

## ORIGINAL ARTICLE

# MOTORCYCLE INJURIES: ACCIDENT CHARACTERISTICS AND USE OF PROTECTIVE EQUIPMENT

Ananda Cerqueira Barbosa de Vasconcelos<sup>1</sup>, Tatyane Silva Rodrigues<sup>2</sup>, Ana Maria Ribeiros dos Santos<sup>3</sup>, Maria Zélia de Araújo Madeira<sup>4</sup>, Elaine Maria Leite Rangel Andrade<sup>5</sup>

### ABSTRACT

**Objective:** Analyze the relationship among the occurrence of motorcycle injuries, the characteristics of traffic accidents, and use of protective equipment by motorcyclists.

**Method:** This is a correlational cross-sectional study conducted in an urgent care hospital in Teresina, State of Piauí, from December 2016 to April 2017, with 360 injured motorcyclists. Descriptive statistics were analyzed and associations were identified using the chi-square test and Fisher's exact test.

**Results:** Prevalence of injuries was observed in men of low school education level, with own motorcycle, but without a driver license. Also, statistically significant associations were found between the occurrence of head injuries; having a driver license; use of protective equipment; blood alcohol content; lower limb injuries; driving experience; and being economically active.

**Conclusion:** Findings demonstrate the importance of inspection to prevent motorcycle accidents and draw the attention of nursing researchers and professionals who assist this population to the importance of educational actions and campaigns, mainly of nurses in primary care.


**DESCRIPTORS:** External Causes; Traffic Accidents; Motorcycles; Wounds and Injuries; Trauma.


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<sup>1</sup>Nurse. Federal University of Piauí. Teresina, PI, Brazil. 

<sup>2</sup>Nurse. MSc in Nursing. Nursing Professor from Association of Higher Education of Piauí. Teresina, PI, Brazil. 

<sup>3</sup>Nurse. PhD in Science. Nursing Professor from Federal University of Piauí. Teresina, PI, Brazil. 

<sup>4</sup>Nurse. PhD in Medical Sciences. Nursing Professor from Federal University of Piauí. Teresina, PI, Brazil. 

<sup>5</sup>Nurse. MSc in Nursing Nursing Professor from Federal University of Piauí. Teresina, PI, Brazil. 

## LESÕES EM MOTOCICLISTAS: CARACTERÍSTICAS DO ACIDENTE E USO DE EQUIPAMENTOS PROTETIVOS

### RESUMO

*Objetivo: analisar a relação entre a ocorrência de lesões, as características do acidente de trânsito e uso de equipamentos protetivos por motociclistas.*

*Método: estudo transversal correlacional realizado em hospital de urgência em Teresina, estado do Piauí, de dezembro de 2016 a abril de 2017, com 360 motociclistas acidentados. Realizou-se estatística descritiva, verificaram-se as associações utilizando teste Qui-quadrado e Exato de Fisher.*

*Resultados: prevalência de lesões em homens, com baixa escolaridade, sem habilitação, porém com motocicleta própria. Constataram-se ainda associações estatisticamente significativas entre ocorrência de lesões na cabeça; existência de habilitação; uso de equipamento protetivo; alcoolemia; lesões em membros inferiores; tempo de condução; e ser economicamente ativo.*

*Conclusão: achados revelam importância da fiscalização para prevenção de acidentes motociclísticos. Direccionam a atenção de pesquisadores da enfermagem e de profissionais que assistem a essa população para a importância de ações e campanhas educativas, principalmente dos enfermeiros na atenção primária.*

*DESCRITORES: Causas Externas; Acidentes de Trânsito; Motocicletas; Ferimentos e lesões; Trauma.*

## LESIONES EN MOTOCICLISTAS: CARACTERÍSTICAS DEL ACCIDENTE Y USO DE EQUIPOS DE PROTECCIÓN

### RESUMEN

*Objetivo: Analizar la relación entre ocurrencia de lesiones, característica del accidente de tránsito y uso de equipos de protección en motociclistas.*

*Método: Estudio transversal, correlacional, realizado en hospital de urgencias de Teresina, Piauí, entre diciembre de 2016 y abril de 2017, participando 360 motociclistas accidentados. Se aplicó estadística descriptiva, verificándose las asociaciones por test de Chi-cuadrado y Exacto de Fischer.*

*Resultados: Hubo prevalencia de lesiones en hombres, de baja escolarización, sin licencia habilitante, aunque con motocicleta propia. Se constataron también asociaciones estadísticamente significativas entre lesiones de cabeza; licencia habilitante; uso de equipos de protección; alcoholemia; lesiones en miembros inferiores; tiempo de conducción y ser económicamente activo.*

*Conclusión: Los hallazgos revelan la importancia del control preventivo de accidentes motociclísticos, llamando la atención de investigadores de enfermería y otros profesionales que atienden a esta población, sobre la importancia de acciones y campañas educativas, particularmente de enfermeros, en atención primaria.*

*DESCRIPTORES: Causas Externas; Accidentes de Tránsito; Motocicletas; Heridas y Traumatismos; Trauma.*

## INTRODUCTION

Traffic accidents are a global public health problem. In 2012, these accidents were the main cause of death in the world among people aged 15 to 29 years, accounting for 1.2 million deaths in that year. In addition, around 50 million people have non-fatal injuries resulting from such accidents every year<sup>(1)</sup>. In Brazilian public hospitals, from 2002 to 2011, the rate of patients involved in land transportation accidents accounted for 15% of all hospitalizations due to external causes<sup>(2)</sup>.

In Brazil, the number of motorcyclists involved in motor vehicle accidents has increased since the 1990s, a result of poor quality of public transportation, leading to increased acquisition of motorcycles<sup>(3)</sup>. Easy acquisition, low maintenance cost, and growth in the delivery and transportation market have made motorcycles the main vehicle of many people, who also use it as a work vehicle<sup>(4-5)</sup>.

Although accessible, motorcycles offer less protection to drivers and passengers due to the lack of structures that guarantee safety<sup>(3)</sup>. Such vulnerability, as well as traffic conditions and driver practices, including alcohol intake, high speed and risky maneuvers, contribute to high accident rates<sup>(6-7)</sup>.

Victims of motorcycle accidents are mainly young male drivers<sup>(8-9)</sup>, causing an impact on the economically active population of the country<sup>(10)</sup>. Piauí, a Brazilian State, reported 540 deaths due to land transportation accidents in 2013<sup>(11)</sup>. A study conducted in the capital of Piauí in 2016 showed that, from 110 interviewees, 93 (84.5%) were motorcycle drivers. Among the victims, 109 (99.1%) had injuries, 38 (34.5%) of them were lower limb injuries<sup>(8)</sup>.

These injuries cause social and economic impacts, since victims present irreversible sequelae and involve costly hospitalizations and treatments, creating obstacles for social reintegration and causing emotional suffering<sup>(10)</sup>. In this perspective, initiatives have been developed aiming to reduce rates of traffic injuries and deaths, such as the Brazilian Traffic Code; Alcohol Prohibition Law, and the Traffic Life Project.

Despite the fact that traffic accidents with motorcycle are considered a health problem in Brazil, of multiple and complex causes, the literature has few studies that associate motorcycle injuries with characteristics of motorcycle accidents and inadequate use of protective equipment.

Then, a deep understanding of the relationship between these factors and the occurrence of injuries may help quantitatively reduce the severity of such events, since it will allow interventions targeting the identified aspects. Considering the above, this study aimed to analyze the relationship among the occurrence of injuries, the characteristics of traffic accidents, and use of protective equipment by motorcyclists.

## METHOD

This is a correlational cross-sectional study conducted in an urgent care hospital for victims of trauma, from December 2016 to April 2017

The study population consisted of motorcycle drivers hospitalized in the hospital above due to traffic accident traumas. The sample (n) was calculated by the equation  $n = z^2 \cdot p \cdot (1 - p) / e^2$ , where z is the quartile of normal distribution, p is the proportion of motorcyclists hospitalized in 2016 in the hospital where the study was conducted, and with a margin of error of 5%. Then, Cochran's correction formula was applied to finite populations<sup>(12)</sup>, leading to a sample of 360 injured motorcycle drivers.

The consecutive non-probability sample considered the following criteria: participants aged 18 years or older, motorcycle driver in a traffic accident hospitalized in the urgent

care hospital during the data collection period, patient able to fill data collection form, meet the Glasgow Coma Scale criteria. Participants readmitted due to complications of previous motorcycle accident were excluded.

Data were collected on a form developed by the researchers, which included sociodemographic data of the victims, accident characteristics, identification of the body region affected, and injury classification according to ICD-10, which was taken from patient records.

Data were inserted in Microsoft Excel, with double entry for correction of typing errors; data were later analyzed in the Statistical Package for the Social Sciences - SPSS for Windows (version 21.0). A descriptive statistical analysis was conducted, and associations between qualitative variables were obtained using the chi-square test and Fisher's exact test. The association hypothesis was accepted when  $p \leq 0.05$ . The crude odds ratio was calculated with a 95% confidence interval.

This study was approved by the Research Ethics Committee of Universidade Federal do Piauí, protocol 1.806.555.

## RESULTS

Table 1 shows the body regions of injuries according to sociodemographic data. Prevalence of injuries was observed in male participants, corresponding to 467 injuries in 324 participants. Of these, 65 (20.1%) were head injuries, 29 (9%) were thorax/abdomen injuries, 227 (70.1%) in the lower limbs, and 146 (45.1%) in the upper limbs. Most individuals were up to 59 years of age ( $n = 339$ ) who presented 235 (69.3%) and 157 (46.3%) injuries in the lower and upper limbs, respectively; 21 participants were over 60 years old, with two (9.5%) head injuries. Most participants were economically active ( $n=312$ ).

Table 1 – Injuries in motorcycle drivers according to sociodemographic variables ( $n=360$ ). Teresina, PI, Brazil, 2017 (continues)

	Head		Thorax/abdomen		Lower limbs		Upper limbs	
	Yes	No	Yes	No	Yes	No	Yes	No
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Sex								
Male	65 (20)	259 (80)	29 (9)	295 (91)	227 (70)	97 (30)	146 (45)	178 (55)
Female	5 (14)	31 (86)	4 (11)	32 (89)	25 (69)	11 (31)	16 (44)	20 (56)
Age group								
Up to 59 years	68 (20.1)	271 (79.9)	32 (9.4)	307 (90.6)	235 (69.3)	104 (30.7)	157 (46.3)	182 (53.7)
60 years or older	2 (9.5)	19 (90.5)	1 (4.8)	20 (95.2)	17 (81)	4 (19)	5 (23.8)	16 (76.2)
Economically active								
No	13 (27.1)	35 (72.9)	2 (4.2)	46 (95.8)	27 (56.3)	21 (43.8)	24 (50)	24 (50)

Yes	57 (18.3)	255 (81.7)	31 (9.9)	281 (90.1)	225 (72.1)	87 (27.9)	138 (44.2)	174 (55.8)
Skin color								
White	8 (14)	48 (86)	4 (7)	52 (93)	42 (75)	14 (25)	22 (39)	34 (61)
Brown	54 (22)	193 (78)	23 (9)	224 (91)	171 (69)	76 (31)	117 (47)	130 (53)
Black	8 (14)	48 (86)	6 (11)	50 (89)	38 (68)	18 (32)	23 (41)	33 (59)
Income								
No income/ Less than one MW*	30 (24)	94 (76)	10 (8)	114 (92)	89 (72)	35 (28)	53 (43)	71 (57)
One or more MW*	40 (17)	196 (83)	23 (10)	213 (90)	163 (69)	73 (31)	109 (6,2)	127 (53,8)
School education								
Illiterate/ Elementary education	37 (21)	142 (79)	15 (8)	164 (92)	133 (74)	46 (26)	79 (44)	100 (56)
High school/ Higher education	33 (18)	148 (82)	18 (10)	163 (90)	119 (66)	62 (34)	83 (46)	98 (54)

\*MW: minimum wage.

Regarding skin color, 247 (68.6%) of the injured drivers reported brown skin. Based on their socioeconomic profile, most victims 236 (65.5%) had incomes above one minimum wage. Regarding school education level, a more balanced result was obtained: 179 (49.7%) participants were illiterate or had elementary education, and 181 (50.2%) reported high school or higher education (Table 1).

Of all 360 injured drivers, 229 (63.6%) reported not owning a driver license or license in progress, although 278 (77.2%) reported own motorcycle, and 280 (77.7%) reported more than four years of driving experience. Regarding motorcycle engine, 294 participants had motorcycles over 125cc. Protective equipment at the moment of the accident was reported by 229 (63.6%) participants. Of all interviewees, 272 (75.5%) denied blood alcohol at the moment of the accident, and only 27 (7.5%) claimed to be professional motorcyclists.

Regarding the occurrence of injuries, data were analyzed by body region affected, grouped according to ICD 10 in the following regions: head, thorax/abdomen, upper limbs, and lower limbs.

Of the total number of participants with a head injury, 54 (23.6%) had no driver license. However, 55 (19.8%) reported owning a motorcycle, 53 (18.9%) had more than four years of driving experience, 55 (18.7%) had a motorcycle over 125cc, 41 (31.3%) reported no protective equipment at the moment of the accident, 44 (16.2%) did not report blood alcohol content, and 67 (20.1%) were not professional motorcyclists. Statistically significant associations were observed between the occurrence of this injury and the variables: having a driver license ( $p=0.009$ ), use of protective equipment ( $p<0.001$ ), and suspicion of blood alcohol content at the moment of the accident ( $p=0.006$ ) (Table 2).

Table 2 – Occurrence of head injuries among motorcyclists according to accident characteristics (n=360). Teresina, PI, Brazil, 2017

Variables	Head injury		p-value	Crude odds (CI 95%)
	Yes (N=70) n (%)	No (N=290) n (%)		
Has a driver license?				
Yes	16 (12.2)	115 (87.8)	<b>0.009</b>	1
No or in progress	54 (23.6)	175 (76.4)		2.218 (1.211-4.063)
Own motorcycle?				
Yes	55 (19.8)	223 (80.2)	0.764	1.102 (0.585-2.074)
No	15 (18.3)	67 (81.7)		1
Driving experience				
Up to 4 years	17 (21.3)	63 (78.8)	0.644	1.156 (0.626-2.134)
Over 4 years	53 (18.9)	227 (81.1)		1
Motorcycle engine				
Up to 115cc	14 (24.1)	44 (75.9)	0.341	1.383 (0.708-2.699)
> 125cc	55 (18.7)	239 (81.3)		1
Use of protective equipment				
Yes	29 (12.7)	200 (87.3)	<b>&lt;0.001</b>	1
No	41 (31.3)	90 (68.7)		3.142 (1.837-5.374)
Suspicion of blood alcohol content				
Yes	26 (29.5)	62 (70.5)	<b>0.006</b>	2.173 (1.241-3.805)
No	44 (16.2)	228 (83.8)		
Professional motorcyclist				
Yes	3 (11.1)	24 (88.9)	0.255	0.496 (0.145-1.697)
No	67 (20.1)	266 (79.9)		

Chi-square test. Fisher's exact test.

The relationship between thorax/abdomen injury and accident characteristics showed that 20 (8.7%) of all participants did not have a motorcycle driver license or were obtaining it. However, 26 (9.4%) reported having their own motorcycle, and 28 (10%) had more than four years of driving experience. Regarding motorcycle engine, 28 (9.5%) had motorcycle over 125cc, only 10 (7.6%) did not use protective equipment at the moment of the accident, and 11 (12.5%) reported blood alcohol content. Among those who presented thorax/abdomen injury, 31 (9.3%) were not professional motorcyclists.

The relationship between upper limb injury and accident characteristics showed that 100 (43.7%) of participants with upper limb injury had no motorcycle driver license or license in progress. However, 126 (45.3%) owned a motorcycle, 125 (44.6%) had more than four years of driving experience, and 131 (44.6%) had a motorcycle over 125cc. Among victims with upper limb injury, 67 (51.1%) reported no protective equipment. Suspicion of blood alcohol content was denied by 120 (44.1%) of all participants, 148 (44.4%) were not professional motorcyclists.

Table 3 relates lower limb injuries and accident characteristics. Of all participants

with these injuries, 160 (69.9%) reported no driver license or license in progress. However, 195 (70.1%) stated they had their own motorcycle, 204 (72.9%) had more than four years of driving experience, 207 (70.4%) had a motorcycle over 125cc, 89 (67.9%) reported no protective equipment, and 193 (71.0%) denied blood alcohol content. Among those with lower limb injuries, 229 (68.8%) were not professional motorcyclists. This type of injury presented the highest incidence, affecting 252 (70%) of injured drivers, and a statistical association was observed with driving years ( $p=0.027$ ).

Table 3 – Occurrence of lower limb injuries among motorcyclists according to accident characteristics (n=360). Teresina, PI, Brazil, 2017

Variables	Lower limb injury		p-value	Crude odds (CI95%)
	Yes (N=252) n (%)	No (N=108) n (%)		
Has a driver license?				
Yes	92 (70.2)	39 (29.8)	0.943	1
No or in progress	160 (69.9)	69 (30.1)		0.983 (0.615-1.571)
Own motorcycle?				
Yes	195 (70.1)	83 (29.9)	0.913	1.030 (0.603-1.761)
No	57 (69.5)	25 (30.5)		1
Driving experience				
Up to 4 years	48 (60.)	32 (40)	<b>0.027</b>	0.559 (0.333-0.939)
Over 4 years	204 (72.9)	76 (27.1)		1
Motorcycle engine				
Up to 115cc	39 (67.2)	19 (32.8)	0.631	0.863 (0.472-1.576)
> 125cc	207 (70.4)	87 (29.6)		1
Use of protective equipment				
Yes	163 (71.2)	66 (28.8)	0.519	1
No	89 (67.9)	42 (32,1)		0.858 (0.539-1.366)
Suspicion of blood alcohol content				
Yes	59 (67)	29 (33)	0.487	0.833 (0.497-1.395)
No	193 (71)	79 (29)		
Professional motorcyclist				
Yes	23 (85.2)	4 (14.8)	0.073	2.611 (0.881-7.742)
No	229 (68.8)	104 (31.2)		

Chi-square test. Fisher's exact test.

## DISCUSSION

According to socio-demographic data, this study had a predominance of male participants. Studies conducted in Sobral and Teresina in the last two years found similar

results. They found 68% and 87.3% male participants<sup>(8-9)</sup>. Sociocultural issues show that, despite an increase in female motorcyclists, most motorcycle drivers are still male<sup>(13)</sup>. In addition, men tend to expose themselves to more risks and risky maneuvers as they feel they have better driving skills than women<sup>(6)</sup>.

Regarding the age group, this study showed that young adults are the population most affected by motorcycle accidents, in agreement with other studies in this field<sup>(9,13-14)</sup>. This finding is associated with inability, inexperience, optimism regarding risks, and excessive speed among young drivers<sup>(6)</sup>.

However, the percentage of elderly victims of motorcycle accidents found in this study should be noted, which is similar to a study conducted in 2017<sup>(9)</sup>, as 9.5% of them had a head injury. A study on the epidemiological profile of hospitalizations due to head trauma shows the lethality of this injury has a maximum value among individuals over 60 years of age, due to an increase in life expectancy and vulnerability to traffic accidents related to aging<sup>(15)</sup>.

A study conducted in several Brazilian capitals showed a predominance of black/brown color in motorcycle accidents, in agreement with this study. However, a study conducted in the west region of Santa Catarina had 95% of white interviewees<sup>(16)</sup>. Such divergence is due to the high demographic and cultural miscegenation resulting from the presence of diverse ethnical groups in the country.

Regarding school education, a study showed protective equipment becomes more frequent as the level of instruction increases<sup>(17)</sup>. Data from the municipality of Picos, in Piauí, reported accident victims with incomplete elementary education and no income, representing 40% and 55%, respectively<sup>(18)</sup>. Divergent findings in a study conducted in São Paulo show victims with high school education and income of 1-2 minimum wages<sup>(19)</sup>.

These findings show that low income is directly related to the level of education, which may be associated with a low level of traffic education. The high accident rates among the Northeastern population<sup>(11)</sup> showed educational improvements are required<sup>(18)</sup>.

Most interviewees had no driver license, which agrees with data found in the literature. Data from Piauí and Maranhão show 52.7% and 62.5%, respectively, of motorcycle accident victims without driver license<sup>(8,17)</sup>. Data from the capital of Rondônia point to lack of driver license as one of the causes of traffic accidents, besides blood alcohol content and poor knowledge of traffic safety and education<sup>(20)</sup>.

This study also showed that, although without driving skills, most interviewees had their own motorcycle. This finding can be justified by the easy acquisition of motorcycle, low maintenance costs<sup>(21)</sup>, and the fact that a motorcycle can be bought without a driver license in Brazil. Poor traffic inspection results in greater risks, since unsafe practices such as the lack of helmet are common<sup>(22)</sup>.

The prevalence of lower limb injuries followed by upper limb injuries is consistent with other Brazilian studies<sup>(9,19)</sup>. Regarding the age of injured motorcyclists, disabling sequelae are observed among the economically active population of the country. A study on social and hospital costs of motorcycle accidents showed that, even six months after of the accident, 73.5% of the interviewees were not able to resume their professional activities<sup>(19)</sup>.

Driver vulnerability is the main cause of injuries, since motorcycles do not provide protection in situations of collision<sup>(17,23)</sup>. Although not fatal, these injuries lead to changes in family dynamics, physical and psychological dependence, personal and health system expenses with hospital treatments, and reduced productivity due to work absenteeism<sup>(19)</sup>. Despite the frequency of limb trauma from motorcycle injuries reported in the studies, these investigations fail to provide preventive measures to reduce such injuries<sup>(9)</sup>.

The relationship between driver license and head injury was significant ( $p=0.009$ ). Lack of experience and overconfidence of young drivers with no legal age for a driver

license, lead to an increase in traffic accidents<sup>(13,24)</sup>. However, a study showed victims with more driving experience often learn how to drive with friends or relatives and acquire inadequate driving practices and consider driver license is just formality<sup>(19)</sup>.

In this perspective, having a driver license would imply greater knowledge and respect for traffic laws. However, in agreement with a study conducted in Ceará, the reality of Piauí shows a high number of unable motorcyclists due to poor inspection and obstacles to obtaining a driver license<sup>(18)</sup>.

Use of protective equipment at the moment of the accident showed a significant association with head injury ( $p < 0.001$ ). A study conducted in Kenya found similar results and associated helmet use with relevant reduction of head injuries<sup>(25)</sup>.

Helmets are the main protective equipment required by law<sup>(17)</sup>. A direct relationship was observed between failure to use a helmet and the occurrence of traumatic brain injury (TBI) in a documental study, since 86% of 270 TBI victims did not wear a helmet at the moment of the accident<sup>(14)</sup>, so it is the main cause of mortality and severe sequelae among motorcyclists<sup>(20)</sup>. However, although drivers agree with the mandatory use of a helmet, they do not use it properly<sup>(19)</sup>. This reality is mainly justified by the lack of inspection and traffic education<sup>(2,26-27)</sup>.

Just like this study, an observational study on blood alcohol content among motorcyclists found 39.1% of interviewees reporting alcohol intake at the moment of the accident<sup>(9)</sup>. This study identified a statistical association between suspicion of blood alcohol content at the moment of the accident and head injury ( $p < 0.006$ ).

The effect of alcohol on driving a motorcycle was reported as one of the most common causes of fatal injuries and accidents<sup>(9)</sup>. This relationship between alcohol intake and absent helmet was demonstrated in a study conducted in Ceará, which differs from this study of lower rates: 86.7% of interviewees reported no helmet and 61.5% reported alcohol intake<sup>(14)</sup>.

Alcohol intake reduces motor and cognitive responses and provides driver overconfidence<sup>(28)</sup>, leading to failure to use protective equipment, risky maneuvers, increased exposure on public roads, and, consequently, accidents with severe sequelae or death<sup>(29)</sup>.

Less than four years of driving experience showed an association with lower limb injury ( $p = 0.027$ ). This statistical relationship can be explained by the greater exposure to risks due to driver inexperience and poor traffic education<sup>(20)</sup>, especially those under the legal age for a driver license<sup>(23)</sup>, associated with lower limb vulnerability.

The existing limitation is due to the studied population, as this study was conducted in only one hospital, which although being a reference service in Piauí, it may not represent the reality of other places. The findings showed the need for traffic education and constant inspection with interventions to prevent motorcycle accidents, and other traffic accidents in general.

## CONCLUSION

This study reported the prevalence of injuries among young male drivers of low school education, income of at least one minimum wage, and most drivers had no driver license, but owned a motorcycle. This reality, when related to statistical associations between helmet use, driver license and blood alcohol content versus head injuries, as well as the frequency of lower limb injuries associated with driving experience, is a complex occurrence that represents an important health issue.

Sharing these results will attract the attention of nursing researchers and professionals

that serve this population to the importance of educational actions and campaigns, mainly of nurses in primary care.

Characterization of motorcyclists involved in traffic accidents and accident characteristics can guide interventions to reduce morbidity and mortality due to this type of accident. In this perspective, preventive measures are suggested, such as rigorous inspection, traffic education, and incentive to proper use of protective equipment, particularly among male motorcyclists at a productive age. Also, further studies should be conducted in more than one service, using different study designs on this subject, seeking data to support the development of intersectoral interventions aiming to ensure safe traffic.

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**Corresponding author:**

Ananda Cerqueira Barbosa de Vasconcelos

Universidade Federal do Piauí

R. Lincoln Fontenele Guimarães, 120 – 64053-240 - Teresina, PI, Brasil

E-mail: [ananda.anibal@gmail.com](mailto:ananda.anibal@gmail.com)

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