

## Motorcycle Accidents: Morbidity and Associated Factors in a city of Northeast of Brazil

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**Abstract:** Motorcycle accidents are becoming a public health problem in developing world. The objective of this paper was to assess the factors related to morbidity and mortality among victims of motorcycle accidents in a trauma center. An analysis of 9,734 medical records of patients hospitalized for external causes at the Regional Emergency and Trauma Hospital of Campina Grande, Paraíba, Brazil, from January to December 2009 was done. The cases of accidents with motorcycles accounted for 20.8% of all hospital care, mostly affecting men (85.8%) aged 21-29 years old (33.9%). Legs and feet (55.2%) and arms and hands (26.9%) were the most affected parts of the body. The association between the occurrence of motorcycle accident affecting the face ( $p=0.001$ ), the chest ( $p<0.001$ ), arms and hands ( $p=0.004$ ) and legs and feet ( $p<0.001$ ) was observed. Multiple lesions were present in 40.4% of the cases; and the majority (80.6%) involved fractures. Amputation and functional impairment were observed in 15.3% and 4.3% of the victims, respectively. Vascular lesions in the lower limbs had a 3.5 times higher chance of occurrence among injured motorcyclists. Fatal accidents accounted for 1.3% of the injured victims. In conclusion, motorcycle accidents affect men, predominantly, most of them being young, causing fractures and multiple lesions, mainly in the lower limbs. There is need for greater incentive to actions concerning traffic safety education focusing on motorcyclists, as well as greater control by competent authorities as regards to the use of motorcycles in the country.

**Keywords:** accidents, traffic, morbidity, mortality, motorcycles, Brazil

### Introduction

In recent years, there has been a growing concern with the significant increase of individuals injured as a result of accidents involving motorcycles in a number of countries (Naci *et al.*, 2009). Despite the use of motorcycles as a major means of transport in some countries (Fitzharris *et al.*, 2009; Haquea *et al.*, 2009; Oluwadiyaa *et al.*, 2009), or even as an instrument of leisure in others (Bevan *et al.*, 2008; Jamaa *et al.*, 2011; Mikocka-Walus *et al.*, 2010; Weiss *et al.*, 2010), these vehicles constitute a means of transport considered very risky (Nunn, 2011). This is because they do not have safety devices to the entire body or protection structure for drivers and passengers (Albalate & Fernández-Villadangos, 2010). In this context, motorcyclists are considered one of the groups most vulnerable to transport accidents (Peden *et al.*, 2004; WHO, 2009). In Brazil, motorcycles are the second largest fleet of vehicles; but they are responsible for the highest death rate due to traffic accidents. In Singapore, motorcycles constitute about 19% of all vehicles; yet they are responsible for only 36% of total accidents (Haquea *et al.*, 2008). In Great Britain, motorcycles account for less than 1% of vehicles, but drivers suffer 14% of total deaths and serious injuries in roads (Clarke *et al.*, 2007).

In Brazil, most of the population makes use of motorcycles to move around. Motorcycles are also used as a work vehicle for taxi motorcyclists and delivery men. Moreover, this means of transport has lower cost compared to others and is accessible to low-income people who use it as locomotion vehicle (Cavalcanti *et al.*, 2011). Considering that motorcycle accidents are a major cause of injuries related with fatalities and disabling injuries (MacLeod *et al.*, 2010), several studies have attempted to identify how individual (sex, age, licensing), behavioral (over-speed, alcohol use), geophysical (structure of roads) and situational factors (impact objects) may be linked to the greater involvement of motorcyclists in traffic accidents (Nunn, 2011; Savolainen & Mannering, 2007; Haquea *et al.*, 2008; Oluwadiyaa *et al.*, 2009; Albalate & Fernández-Villadangos, 2010).

Given the importance of understanding the magnitude of road accidents for the implementation of public policies, the objective of this study was to evaluate the factors associated with morbidity and mortality among victims of motorcycle accidents at a trauma

center in a city in north-eastern Brazil. In order to understand the magnitude of accidents involving motorcyclists, the Trauma and Emergency Hospital of Campina Grande was selected for the conduction of this study. This choice was due to the fact that this institution represents the only public health service with high complexity, which is reference for the treatment of patients affected by external causes in the semiarid region of the state of Paraiba.

## **Materials and Methods**

### **Study area and medical record review**

This study was conducted in Campina Grande, which is the second most important city in the state of Paraiba, Brazil. The city is about 130 km from the capital of Paraiba State and is located in the "Agreste" region in the eastern region of the Borborema plateau. The city has an estimated population of 371,060 habitants and a municipal human development index (HDI) value of 0.72.

The study sample included an analysis of 9,734 medical records. The sample consisted of all medical records of children and adults affected by motorcycle accidents, duly verified and hospitalized due to injuries at the Regional Emergency and Trauma Hospital of Campina Grande, Paraiba, from January to December 2009.

The following variables were analyzed: age group, sex, date of the accident, the injured region of the body (head, face, thorax, arms and hands, legs and feet), number of injuries (single and multiple), presence of vascular lesion, number of surgical interventions, presence of fracture, functional impairment, limb amputation and death.

### **Data analysis**

Data analysis involved descriptive statistics (frequency distribution) and analytic statistics. For inferential analyses, Odds Ratio was used as a measure of association. Pearson's chi-square was used to test for statistical differences between comparisons groups with significance level set at 95%. The statistical programme used was SPSS (Statistical Package for Social Sciences) version 15.

### **Ethical considerations**

This study was conducted in compliance with the ethical guidelines issued by the Resolution 196/96 of the Brazilian National Health Council/Ministry of Health on research involving human subjects. The research project was independently reviewed and approved by the Ethics in Research Committee of the State University of Paraiba, Brazil.

## **Results**

Cases of motorcycle accidents accounted for 20.8% (n=372) of hospitalizations due to external causes, and 319 victims, (85.8%) were men with a sex ratio of 6.0:1. Men were two times more likely to suffer motorcycle accident compared to women. Majority of victims were in the age group 21-29 years old (33.9%) with 41.9% of cases reported to have occurred over the weekend days (Saturday and Sunday). The percentages of motorcycle accidents were higher in the following age groups: 21-29 years (33.9%), 30 to 39 years (28.3%) and 40-49 (22.2%) and the lowest in the age group 0- 9 years (0.9%) and 60 or older (9.5%) (Table 1).

When analyzing body part that was injured, legs and feet (55.2%) and arms and hands (26.9%) were the most affected regions and victims of motorcycle accidents were 2.59 times more likely to suffer injuries on legs and feet. There was association between the occurrence of motorcycle accidents with injuries on face ( $p = 0.001$ ), thorax ( $p < 0.001$ ), arms and hands ( $p = 0.004$ ), legs and feet ( $p < 0.001$ ). The percentage of victims who had lesions on face (17.4% versus 10.9%) and legs and feet (55.2% versus 32.2%) were higher among those who have suffered motorcycle accidents (Table 2).

**Table 1: Occurrence of motorcycle accidents by age, sex and day of the week**

Variable		Motorcycle accidents				Total	P-value	OR (IC95%)
		Yes		No				
		N	%	N	%			
Age group	0 – 9	2	0.9	216	99.1	218	< 0.001	-
	10 – 20	53	16.1	277	83.9	330	-	-
	21 – 29	151	33.9	295	66.1	446	-	-
	30 – 39	86	28.3	218	71.7	304	-	-
	40 – 49	40	22.2	140	77.8	180	-	-
	50 – 59	18	16.5	91	83.5	109	-	-
	≥60	18	9.5	172	90.5	190	-	-
	Total†	368	20.7	1409	79.3	1777	-	-
Sex	Male	319	232	1057	76.8	1376	< 0.001	2.05(1.50-2.81)
	Female	53	12.8	360	87.2	413		1.00
	Total	372	20.8	1417	79.2	1789		
Day	Weekends	156	26.7	428	73.3	584	< 0.001	1.67 (1.32 – 2.11)
	Weekdays	216	17.9	989	82.1	1205		1.00
	Total	372	20.8	1417	79.2	1789		

Key: †- Information was missing in four medical records; Weekends= Saturday and Sunday; Weekdays= Monday-Friday

**Table 2: Association between body part that was injured and the occurrence of motorcycle accidents**

Body part		Motorcycle accidents				Total	P-value	OR (IC95%)	
		Yes		No					
		N	%	N	%				
Head	Yes	22	6.0	71	5.1	93	5.3	0.527	1.17 (0.72 – 1.92)
	No	346	94.0	1309	94.9	1655	94.7		1.00
Face	Yes	64	17.4	151	10.9	215	12.3	0.001	1.71 (1.25 – 2.36)
	No	304	82.6	1229	89.1	1533	87.7		1.00
Thorax	Yes	32	8.7	268	19.4	300	17.2	< 0.001	1.00
	No	336	91.3	1112	80.6	1448	82.8		2.53 (1.72 – 3.72)
Arms and hands	Yes	99	26.9	481	34.9	580	33.2	0.004	1.00
	No	269	73.1	899	65.1	1168	66.8		1.45 (1.13 – 1.88)
Legs and feet	Yes	203	55.2	444	32.2	647	37.0	< 0.001	2.59 (2.05 – 3.28)
	No	165	44.8	936	67.8	1101	63.0		1.00

Regarding the number of lesions, 40.4% of victims had multiple lesions and 69.7% required a single surgical intervention. The presence of fractures was observed in 80.6% of patients. There was an association between the occurrence of motorcycle accidents with the number of lesions ( $p < 0.001$ ), number of surgical interventions ( $p < 0.001$ ) and presence of fractures ( $p < 0.001$ ). Victims of motorcycle accidents were 3.5 times more likely to have vascular lesions in the lower limbs and 7.8 times more likely to suffer bone fractures (Table 3).

The presence of functional impairment was observed in 15.3% of the victims, while the occurrence of amputation was 4.3%. The number of deaths recorded was extremely low (1.3%). There was association between the occurrence of motorcycle accidents and the existence of functional impairment ( $p=0.002$ ) and the presence of limb amputation ( $p=0.010$ ), so that victims of motorcycle accidents were 2.2 times more likely to suffer amputation (Table 4).

**Table 3: Number of lesions, presence of vascular lesion in the lower limbs, number of surgical interventions and presence of fractures associated with motorcycle accidents**

Variable	Motorcycle accidents				Total Group		P-value	OR (IC95%)
	Yes		No		n	%		
	N	%	n	%				
<b>No. of lesions</b>								
Single	220	59.6	1006	71.4	1226	69.0	< 0.001	1.00
Multiple	149	40.4	403	28.6	552	31.0		1.69 (1.33 - 2.14)
<b>Vascular lesion in the lower limbs</b>								
Yes	8	57.1	18	27.3	26	32.5	0.056	3.56 (1.08 - 11.68)
No	6	42.9	48	72.7	54	67.5		1.00
<b>No. of surgical interventions</b>								
No treatment	76	20.5	454	32.3	530	29.9	< 0.001	1.00
One	258	69.7	865	61.6	1123	63.3		1.78 (1.35 - 2.36)
Two or more	36	9.7	85	6.1	121	6.8		2.53 (1.60 - 4.00)
<b>Fractures</b>								
Yes	300	80.6	491	34.7	791	44.2	< 0.001	7.86 (5.94 - 10.39)
No	72	19.4	926	65.3	998	55.8		1.00

**Table 4: Number (proportion) of functional impairment, limb amputation and death due to motorcycle accidents**

Variable	Motorcycle accidents				Total Group		p-value	OR (IC95%)
	Yes		No		n	%		
	n	%	n	%				
<b>Functional impairment</b>								
Yes	57	15.3	137	9.7	194	10.8	p = 0.002	1.69 (1.21 - 2.36)
No	315	84.7	1280	90.3	1595	89.2		1.00
<b>Limb amputation</b>								
Yes	16	4.3	28	2.0	44	2.5	p = 0.010	2.23 (1.19 - 4.17)
No	356	95.7	1389	98.0	1745	97.5		1.00
<b>Death</b>								
Yes	5	1.3	22	1.6	27	1.5	p = 0.769	1.00
No	367	98.7	1395	98.4	1762	98.5		1.16 (0.44 - 3.08)

## Discussion

In recent years, injuries caused by traffic accidents have become one of the main causes of death and disability worldwide (Peden *et al.*, 2004; WHO, 2009). Several countries (Clarke *et al.*, 2007; Savolainen & Mannering, 2007; Albalate & Fernández-Villadangos, 2010), including Brazil (Reichenheim *et al.*, 2011), have experienced a considerable increase in the number of accidents involving motorcycles in response to the significant growth in the number of these vehicles. Despite its widespread use, the significant number of motorcycle accidents shows the vulnerability of motorcyclists due to the lower stability of motorcycles compared to other vehicles (Mallikarjuna & Krishnappa, 2009) and greater body exposure of the motorcyclists (Jain *et al.*, 2009; Albalate & Fernández-Villadangos, 2010; Saadat & Soori, 2011). In association with the previously mentioned factors, it is important to emphasize that traffic disorganization, failure in vehicle inspection, poor maintenance conditions, reckless driving and the impunity of infringers, significantly contribute to the occurrence of traffic accidents, especially involving motorcyclists (Bastos *et al.*, 2005; Reichenheim *et al.*, 2011).

Analyzing the profile of motorcyclists in this study, a predominance of male victims was observed. Similar findings have been reported by other studies (Fitzharris *et al.*, 2009; Jain *et al.*, 2009; Nunn, 2011; Talving *et al.*, 2010; Weiss *et al.*, 2010). In terms of age, individuals in the third decade were among the most affected, which corroborates other findings (Mallikarjuna & Krishnappa, 2009; Weiss *et al.*, 2010; Hashim & Iqbal, 2011). Thus, it is important to emphasize that the greater involvement of young male individuals in motorcycle accidents is mainly the result of the reckless driving of such vehicles (Bacchieri & Barros, 2011; Saadat & Soori, 2011).

More than one third of accidents observed in this study occurred over the weekend, similar to results found in studies in Australia (Jamaa *et al.*, 2011), New Zealand (Jamaa *et al.*, 2011), United States (Nunn, 2011) and India (Mallikarjuna & Krishnappa, 2009). Santos *et al.* (2008) have observed that there is three times greater chance of accidents over the weekend among motorcyclists who had used alcohol. In this sense, although the high number of accidents occurred on weekends is suggestive for association with alcohol consumption, this study did not obtain data about the alcohol consumption of motorcyclists. Alcohol consumption among Brazilian drivers involved in traffic accidents is considered very common (Bacchieri & Barros, 2011; Reichenheim *et al.*, 2011).

This study identified that the body part most frequently injured were the upper and lower limbs, similar to results reported by others (Gawryszewski *et al.*, 2003; Sirathranont & Kasantikul, 2003; Talving *et al.*, 2010). Consistent with this study, cases of limb amputations associated with motorcycle accidents were also reported by other authors (Obalum & Okeke, 2009; Talving *et al.*, 2010). Another important aspect related to limb injuries found in this study relates to vascular lesions in the lower limbs. Cases of vascular lesions in the lower limbs are also associated with significant rates of limb loss and functional impairment (Bechara & Huynh, 2007). In this context, it is noteworthy that although not considered vital regions, lesions in body extremities can result in long morbidity periods (Kraus *et al.*, 2002).

Although this study found no statistically significant difference between the occurrence of head injuries and motorcycle accident, several studies have shown that the head is one of the body parts most injured in accidents involving motorcycles (Kraus *et al.*, 2002; Oluwadiyaa *et al.*, 2009; Fitzharris *et al.*, 2009), especially among drivers and passengers not using helmets (Soumitra *et al.*, 1995; Fitzharris *et al.*, 2009; Crompton *et al.*, 2011). The use of helmets has been reported to reduce the mortality rate from 37%-40% (Mikocka-Walus *et al.*, 2010; Crompton *et al.*, 2011) of cases of motorcycle accidents, and reduce by 65% the possibility of traumatic brain injury (Crompton *et al.*, 2011). Therefore, the use of helmet is important, since head injury is a cause commonly associated with death and long-term disability (MacLeod *et al.*, 2010). Although in this study, thorax injuries were few, other studies have shown that this region can be frequently affected by motorcycle accidents (Soumitra *et al.*, 1995; Kraus *et al.*, 2002; Mikocka-Walus *et al.*, 2010; Talving *et al.*, 2010).

The number of fatally injured motorcyclists found in this study was proportionally low. However, the high proportion of bone fractures showed by the majority of motorcyclists involved in accidents attracts attention, demonstrating that they are eight times more likely to be injured in case of accidents. Consistent with these findings, the presence of fractures in different body parts has been reported in other studies (Sirathranont & Kasantikul, 2003; Crandon *et al.*, 2009; Oluwadiyaa *et al.*, 2009; Talving *et al.*, 2010). Due to the bone involvement, victims of fractures require longer hospital stays, as they need intervention procedures that require longer follow-up and recovery time (Amin *et al.*, 2011).

One of the limitations of this study is the source of data. One of the difficulties in working with secondary data lies in the fact that in many situations, the incomplete recording of information prevents the transcription of findings. In this study, some medical records were not properly filled, preventing the acquisition of some information of interest.

In conclusion, accidents involving motorcycles predominantly affect young men, causing multiple fractures and injuries, especially in the lower limbs. The cases of limb amputation and

functional impairment involving motorcyclists show the severity of accidents associated with this type of road transportation.

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