

Research Article

Study of the Prevalence and Factors Associated with Accidents on Public Roads Among Motorcyclists in the Health District of Kaolack (Senegal) in 2019

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Abstract

Road accidents are a public health problem throughout the world, particularly in developing countries such as Senegal. In the Kaolack region, located in the centre of the country, the advent of motorbikes commonly known as ‘Moto Jakarta’ has only increased this road morbidity and mortality, the consequences of which are taking a heavy toll on global and national economies, as well as household finances. It is in this context that this study was undertaken to identify the factors associated with road accidents among motorcyclists in the Kaolack health district. A cross-sectional, descriptive and analytical study was conducted during the first half of 2019. Among motorcyclists active in the Kaolack health district. A recruitment of 400 motorcyclists meeting the inclusion criteria was carried out. Data were analysed using Epi Info and R software. Qualitative variables were described by absolute and relative frequencies and quantitative variables by mean, standard deviation and extremes. The binary logistic regression method was used for the multivariate analysis. The adjusted Odds Ratios (aOR) with their 95% confidence intervals were determined for each variable retained in the final model. The average age of participants was 27.5. Motorbike taxi drivers were in the majority (61%). Only 17.8% of participants had a driving licence. More than half of the drivers (63.7%) had been involved in a road accident at least once in their lifetime. Road accidents among motorcyclists were favoured by the fact that they: living outside Kaolack (aOR = 3.7 [1.4-9.7]); driving a motorbike that was at least 5 years old (aOR = 1.8 [1.5-3]); owning the motorbike (aOR = 1.9 [1.1-3]); driving at night (aOR = 1.8 [1.1-2.9]); drinking alcohol (aOR = 3.1 [1.5-3.4]) and driving with more than one supported person (aOR = 2.0 [1.2-3.2]). Road accidents among motorcyclists are a real public health problem in the Kaolack region. More in-depth investigations, particularly of a qualitative nature, will be needed to gain a more exhaustive understanding of this phenomenon, in order to provide a more rigorous and well-founded basis for decision-making in this area.

Keywords

Prevention, Accident, Road Safety, Motorcyclist, Senegal

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1. Introduction

Road traffic accidents represent a significant global burden due to the high number of victims, largely attributable to the modernization of vehicle fleets and increasing road traffic. According to the World Health Organization (WHO), more than half of global road traffic deaths involve motorcyclists (23%), pedestrians (22%), and cyclists (4%) [1].

Each year, approximately 1.2 million people lose their lives on the roads, which equates to over 3,000 deaths per day. Additionally, 140,000 injuries are recorded annually, including 15,000 individuals who sustain lifelong disabilities [2].

The likelihood of road users losing their lives varies across regions. The African region has the highest rate of fatalities among motorcyclists, pedestrians, and cyclists (43% of road traffic victims), whereas these rates are relatively lower in the Southeast Asian region [1].

In 2018, 3,940 road accidents were reported in Senegal, with a fatality rate of 15.5%. Motorcycles were involved in 17.15% of these cases [3]. Economically, Senegal loses over 2% of its GDP annually due to road traffic accidents [4].

Human factors are among the primary causes of road traffic accidents involving motorcyclists. The age and gender of motorcyclists are also critical factors, as young male drivers are disproportionately involved in road accidents. Additionally, poor road conditions, unfavorable weather, and fatigue contribute to the occurrence of road traffic accidents [5, 6].

Commonly referred to as “Moto Jakarta” in the Kaolack region, motorcycle taxi services have become an integral part of local transportation. Their advantages, including the ability to navigate poorly maintained roads, reach remote areas, and provide cost-effective services, have made this mode of transport highly popular among the population of this region [7]. However, this mode of transportation has also been linked to a growing number of road accidents, with significant socioeconomic and health consequences. In Senegal, limited data are available on road traffic accidents involving motorcyclists. We found it pertinent to study the factors associated with road traffic accidents among motorcyclists in the Kaolack health district in 2019.

2. Methodology

2.1. Study Framework

The Kaolack region is located in central Senegal, situated between the southern Sahelian and northern Sudanian zones. Together with the Kaffrine, Fatick, and Diourbel regions, it forms the heart of Senegal's groundnut basin. In 2019, the population was estimated at 1,155,433 inhabitants. The Kaolack region is predominantly agricultural, with 65% of the active population engaged in farming. Commercial activities drive the regional economy and

represent its most dynamic sector.

The road network in the region is relatively extensive, covering 1,677 km, facilitating accessibility within and to the region. In recent years, the growth of motorcycle taxi services has played a significant role in urban and inter-regional transportation. In 2019, the region had one hospital, four health districts, and four health centers. Additionally, there were 113 health posts and 226 health huts [8].

2.2. Type and Period of Study

A cross-sectional, descriptive, and analytical study was conducted during the first half of 2019.

2.3. Study Population

The study population consisted of all active motorcyclists in the Kaolack health district.

2.4. Sampling

2.4.1. Selection Criteria

Any motorcyclist aged 18 years or older and residing in the Kaolack health district was eligible for inclusion in the study. Among eligible individuals, those who declined to participate were not included.

2.4.2. Sample Size Calculation

The sample size was calculated using a 50% prevalence of road traffic accidents in the absence of local data. This resulted in a minimum required sample size of 384 individuals, determined using Schwartz's formula $N = \frac{z^2 PQ}{i^2}$ with a 5% margin of error and a 5% alpha risk. The sample size was then rounded up to 400 individuals.

The following Schwartz formula was used:

$n = \frac{z^2 pq}{i^2}$; reduced gap = 1.96; p: estimated prevalence = 50%; q: complement of p $q = 1 - p = 0.5$; i: precision = 0.05.

$N = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2$

$N = 384$; the sample size N was rounded up to 400 motorcyclists

2.4.3. Sampling Procedure

The sampling was based on a two-stage random survey. In the first stage, 20 parking points were randomly selected from all those identified within the district. In the second stage, 20 motorcyclists were also randomly chosen from the list of motorcyclists provided by the parking point manager. A total of 400 individuals were included in the study.

2.5. Data Collection

A questionnaire designed based on a literature review on

the subject was developed in alignment with the study's objectives. It was used to collect data through direct administration to motorcyclists, primarily conducted at their busiest parking points. The questionnaire was administered in person. At each location, an initial discussion was held with the parking point manager and the motorcyclists to explain the study's objectives. The maximum duration of an interview was 30 minutes.

Operational definition of variables

Alcohol consumption

This variable was defined as the self-reported frequency of alcohol consumption by the driver, with four initial response categories (always, sometimes, rarely, never). For analysis purposes, "always" and "sometimes" were recoded as Yes, while "rarely" and "never" were recoded as No.

Night driving

This variable referred to the self-reported frequency of driving at night (always, sometimes, rarely, never). For the analysis, "always" and "sometimes" were coded as Yes, and "rarely" and "never" as No.

Driving in the rain

This variable measured the frequency of driving under rainy conditions as reported by the driver (always, sometimes, rarely, never). In the analysis, "always" and "sometimes" were grouped as Yes, while "rarely" and "never" were grouped as No.

Road traffic accident

This variable was defined as having ever been a victim of at least one road traffic accident during one's lifetime (Yes/No).

2.6. Data Analysis

Quantitative variables were described using the mean, median, mode, and standard deviation. For qualitative variables, both absolute and relative frequencies were calculated.

In the analytical section, both bivariate and multivariate analyses were performed, with cross-tabulations between variables to address the study objectives. The dependent variable was being a victim of a road traffic accident. The Chi-square test or Fisher's exact test, depending on their applicability conditions, were used. A test was considered significant if the p-value was less than 0.05.

Variables with a p-value < 0.25 were introduced into the model using simple logistic regression with R software [9]. The adjusted odds ratio along with its confidence interval was used to quantify the strength of the associations found.

2.7. Ethical Considerations

Authorization for the survey was obtained from the Chief Medical Officer of the Kaolack Health District before the study began. After a verbal explanation of the purpose and interest of the study, a consent form was offered to participants before submission of the questionnaire. Data were collected anonymously and confidentially using identification codes, and

no personal identification was left on the questionnaire.

3. Results

3.1. Socio-demographic Characteristics

A total of 400 motorcyclists participated in the study, with the average age being 27.5 years. The majority of participants were male (99.8%). More than half of the participants were unmarried, representing 57%. Motorcycle taxi drivers were the predominant group (61%). Less than a quarter of the motorcyclists in the Kaolack district were uneducated, accounting for 23.8%. Almost all motorcyclists (91%) resided in the Kaolack region (Table 1).

3.2. Knowledge and Practices

The majority of drivers were aware of the protective helmet, accounting for 99.3% of the drivers. Only 7% of motorcyclists were familiar with a motorcycle insurance company. Those who had received first aid training for road emergencies represented 17.5%. The average driving experience among motorcyclists was 7.3 years. Of them, 17.8% held a driving license, 4.5% had a motorcycle identification number, and 1.3% had motorcycle insurance. More than a third of participants (34.5%) had received training on traffic rules. Half of the motorcyclists (50%) drove at night. About 8.3% of motorcyclists self-reported alcohol consumption. More than a quarter (27%) drove without lights at night or at dawn. Approximately three-quarters of participants (76.2%) drove without a protective helmet, and over half (58.5%) transported more than one passenger. Additionally, 50% of them used their mobile phone while driving. The majority of motorcyclists (71.3%) drove every day of the week. Only 9% had ever participated in a road safety education session (Table 2).

3.3. Accident Characteristics

More than half of the motorcyclists, 63.7%, had been victims of a road traffic accident. The accident primarily involved a collision between two motorcycles (38.8%). Poor driving and speeding were the main causes of accidents, accounting for 36.9% and 33.7%, respectively. Less than half of the accident victims were transported to the hospital (43.5%). The mode of transportation to the hospital was non-medicalized for more than half of the victims (53.1%). Hospital costs were mainly covered by the victims themselves (55%). A proportion of 7.2% of motorcyclists had sustained injuries, which were physical disabilities in 50% of cases and post-traumatic stress in 30% of cases (Table 3).

3.4. Factors Associated with Road Accidents Among Motorcyclists

Road traffic accidents were influenced by factors such

as the duration of motorcycle use, nighttime driving, alcohol consumption, transporting more than one passenger, motorcycle ownership, and residing outside the Kaolack health district.

Individuals living outside the Kaolack district were four times more likely to be involved in a road traffic accident than those residing within the district (aOR = 3.7 [1.4-9.7]). Riding a motorcycle for at least five years posed a twofold higher risk

of an accident compared to those with less than five years of motorcycle use (aOR = 1.8 [1.5-3.0]). The same was true for owning a motorcycle (aOR = 1.9 [1.1-3.0]), driving at night (aOR = 1.8 [1.1-2.9]), and transporting more than one passenger (aOR = 2.0 [1.2-3.2]). Furthermore, drivers who consumed alcohol were three times more likely to be involved in an accident than those who did not drink alcohol (aOR = 3.1 [1.5-3.4]) (Table 4).

Table 1. Socio-demographic characteristics (N=400).

Socio-demographic characteristics	Absolute frequency (N)	Relative frequency (%)
Sexe		
Men	399	99,8
Female	1	0,2
Marital status		
Bride	172	43
Unmarried	228	57
Instruction		
Yes	305	76,2
No	95	23,8
Profession		
Motorcycle cab driver	247	61,8
Worker	54	13,5
Student	35	8,8
Driver	20	5,0
Teacher	13	3,3
Shopkeeper	5	1,3
Tailor	4	1,0
Farmer	4	1,0
Other	18	4,6

Table 2. Knowledge and practices of motorcyclists.

Knowledge and practices	Absolute frequency (N)	Relative frequency (%)
Knowledge		
Helmet knowledge		
Yes	397	99,3
No	3	0,7
Knowledge of a motorcycle insurance company		
Yes	28	7
No	372	93

Knowledge and practices	Absolute frequency (N)	Relative frequency (%)
Highway code training		
Yes	138	34,5
No	262	65,5
Participation in an educational session on road safety.		
Yes	36	9
No	364	91
Roadside first aid training		
Yes	70	17,5
No	330	82,5
Possession of a driver's license		
Yes	71	17,8
No	329	82,2
Possession of a motorcycle identification number		
Yes	18	4,5
No	382	95,5
Possession of motorcycle insurance		
Yes	5	1,3
No	395	98,7
Practices		
Night driving		
Yes	200	50
No	200	50
Driving without lights at night or dawn		
Yes	108	27
No	292	73
Driving without a helmet		
Yes	305	76,2
No	95	23,8
Alcohol consumption		
Yes	33	8,3
No	367	91,7
Notion of carrying more than one passenger		
Yes	234	58,5
No	166	41,5
Cell phone use while driving		
Yes	200	50
No	200	50
Driving every day of the week		
Yes	285	71,3

Knowledge and practices	Absolute frequency (N)	Relative frequency (%)
No	115	28,7

Table 3. Accident characteristics.

Accident characteristics	Absolute frequency (N)	Relative frequency (%)
Have been the victim of a traffic accident		
Yes	255	63,7
No	145	36,3
Type of collision (N=255)		
Motorcycle	99	38,8
Car	83	32,5
Fall alone	50	19,6
Inert object	8	3,1
Animal	6	2,4
Person	5	2,0
Child	3	1,2
Cart	1	0,4
Causes of road accidents (N=255)		
Misconduct on the part of the driver of the collision vehicle	93	36,9
Excessive speed	86	33,7
Faulty road	28	11,0
Sleepiness	13	5,1
Loss of control	11	4,3
Technical failure of motorcycle	7	2,8
Animal break-in	4	1,6
Recklessness of motorcyclist	4	1,6
Telephoning while driving	4	1,6
Drunkenness	2	0,8
Pedestrian haste	2	0,8
Unlit or poorly lit road	1	0,4
Transport to hospital after accident (N=255)		
Yes	111	43,5
No	144	56,5
How to get to the hospital (N=111)		
Medical	52	46,9
Non-medicalized	59	53,1
Coverage of hospital costs (N=111)		
Victim herself	61	55

Accident characteristics	Absolute frequency (N)	Relative frequency (%)
Parents	34	30,6
Collision vehicle owner	14	12,6
Friend	2	1,8
Presence of after-effects following the accident (N=111)		
Yes	8	7,2
No	103	92,8
Type of after-effects (N=13)		
Headaches	2	15,4
Physical disability	5	38,4
Post-trauma stress	3	23,1
Other	3	23,1

Table 4. Factors associated with road accidents among motorcyclists in the Kaolack region.

Variables	OR [Ic à 95%]	P value
Socio-demographic characteristics		
Residence		
Kaolack	Ref	
Outside Kaolack	3,7 [1,4-9,7]	0,007
Road safety knowledge		
Number of sources of information on road safety		
>1 source	Ref	
≤1 source	2,5 [1,0-6,5]	0,059
Number of times witnessed in motorcycle accidents		
<10 accidents	Ref	
≥10 assisted	1,7 [1,1-2,7]	0,026
Behaviors		
Number of years riding motorcycles		
<5 ans	Ref	
≥5 ans	1,8 [1,5-3,0]	0,012
Motorcycle owner		
Other owners	Ref	
The driver himself	1,8 [1,1-3,0]	0,016
Driver's license		
Yes	Ref	
No	1,7 [0, 9-3, 0]	0,081
Riding a motorcycle at night		
No	Ref	

Variables	OR [Ic à95%]	P value
Yes	1,8 [1, 1-2, 9]	0,014
Motorcycle driving every day		
No	Ref	
Yes	1,6 [1, 0-2, 6]	0,061
Alcohol consumption		
No	Ref	
Yes	3,1 [1, 5-3, 4]	0,010
Driving with more than one supported person		
No	Ref	
Yes	2,0 [1, 2-3, 2]	0,006

4. Discussion

With the population growth in Senegal and the increase in the vehicle fleet, the pressure on the road network is intensifying. Travel, essential for carrying out daily activities such as work, leisure, shopping, and visits, now requires means of transportation that occupy a dominant place, both in urban space and time. As a result, to facilitate faster travel, more and more people are turning to the use of motorized two-wheelers.

4.1. Study Limits

However, this study has some limitations. The cross-sectional nature of the study does not allow for a clear establishment of a causal relationship between the associated factors and the occurrence of road traffic accidents. Furthermore, self-reporting of the event may introduce information bias. Whenever possible, the research team attempted to minimize these limitations during data collection.

4.2. Socio-demographic Characteristics

Almost all Jakarta drivers were men (99.8%). This male dominance could be linked to the higher number of men in road traffic, driving vehicles, and their bolder driving behaviors [10]. This male predominance is also reported by Sadmi K (2017) [11], who found that 97.87% of the drivers involved were men. Our results are higher than those found by Sangar é D [12], who also observed male dominance, with a rate of 88.9% compared to 11.1%

4.3. Knowledge and Practices of Motorcyclists

Regarding helmet knowledge, nearly all Jakarta motorcycle

drivers in the Kaolack region (99.3%) were aware of helmets. Cranial protection was the main benefit cited by Jakarta drivers in Kaolack (92.7%). Kumphong J, in his study on the determinants of helmet use [13], found that motorcyclists crossing intersections with a police booth were 2.2 times more likely to wear helmets than those crossing intersections without a police booth. In our study, we also observed that the drivers only had one helmet, even though these drivers typically carry at least one passenger. This poses a problem because the driver concerns themselves with their own safety, not the safety of the passenger they carry. As a result, in the event of an accident, the passenger is literally exposed to the risk of head injuries or death [14]. Kumphong J made a similar observation in Thailand [13], where drivers generally wore helmets at rates 2.7 times higher than passengers.

Only 17.8% of motorcycle drivers had a driver's license. These drivers claim they neither have the money nor the time to obtain a driver's license, especially since the enforcement of licenses is irregular [15]. The results found by Bousso A. and colleagues in a study conducted at the trauma service of Grand Yoff General Hospital in Dakar [16] were higher, with 40.5% of drivers holding a driver's license. Indeed, the level of road safety enforcement is much higher in Dakar.

Regarding phone usage, half of the motorcyclists used their phone while driving. They explain that phone use is inevitable because it is the only way for their clients, especially subscribers, to reach them. However, even though most of them claim they always answer with their helmet on, using the phone causes distractions for the driver, who is no longer attentive to the road, thus increasing the risk of accidents [17].

4.4. Accident Characteristics

More than half of the motorcyclists in Kaolack (63.7%) have been victims of a road accident. These accidents are steadily increasing in our regions due to the proliferation of high-speed vehicles, poor road conditions, and the failure to

comply with basic traffic rules [18]. Data from the Bulletin of Analysis of Bodily Injury Accidents (BAAC) highlight the extreme vulnerability of two-wheeled motor vehicle users: when involved in an accident, 7 out of 10 users sustain light injuries, and 2 out of 10 sustain serious injuries [19].

The accidents were most often moto-moto collisions (38.8%). A similar study conducted by Coulibaly Y [20] found that moto-moto collisions were the most common, accounting for 32.5% of cases.

In our study, 43.5% of motorcyclists were transported to the hospital. The mode of transport to the hospital was most often non-medicalized, representing 53.1% of the victims, even though most accidents cause injuries that require medical care [21]. This contrasts with a study conducted in Ouagadougou, where 91% of the transports used the services of Mobile Emergency and Resuscitation Units (SMUR), and 7% were non-medicalized [22]. Similarly, the study by Mchich FE in Morocco in 2019 [23] showed that 47.5% of victims were transported to the hospital by medicalized transport, with 33.3% using public ambulances and 14.4% using private ambulances, while 9% used their own means of transport.

4.5. Factors Associated with Road Accidents Among Motorcyclists

In our study, one of the factors associated with the occurrence of accidents among motorcyclists in the Kaolack district is residency. Indeed, accidents were four times more frequent among those who lived outside the Kaolack district compared to residents. This could be explained by the lack of driving experience and knowledge of proper driving practices among non-residents of Kaolack, most of whom lived in rural areas [24].

Another factor linked to accidents among motorcyclists is the duration of driving. Accidents were twice as frequent among those who had been riding a motorcycle for at least five years. They tend to adopt risky driving behaviors, as for them, the motorcycle is essentially a leisure activity, and they perceive their risk as low, even though they are actually dangerous [25].

Additionally, those who ride their own motorcycles were twice as likely to have an accident compared to those who rode someone else's motorcycle. This could be because those riding someone else's motorcycle tend to drive more cautiously to avoid damage and liability in case of an accident [26].

Similarly, the study showed that the risk of an accident was twice as high for those who drove at night. Although driving at night may seem safer due to less traffic, half of fatal accidents occur at night. Driving at night involves many risks [27]. A study by Sango HA [28] found similar results, showing an increased risk of accidents at night compared to the daytime.

The risk of an accident is three times higher among alcohol consumers. This finding is consistent with the report on road accidents in France in 2017, where 23% of motorcyclists involved in fatal accidents, whose blood alcohol levels were

known, had an alcohol level exceeding the legal limit [29]. The significant effect of alcohol on the risk of loss of control accidents has been demonstrated due to its weakening of driving abilities and sometimes a misjudgement of the driver's abilities when intoxicated [30]. Many studies have reported a high proportion of drivers under the influence of alcohol involved in accidents, including those involving at least one motorcycle [31]. A recent observational study from a trauma center in New York, conducted by Sethi M et al., analyzed data from 689 accident victims, with 15.1% having consumed alcohol before the accident.

The risk of accidents was twice as high for those transporting at least two passengers. Several factors could explain the frequency of accidents in such cases, such as the motorcycle's limited capacity to carry an excessive number of passengers, potentially causing a loss of balance and falling [32].

5. Conclusion

The burden of traffic accidents continues to increase worldwide, particularly among motorcyclists. This road carnage could be prevented through better preventive measures. Primary prevention will focus on preventing accidents and reducing risk factors by relying on three types of research: research on the vehicle, which will aim to equip it with all necessary tools to avoid collisions; research on the driver, which will aim to reform their behavior; and research on infrastructure, which will focus on reducing hazardous areas or using infrastructure to aid safer driving. Secondary prevention will focus on reducing the consequences of accidents, while tertiary prevention will aim to analyze accidents and improve the care provided to victims.

Abbreviations

aOR	Adjusted Odds Ratios
WHO	World Health Organization
BAAC	Bulletin of Analysis of Bodily Injury Accidents

Conflicts of Interest

The authors declare no conflicts of interest.

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