No	28	17.95	12.64-24.85
Alcohol consumption			
Yes	82	13.92	11.35-16.97
No	26	8.78	6.04-12.61
Tobacco use			
Yes	17	16.67	10.54-25.35
No	91	11.62	9.55-14.07
Use of sleeping pills			
Yes	3	12.50	3.73-34.49
No	105	12.20	10.17-14.56
Use of stimulants			
Yes	17	34.69	22.41-49.43
No	91	10.89	8.94-13.19
Phone use			
Yes	3	21.43	5.96-54.02
No	105	12.06	10.05-14.40
History of chronic illness			
Yes	30	20.69	14.80-28.15
No	78	10.54	8.52-12.97
History of road crashes			
Yes	34	10.83	7.83-14.80
No	74	12.96	10.44-15.98
Time of the collision			
Dawn	5	8.47	3.48-19.22
Daytime	22	4.92	3.26-7.37
Dusk	24	16.78	11.46-23.92
Night-time	57	24.15	19.08-30.07
Visibility at the collision site			
Poor	34	24.64	18.09-32.61
Acceptable	27	24.11	16.99-33.02
Good	47	7.40	5.60-9.72
Type of road at the collision site			
Inter-State National Road	31	23.48	16.95-31.57
Other	77	10.23	8.25-12.61

Table III. Factors associated with driver fatigue, Benin.

	Univariate analysis			Multivariate analysis		
Variables	cOR	95% CI	P	aOR	95% CI	P
Age in years						
<30	1.00					
30-49	1.62	1.01-2.61	0.046			
50 and over	1.68	0.91-3.11	0.095			
Sex						
Male	4.36	1.35-14.03	0.014	3.60	1.08-11.98	0.037
Female	1.00			1.00		
Reason for the trip						
Professional	1.84	1.22-2.78	0.004	2.09	1.30-3.37	0.002
Private	1.00			1.00		
Helmet use						
Yes	1.00			1.00		
No	1.77	1.11-2.84	0.017	1.85	1.09-3.13	0.022
Alcohol consumption						
Yes	1.68	1.05-2.67	0.029			
No	1.00					
Tobacco use						
Yes	1.52	0.86-2.68	0.146			
No	1.00					
Use of sleeping pills						
Yes	1.03	0.30-3.51	0.964			
No	1.00					
Use of stimulants						
Yes	4.35	2.32-8.14	<0.001	3.13	1.50-6.54	0.002
No	1.00			1.00		
Phone use						
Yes	1.99	0.55-7.25	0.297			
No	1.00					
History of chronic illness						
Yes	2.21	1.39-3.53	0.001	1.95	1.16-3.27	0.011
No	1.00			1.00		
History of road crashes						
Yes	0.82	0.53-1.26	0.355			
No	1.00					
Time of the collision						
Dawn	1.79	0.65-4.92	0.260	1.62	0.57-4.62	0.369
Daytime	1.00			1.00		
Dusk	3.90	2.11-7.19	<0.001	4.22	2.22-8.02	<0.001
Night-time	6.15	3.65-10.37	<0.001	6.90	3.95-12.05	<0.001
Visibility at the collision site						
Poor	4.09	2.51-6.66	<0.001			
Acceptable	3.97	2.35-6.72	<0.001			
Good	1.00					

Table III. Continued.

	Univariate analysis			Multivariate analysis		
Variables	cOR	95% CI	P	aOR	95% CI	P
Type of road at the collision site						
Inter-State National Road	2.69	1.69-4.30	<0.001	2.01	1.18-3.43	0.011
Other	1.00			1.00		

Goodness of fit test Pearson chi2(94)=80.44 Prob>chi2=0.839.

CI=1.18-3.43) of reporting fatigue while driving as those who travelled on other roads.

Discussion

This exploratory study aimed to determine the prevalence of fatigue while driving among motorcyclists and identify associated factors. Based on the participants' self-reported statements, 12.20% were fatigued.

In the literature, studies investigating the extent of fatigue while driving among drivers have focused more on professionals and shown prevalence ranging from 27 to 62% among truck, taxi, and bus drivers (18-22). These percentages are all higher than the one we found. These findings agrees with studies suggesting an excess risk of fatigue on the road among professionals compared to other drivers (17,21,23,24). Furthermore, this study focused on two-wheeled vehicle drivers who seem less likely to travel long distances than car drivers, reducing the risk of fatigue while driving. In addition, there is heterogeneity in the approaches used to measure fatigue while driving. According to the study, drivers were asked to indicate how often they experienced fatigue while driving (22), the frequency with which they were fatigued on the road in the 12 months before the survey (20), whether they were fatigued during their last trip (18), and to complete the Epworth Sleepiness Scale to assess daytime sleepiness (25). In our study, we asked participants if they were in a state of fatigue immediately preceding the collision. The common thread among these approaches, including our paper, is that data on fatigue while driving was self-reported by participants, which is a source of several biases. Respondents may have difficulty remembering their past behaviors or experiences accurately, especially in this study, which focused on road crash victims and required information on their fatigue state immediately before the collision. Some participants may be reluctant to answer honestly or deliberately underestimate the frequency they were tired while driving. There is also some subjectivity related to variable manifestations of fatigue symptoms from one individual to another. It highlights the need for standardized data collection methods to facilitate comparisons.

Male drivers were more likely to fatigue while driving than their female counterparts. Previous studies have shown that men are more prone to adopting risky behaviours on the road (30-33).

We found that people travelling for work were twice as likely to be fatigued while driving as those making private trips. In Benin, professional drivers using two-wheeled vehicles are mostly accounted for by motorcycle taxi drivers. With professionalization, motorcycle taxi drivers are one of the categories of users who record the highest number of hours spent on the roads (to have maximum customers) without being able to take sufficient breaks, which can lead to chronic fatigue. It is up to motorcycle taxi drivers not to ignore the fatigue that may result from the exercise of their activity by planning their work schedule, observing regular breaks, sleeping sufficiently, and limiting the consumption of psychoactive substances.

We observed that drivers with a history of chronic diseases were about two times more likely to fatigue while driving than individuals who are not carriers of these conditions. Some chronic diseases or risk factors for chronic diseases are likely to disrupt the quality and quantity of sleep, which can lead to increased fatigue. According to a 2021 study, the likelihood of severe fatigue is 1.6 to 5.5 times higher in carriers of chronic diseases (34). In a 2018 study, obesity, hypertension, hypercholesterolemia, diabetes, and depression were associated with shorter sleep duration (35). We can also mention sleep apnea syndrome, a respiratory disorder occurring in sleep, where breathing is repeatedly interrupted (36). Drivers who suffer from obstructive sleep apnoea experience a significantly higher number of instances of sleepiness while driving and in road traffic crashes (37). The link between a history of chronic diseases and fatigue while driving can also be explained by the side effects of certain medications prescribed to treat these conditions (38,39) Strengthening medical follow-up and adjusting the driving time of people with chronic diseases are ways to reduce the risk of driver fatigue for this group.

Individuals who did not wear a helmet were more at risk of fatigue while driving. Not wearing a helmet is risky behaviour that appears to be associated with other risky behaviours, including driving while fatigued. The consumption of stimulants by drivers has also been identified as an associated factor of fatigue while driving. Some drivers, especially professionals, may use stimulants to reduce the feeling of fatigue during their activity (40). A study in 2015 showed 45% addiction to Tramadol among motorcycle taxi drivers in Parakou (Benin) (40). Over time, this substance consumption can lead to insomnia and disrupt sleep quality, resulting in daytime

fatigue or drowsiness (41). Some people may rely more on stimulants to counteract this fatigue, worsening insomnia and perpetuating the vicious cycle. In the long term, frequent use of stimulants can also lead to addiction, which can lead to sleep disturbances and fatigue. It is essential to break this vicious cycle by adopting healthy sleep management strategies and limiting or eliminating the use of stimulants.

Dusk and night were associated with a higher risk of fatigue while driving among participants. The production of melatonin, a hormone associated with sleep, naturally increases when darkness sets in, increasing the risk of drowsiness in the driver (42).

When respondents travelled on roads other than Inter-State National Road (roads that connect the country to neighbouring states), they were less likely to be fatigued while driving. Inter-State National Roads are generally larger and better maintained than other roads and facilitate travel and trade. Driving on roads other than Inter-State National Road, which are in a poorer condition in terms of infrastructure, may require more vigilance of the driver.

The study has some limitations. Data came from five hospitals that may not necessarily be representatives of the country, even though the selection was based on the use of services related to the care of traffic accident victims. The retrospective nature of some questions, which rely on memory, could be a source of recall bias. Questions about risky driving behaviours could be subject to social desirability bias, resulting in an underestimation of the prevalence of these behaviours. Moreover, since this study used an existing database, it does not include all variables that could be considered as predictors of driver fatigue. These include variables related to professional activities, type of work, work schedules, and the number of work hours, as well as variables related to sleep, such as daily sleep duration or the presence of sleep disorders such as sleep apnea. Hence, it is essential to consider these different aspects in addition to the factors identified here in future studies on the topic.

Conclusions

A relatively high proportion of road crash victims had shown signs of fatigue in the moments leading up to the crashes. Depending on their characteristics and those of the road environment, fatigue while driving did not affect participants equally. The risk of fatigue while driving was significantly higher among male drivers, during professional travel, non-helmet users, users of stimulants, those with a history of chronic diseases, at dusk and night, and on National Inter-State Roads. Driving fatigue is a risk factor for road crashes in Benin, associated with other known risk factors that highlight priority targets for road safety. The integration of prevention policies based on the identification of these cumulative risk factors will contribute to the efficiency of improving road safety.

Author's contributions

YGA, and AK were involved in designing the research protocol; LS and BHDS were involved in data collection and entry; the data analysis and the interpretation of the results were performed by YGA NG, and AK; the first draft of the manuscript was written by YGA and critically reviewed by AK, SL BHDS, and AL. All the authors have read and approved the final version of the manuscript and agreed to be held accountable for all aspects of the work.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate

The protocol of TraumAR study gets approbation by the University of Parakou (Benin) Ethics Committee under the number 0182/CLERB-UP/P/SP/R/SA. Before the interviews, eligible respondents provided free, written, and informed consent. In addition, the dataset used for analysis was anonymized so that survey respondents could not be identified in any way.

Conflict of interest

The authors declare no potential conflict of interest.

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References

1. Xu Y, Chen M, Yang R, Wumaierjiang M and Huang S: Global, regional, and national burden of road injuries from 1990 to 2019. Int J Environ Res Public Health 19: 16479, 2022.
2. World Health Organization. Global status report on road safety 2018. Geneva, Switzerland, WHO, 2018. Report No.: WHO/NMH/NVI/18.20. Available: https://apps.who.int/iris/handle/10665/277370.
3. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, Abbasi-Kangevari M, Abbastabar H, Abd-Allah F, Abdelalim A, Abdollahi M, *et al*: Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: A systematic analysis for the Global Burden of Disease Study 2019. Lancet 396: 1204-1222, 2020.
4. Hounkpe Dos Santos B, Glele Ahanhanzo Y, Kpozehouen A, Daddah D, Ouendo EM, Coppieters Y and Leveque A: Referral conditions for severe road traffic injuries and their influence on the occurrence of hospital deaths in Benin. J Public Health Afr 13: 2138, 2022.
5. Ministère des Infrastructures et des Transports. Annuaire statistique 2017-2018. Cotonou, Benin: MIT, 2021.
6. Bocage C, Mashalla Y, Motshome P, Fane O, Masilo-Nkhoma L, Mathiba O, Mautle E, Kuiperij B, Mmusi T, Holmes JH, *et al*: Applying the Haddon matrix conceptual model to guide motor vehicle crash injury research and prevention in Botswana. Afr J Emerg Med 10 (Suppl 1): S38-S43, 2020.
7. Yousefifard M, Toloui A, Ahmadzadeh K, Gubari MIM, Madani Neishaboori A, Amraei F, Safari S, Baratloo A, Rahimi-Movaghar V and Hosseini M: Risk factors for road traffic injury-related mortality in Iran; a systematic review and Meta-analysis. Arch Acad Emerg Med 9: e61, 2021.

8. Denu ZA, Osman MY, Bisetegn TA, Biks GA and Gelaye KA: Prevalence and risk factors for road traffic injuries and mortalities in Ethiopia: Systematic review and meta-analysis. Inj Prev J Int Soc Child Adolesc Inj Prev 27: 384-394, 2021.
9. Haghdoust Z, Masoumi G, Khorasani Zavareh D, Ebadi A and Moslehi S: A systematic literature review of Driver's sociocultural factors predisposing to road traffic crashes. Med J Islam Repub Iran 36: 21, 2022.
10. Rumar K: The Role of Perceptual and Cognitive Filters in Observed Behavior. In: Evans L and Schwing RC, (eds.). Human Behavior and Traffic Safety. Boston, MA, Springer US, pp151-170, 1985.
11. Mortazavi A, Eskandarian A and Sayed RA: Effect of drowsiness on driving performance variables of commercial vehicle drivers. Int J Automot Technol 10: 391-404, 2009.
12. Seen K, Tamrin SM and Meng G: Driving fatigue and performance among occupational drivers in simulated prolonged driving. Glob J Health Sci 2: 167, 2010.
13. Du H, Zhao X, Zhang X, Zhang Y and Rong J: Effects of fatigue on driving performance under different roadway geometries: A simulator study. Traffic Inj Prev 16: 468-473, 2015.
14. Akerstedt T: Consensus Statement: Fatigue and crashes in transport operations. J Sleep Res 9: 395-395, 2000.
15. Dawson D, Reynolds AC, Van Dongen HPA and Thomas MJW: Determining the likelihood that fatigue was present in a road crash: A theoretical review and suggested accident taxonomy. Sleep Med Rev 42: 202-210, 2018.
16. Hounkpe Dos Santos B, Glele Ahanhanzo Y, Kpozehouen A, Daddah D, Lagarde E and Coppieters Y: Effect of wearing a helmet on the occurrence of head injuries in motorcycle riders in Benin: A case-control study. Inj Epidemiol 8: 17, 2021.
17. Messier S, Bellavance F and Duguay PL Crashes routiers au travail-Revue de la littérature. Montréal (Québec): IRSST; 2013. Report No.: R-791. Available: https://www.irsst.qc.ca/media/documents/PubIRSST/R-791.pdf.
18. Williamson A and Friswell R: The effect of external non-driving factors, payment type and waiting and queuing on fatigue in long distance trucking. Accid Anal Prev 58: 26-34, 2013.
19. Perttula P, Ojala T and Kuosma E: Factors in the fatigue of heavy vehicle drivers. Psychol Rep 108: 507-514, 2011.
20. Russo G, Cassenote AJF, Guilloux AGA and Scheffer MC: The role of private education in the selection of primary care careers in low and middle-income countries. Findings from a representative survey of medical residents in Brazil. Hum Resour Health 18: 11, 2020.
21. Meng F, Li S, Cao L, Li M, Peng Q, Wang C and Zhang W: Driving fatigue in professional drivers: A survey of truck and taxi drivers. Traffic Inj Prev 16: 474-483, 2015.
22. Ren X, Pritchard E, van Vreden C, Newnam S, Iles R and Xia T: Factors associated with fatigued driving among Australian truck drivers: A cross-sectional study. Int J Environ Res Public Health 20: 2732, 2023.
23. Sunwoo JS, Shin DS, Hwangbo Y, Kim WJ, Chu MK, Yun CH, Jang T and Yang KI: High risk of obstructive sleep apnea, insomnia, and daytime sleepiness among commercial motor vehicle drivers. Sleep Breath 23: 979-985, 2019.
24. Fort E, Chiron M, Davezies P, Bergeret A and Charbotel B: Driving Behaviors and On-Duty Road crashes: A French case-control study. Traffic Inj Prev 14: 353-359, 2013.
25. Lim SM and Chia SE: The prevalence of fatigue and associated health and safety risk factors among taxi drivers in Singapore. Singapore Med J 56: 92-97, 2015.
26. Institut National de la Statistique et de l'Analyse Économique. Recensement Général de la Population et de l'Habitation IV: Cahier des villages et quartiers de ville Littoral. Cotonou, Bénin, INSAE, 2016.
27. Ministère de Santé. Annuaire des statistiques sanitaires 2021. Cotonou, Benin, MS, 2022.
28. Djossou GNA: Analyse de l'activité de taxi-moto au Bénin. Public Sector Economics. 2017 [cited 12 Feb 2023]. Available: http://publication.aercafricalibrary.org/handle/123456789/2029.
29. Daddah D, Glèlè Ahanhanzo Y, Kpozehouen A, Hounkpe Dos Santos B, Ouendo EM and Levêque A: Prevalence and risk factors of post-traumatic stress disorder in survivors of a cohort of road crash victims in Benin: Results of a 12-month cross-sectional study. J Multidiscip Healthc 15: 719-731, 2022.
30. Cordellieri P, Baralla F, Ferlazzo F, Sgalla R, Piccardi L and Giannini AM: Gender Effects in young road users on road safety attitudes, behaviors and risk perception. Front Psychol 7: 1412, 2016.
31. Cullen P, Möller H, Woodward M, Senserrick T, Boufous S, Rogers K, Brown J and Ivers R: Are there sex differences in crash and crash-related injury between men and women? A 13-year cohort study of young drivers in Australia. SSM Popul Health 14: 100816, 2021.
32. Konlan KD and Hayford L: Factors associated with motorcycle-related road traffic crashes in Africa, a Scoping review from 2016 to 2022. BMC Public Health 22: 649, 2022.
33. World Health Organization. Road traffic injuries. 2022 [cited 27 Apr 2020]. Available: https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries.
34. Goërtz YMJ, Braamse AMJ, Spruit MA, Janssen DJA, Ebadi Z, Van Herck M, Burtin C, Peters JB, Sprangers MAG, Lamers F, *et al*: Fatigue in patients with chronic disease: Results from the population-based Lifelines Cohort Study. Sci Rep 11: 20977, 2021.
35. Reis C, Dias S, Rodrigues AM, Sousa RD, Gregório MJ, Branco J, Canhão H and Paiva T: Sleep duration, lifestyles and chronic diseases: A cross-sectional population-based study. Sleep Sci 11: 217-230, 2018.
36. Cumpston E and Chen P: Sleep Apnea Syndrome. StatPearls. Treasure Island (FL), StatPearls Publishing, 2022. Available: http://www.ncbi.nlm.nih.gov/books/NBK564431/
37. Smolensky MH, Di Milia L, Ohayon MM and Philip P: Sleep disorders, medical conditions, and road crash risk. Accid Anal Prev 43: 533-548, 2011.
38. Chimirri S, Aiello R, Mazzitello C, Mumoli L, Palleria C, Altomonte M, Citraro R and De Sarro G: Vertigo/dizziness as a Drugs' adverse reaction. J Pharmacol Pharmacother 4 (Suppl 1): S104-S109, 2013.
39. Olowofela AO and Isah AO: A profile of adverse effects of antihypertensive medicines in a tertiary care clinic in Nigeria. Ann Afr Med 16: 114-119, 2017.
40. Djidonou A, Tognon Tchégnonsi F, Gansou G, Ataïgba I, Babaèkpa K, Hers D, *et al*: Prévalence et facteurs associés à l'addiction au Tramadol chez les conducteurs de taxi-moto (Zé) à Parakou/Bénin. Le Bénin Médical 60: 7-13, 2015.
41. Ogeil RP and Phillips JG: Commonly used stimulants: Sleep problems, dependence and psychological distress. Drug Alcohol Depend 153: 145-151, 2015.
42. Xie Z, Chen F, Li WA, Geng X, Li C, Meng X, Feng Y, Liu W and Yu F: A review of sleep disorders and melatonin. Neurol Res 39: 559-565, 2017.