Characteristics of motorcyclists involved in road traffic accidents attended at public urgent and emergency services

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Abstract Injuries resulting from motorcycle road traffic accidents are an important public health issue in Brazil. This study aimed to describe the characteristics of motorcyclists involved in traffic accidents attended in public urgent and emergency services in the state capitals and the Federal District. This is a cross-sectional study based on data from the Violence and Accident Surveillance System (VIVA Survey) in 2014. Data were analyzed according to sociodemographic, event and attendance characteristics. Proportional differences between genders were analyzed by chi-square test (Rao-Scott) with 5% significance level. Motorcyclist-related attendances (n = 9,673) reported a prevalence of men (gender ratio = 3.2), young people aged 20-39 years (65.7%), black / brown (73.6%), paid work (76.4%). Helmet use was reported by 79.1% of the victims, 13.3% had consumed alcohol in the six hours prior to the accident, 41.4% of the events were related to the victim’s work. Accidents were more frequent on weekends, in the morning and late afternoon. These characteristics can support the development of public accident prevention policies and health promotion.

Key words External causes, Road traffic accidents, Motorcycles, Emergency treatment, Epidemiology
Introduction

Injuries resulting from road traffic accidents are a global problem, which results in social, psychological, economic, welfare and environmental impacts, as well as overburden health services. According to the World Health Organization (WHO), in 2013, road traffic-related deaths and injuries accounted for a total cost of 3% of various national Gross Domestic Product (GDP), and this cost was even greater in low- and middle-income countries, at 5% of GDP. Also according to the WHO estimates, about 1.25 million deaths from road traffic injuries are recorded annually, which represents more than 3,400 deaths per day, corresponding to 12% of all deaths worldwide.

In Brazil, road traffic accident-related injuries (ATT) are the second leading cause of death among all deaths due to external causes, with higher incidence in the population aged 15-39 years. In 2014, these accidents were responsible for the death of 43.8 thousand people, and 12,652 of these deaths occurred among motorcyclists. In that same year, 96,292 hospital admissions of motorcyclists were recorded, resulting in a cost of R$ 126 million (US$ 46.7 million), which represented 52% of total expenditure with hospital ATT victims for the Unified Health System (SUS).

Causality of motorcycle accidents is multifactorial and related to the following aspects: vulnerability due to the type of vehicle, motorcycle fleet steep rise, road and vehicle safety, risk behaviors and the increasing use of this vehicle as a work instrument without a work safety-oriented approach.

Since 2006, the Ministry of Health has been monitoring ATT-related emergency care in public urgent and emergency services in the state capitals and the Federal District through the (VIVA Survey), a sentinel surveillance mode. This type of monitoring enables the analysis of the trend of this type of service, complementing the information on the profile of victims and types of events.

Among the various VIVA Survey data publications, specific results of motorcyclist-related accidents attendances had not yet been disclosed. Thus, the current study aims to describe characteristics of motorcyclists involved in road traffic accidents treated at public urgent and emergency services in the Brazilian state capitals and the Federal District in 2014.

Methodology

This is a cross-sectional study on the attendances of motorcyclist-related road traffic accidents obtained from the VIVA Survey study conducted in 2014 in 86 urgent and emergency care services of the SUS located in the Federal District and 24 Brazilian state capitals. State capitals Florianópolis/SC and Cuiabá/MT did not participate in the survey due to local issues related to management and technical and operational aspects.

The facilities of each participating capital that met the following criteria were included in the sample: (a) external causes-related emergency care reference services following a search in the National Register of Health Facilities (CNES) and the Hospital Information System of the Unified Health System (SIH/SUS); (b) services participating in one or more earlier study editions: 2006, 2007, 2009 and 2011. The inclusion of selected services was validated by coordinators of the Noncommunicable Diseases and Illnesses Surveillance Department (DANT) of state and municipal health secretariats participating in the research, due to their knowledge of local flows of external causes-related emergency services. More information can be found in specific publications.

The sample size was at least 2,000 attendances for external causes in each of the state capitals and the Federal District, assuming a coefficient of variation of less than 30% and standard error of less than 3. In each capital, data were collected only in drawn shifts from a total of sixty 12-hour shifts, covering a period of 30 consecutive days, from September to November 2014. The 12-hour shifts draw procedure used was the single-stage cluster probability sampling stratified by type of establishment (general emergency, emergency care facilities and specialized emergencies), and shift was the primary sampling unit. All external causes-related attendances in the drawn shift of the selected establishment were eligible for interview. Cases where patients sought the same service for the second time or more than twice for the same cause, medical care returns and care-derived complications were excluded.

Data were collected through a standardized questionnaire applied by trained interviewers. Attendance was classified into two groups: violence and accidents. The definitions of 10th revision of the International Classification of Diseases and Related Health Problems (ICD-10) related
to Chapter XX-External causes of morbidity and
mortality were used to identify the type of event
that led to seeking care

According to ICD-10 definitions, a motorcyclist is any person traveling on a motorcycle, side-
car or a trailer attached to this vehicle, including
drivers or passengers. The analysis was restrict-
ed to motorcyclists treated at public urgent and
emergency services and emergency following a
road traffic accident.

We considered the following analysis categories: 1) sociodemographic characteristics (gen-
der, age group in years, self-reported race / skin
color, schooling years of study, paid work, health
insurance plan, disabilities - physical, mental, vi-
sual, hearing and other disabilities / syndromes); 2) Characteristic of event (type of victim, other
party involved, nature of injury, affected body
part, helmet use, alcohol consumption, work-
related event); and 3) characteristics of attendance
(transportation to the hospital, prior care and
outcome).

Analyses were performed in Stata’s “svy”
module, version 14, for obtaining unbiased es-
timates when data stem from complex sample
designs. The differences between qualitative
variables were analyzed by chi-square test (Rao-
Scott) with 5% significance level.

The 2014 VIVA Survey 2014 data was evalu-
ed and approved by the National Research Ethics
Commission (CONEP), the Ministry of Health.
Data collection was performed following consent
of victims or their legal guardians or accompany-
ing persons, when under 18 or if they were un-
conscious victims.

### Results

The 2014 VIVA Survey recorded 15,433 ATT-re-
lated emergency attendances, of which 9,673
(gross percentage = 62.7%) were due to mo-
torcycle accidents. It was observed that motor-
cyclist-related road traffic accidents were more
frequent on weekends (Friday, Saturday and
Sunday) and less frequent on Wednesdays. The
same pattern was observed in the distribution of
attendances by day of the week (Figure 1A).

As for the time of events, accidents were
more frequent in early morning and late after-
noon, with peaks at about 7am (6.3%) and 6pm
(7.3%), respectively. Time with higher incidence
of attendances was 8am (6.5%) and 8pm (7.1%)
(Figure 1B).

Table 1 shows the distribution of frequencies
and weighted percentages of the main features of
these attendances, disaggregated by gender of the
victim, showing a ratio of 3.2 for male-female at-

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ed in study (Table 2). The highest proportion of alcohol consumption declared at the time of the accident by patients attended in selected services was recorded in Teresina (Figure 3).

Victims’ work relationship with the event was reported by 41.4% of victims, with a significantly higher proportion of men (43.7%) (Table 1). The proportion of work-related events was more than 50% in selected services of Goiânia (50.6%), Belo Horizonte (51.0%), Recife (51.2%), São Paulo (54.7%), Porto Alegre (55.6%), Curitiba (59.7%), Brasília (61.0%) and Vitória (61.5%) (Figure 4).

Regarding the characteristics of the attendance, we noted that access to health services occurred, more often, via the SAMU/ambulance/rescue (46.7%) and private vehicle (43.6%). Public transportation was used in less than 6% of cases. Approximately 25% of patients reported prior care in another service for the same cause, with no difference between genders. The out-

**Figure 1.** Distribution of urgent and emergency care for motorcycle road traffic accidents by day (A) and time (B) of event and attendance. Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.


* Except Florianópolis/SC and Cuiabá/MT.
Come of patients after initial treatment varied according to gender: the proportion of discharge was higher in females (73.5%), while the proportion of hospitalization was higher in males (24.9%) (Table 2).

**Discussion**

The study showed that young people aged 20-39 years and males were the main victims of motorcyclist-related ATTs, among SUS urgent and emergency services selected in state capitals and the Federal District in 2014. These results are consistent with other research on the topic, indicating that it is a serious public health problem, which must continue to be the target of more effective public prevention policies.

One of the reasons contributing to the increase of motorcycle accidents cases refers to the lack of use of protective equipment. Head traumas injuries are directly related to the lack of helmet use, which is mandatory in the country, which demands increased enforcement and educational campaigns. A study on road safety by the World Health Organization (WHO) has shown...
Table 2. Urgent and emergency care for motorcycle road traffic accidents, by event and attendance characteristics and by gender – Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Male (n = 7,355)</th>
<th>Female (n = 2,318)</th>
<th>Total (n = 9,673)</th>
<th>p**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Of the event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victim type</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Driver</td>
<td>6,657 (90.4)</td>
<td>1,161 (47.3)</td>
<td>7,818 (80.9)</td>
<td></td>
</tr>
<tr>
<td>Passenger</td>
<td>713 (9.6)</td>
<td>1,159 (52.7)</td>
<td>1,872 (19.1)</td>
<td></td>
</tr>
<tr>
<td>Other party involved</td>
<td></td>
<td></td>
<td></td>
<td>0.317</td>
</tr>
<tr>
<td>Car</td>
<td>2,984 (44.0)</td>
<td>916 (43.8)</td>
<td>3,900 (44.0)</td>
<td></td>
</tr>
<tr>
<td>Motorcycle</td>
<td>1,003 (13.5)</td>
<td>347 (14.6)</td>
<td>1,350 (13.8)</td>
<td></td>
</tr>
<tr>
<td>Bus / Minibus</td>
<td>166 (2.5)</td>
<td>52 (2.4)</td>
<td>218 (2.5)</td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td>93 (1.1)</td>
<td>32 (1.4)</td>
<td>125 (1.2)</td>
<td></td>
</tr>
<tr>
<td>Fixed object</td>
<td>469 (6.8)</td>
<td>127 (5.8)</td>
<td>596 (6.6)</td>
<td></td>
</tr>
<tr>
<td>Animal</td>
<td>375 (4.8)</td>
<td>100 (3.7)</td>
<td>475 (4.6)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1,858 (27.3)</td>
<td>613 (28.3)</td>
<td>2,471 (27.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Nature of injury</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>No injury</td>
<td>184 (2.3)</td>
<td>98 (4.1)</td>
<td>282 (2.7)</td>
<td></td>
</tr>
<tr>
<td>Bruise / sprain / strain</td>
<td>1,990 (30.8)</td>
<td>789 (38.4)</td>
<td>2,779 (32.5)</td>
<td></td>
</tr>
<tr>
<td>Cut / laceration</td>
<td>2,544 (31.0)</td>
<td>746 (27.4)</td>
<td>3,290 (30.2)</td>
<td></td>
</tr>
<tr>
<td>Fracture / amputation / traumaa</td>
<td>2,397 (33.4)</td>
<td>591 (27.2)</td>
<td>2,988 (32.0)</td>
<td></td>
</tr>
<tr>
<td>Otherb</td>
<td>153 (2.5)</td>
<td>68 (3.0)</td>
<td>221 (2.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Body part affected</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.004</td>
</tr>
<tr>
<td>Head / neck</td>
<td>717 (9.8)</td>
<td>171 (8.7)</td>
<td>888 (9.5)</td>
<td></td>
</tr>
<tr>
<td>Chest / abdomen / pelvis</td>
<td>451 (6.5)</td>
<td>121 (5.9)</td>
<td>572 (6.4)</td>
<td></td>
</tr>
<tr>
<td>Upper limbs</td>
<td>1,535 (21.1)</td>
<td>407 (17.7)</td>
<td>1,942 (20.4)</td>
<td></td>
</tr>
<tr>
<td>Lower limbs</td>
<td>2,554 (37.5)</td>
<td>944 (42.7)</td>
<td>3,498 (38.7)</td>
<td></td>
</tr>
<tr>
<td>Multiple organs / parts</td>
<td>1,928 (25.1)</td>
<td>576 (25.0)</td>
<td>2,504 (25.1)</td>
<td></td>
</tr>
<tr>
<td><strong>Helmet use</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.442</td>
</tr>
<tr>
<td>No</td>
<td>1,414 (20.7)</td>
<td>439 (21.7)</td>
<td>1,853 (20.9)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5,694 (79.3)</td>
<td>1,791 (78.3)</td>
<td>7,485 (79.1)</td>
<td></td>
</tr>
<tr>
<td><strong>Alcohol consumption</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>No</td>
<td>5,920 (85.2)</td>
<td>2,048 (91.8)</td>
<td>7,968 (86.7)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,197 (14.8)</td>
<td>201 (8.2)</td>
<td>1,398 (13.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Work-related event</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>No</td>
<td>3,849 (56.4)</td>
<td>1,296 (67.1)</td>
<td>5,145 (58.6)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2,409 (37.7)</td>
<td>512 (32.9)</td>
<td>2,921 (41.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Of the attendance</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.519</td>
</tr>
<tr>
<td>Transport to hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking / bus / minibus</td>
<td>296 (6.1)</td>
<td>74 (5.2)</td>
<td>370 (5.9)</td>
<td></td>
</tr>
<tr>
<td>Private car</td>
<td>3,123 (43.3)</td>
<td>1,030 (44.6)</td>
<td>4,153 (43.6)</td>
<td></td>
</tr>
<tr>
<td>SAMU / ambulance / rescue</td>
<td>3,656 (46.7)</td>
<td>1,128 (46.8)</td>
<td>4,784 (46.7)</td>
<td></td>
</tr>
<tr>
<td>Otherc</td>
<td>257 (3.9)</td>
<td>68 (3.3)</td>
<td>325 (3.8)</td>
<td></td>
</tr>
<tr>
<td>Previous care in another facility</td>
<td></td>
<td></td>
<td></td>
<td>0.225</td>
</tr>
<tr>
<td>No</td>
<td>5,410 (72.8)</td>
<td>1,788 (74.4)</td>
<td>7,198 (73.2)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,851 (27.2)</td>
<td>508 (25.6)</td>
<td>2,359 (26.9)</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Discharge</td>
<td>4,871 (67.7)</td>
<td>1,679 (73.5)</td>
<td>6,550 (69.0)</td>
<td></td>
</tr>
<tr>
<td>Hospitalizationd</td>
<td>1,726 (24.9)</td>
<td>435 (19.9)</td>
<td>2,161 (23.8)</td>
<td></td>
</tr>
<tr>
<td>Outpatient referral</td>
<td>497 (6.0)</td>
<td>142 (5.6)</td>
<td>639 (6.9)</td>
<td></td>
</tr>
<tr>
<td>Othere</td>
<td>80 (1.4)</td>
<td>17 (1.1)</td>
<td>97 (1.3)</td>
<td></td>
</tr>
</tbody>
</table>

* Except Florianópolis/SC and Cuiabá/MT. ** The number of attendances for some variables diverged due to missing data (unknown / blank). b Percentage weighted for sample design. c Chi-square association test (Rao-Scott). d Includes head trauma, dental trauma and polytrauma. e Includes poisoning, burns and other. f Includes police car and other. g Includes hospitalization and referral to other service. h Includes evasion / escape, death and other.
Figure 2. Self-declared helmet use among urgent and emergency care for motorcycle road traffic accidents – Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

*Except Florianópolis/SC and Cuiabá/MT.

Figure 3. Self-declared consumption of alcoholic beverages among urgent and emergency care for motorcycle road traffic accidents –Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

*Except Florianópolis/SC and Cuiabá/MT.
that proper use of helmets reduces by 40% the risk of death and up to 70% the risk of serious head injuries. The Brazilian Traffic Code (CTB) requires the use of helmets as safety items for motorcyclists, which is critical to avoid more serious consequences in the event of road traffic accidents.

Motorcycles are one of the most dangerous forms of motorized transport, due to the small size and direct exposure to the impact, which makes its passengers most vulnerable to multiple and more severe traumas. In fact, unlike cars, motorcycles are not equipped with structure and protection devices, which highly exposes its occupants, and motorcycle accidents result in a risk of death 30 times higher when compared to occupants of other motor vehicles.

Causality of motorcycle accidents is multifactorial and is associated with socioeconomic and environmental determinants, such as schooling, income, access to transportation, condition of roads and highways, systematic checks, vehicle maintenance, fleet increase and correlation with some risk factors, such as lack of personal protective equipment such as helmets, drinking and driving, speeding, vehicle vulnerability, among others.

Analysis evidenced every frequent identification of motorcycle accident as a work-related event. Work-related events may be due to commuting to work, depending on the use of motorcycles as a fast-moving means in big cities’ road traffic. The National Health Survey identified that 30% of accidents were due to commuting to work. Other situations may be included, such as professional bikers, which may be subject to requirements such as pressure from customers for fast, on time and reliable services can be included; high demand for services; poor labor relations; large uncontrollable circumstances, such as rain and road conditions; driver inexperience; vehicle maintenance and faster transport compensation mechanisms. These issues require more than behavioral change, introducing issues related to safety conditions at work, as well as understanding and tackling factors that influence risky driving behavior. It is noteworthy that these events were reported in cities like Vitória, Brasília, Curitiba and Porto Alegre. Further local studies are suggested to understand these local differences.
Drinking and driving was also high in the study. Vehicle driving after alcohol consumption is a major cause of ATTs as it impairs drivers' reflexes and increases risky choices, such as traffic laws violations. High alcohol concentrations in the blood produce various neuromotor disorders, such as decreased attention, false perception of speed, excitement and difficulty of discerning luminosities, drowsiness and reduced peripheral vision. In Brazil, according to survey results of the Risk and Protection Factors for Chronic Noncommunicable Diseases by Telephone Survey (VIGITEL) held in 2014, the frequency of adults who reported driving motor vehicles following alcohol consumption ranged from 3 to 14% in the Brazilian state capitals.

Another highlight is the increased fleet of vehicles, especially motorcycles, reflecting the deterioration of road traffic conditions and increased traffic. Motorcycle'sparticipation in total vehicle fleet in the country increased from 18.2% in 2004 to 26.6% in 2014. During this period, the motorcycle fleet in Brazil went from 7 million to 23 million, that is, an increase of 223.3%, recording 345% in the Northeast and 323.8% in the North.

Factors such as increased fleet and less supervision in the North and Northeast may explain the higher mortality rates in these regions. This study confirms these findings by pointing lower frequencies of helmet use in the Northeastern and Northern state capitals, and higher frequency of alcohol use, above 20% in Teresina, Natal, Aracaju, Maceió and Salvador. These data coincide with findings of the National Health Survey, pointing to less frequent use of helmets in those regions and a higher prevalence of road traffic accidents in these locations.

From 2004 to 2013, motorcyclists' risk of death increased from 2.8 to 6.0 deaths per 100,000 inhabitants. High ATT-related morbidity and mortality rates in Brazil have been associated with the current transportation system model, which prioritizes roads and private car use to the detriment of collective public transport, with inadequate infrastructure, lack of enforcement and poor public transport, as well as increased vehicle fleet in urban centers, lack of regulatory and educational actions, high speed and varying types of vehicles.

A study analyzing the profile of motorcyclists' polytrauma events attended by the Mobile Emergency Service (SAMU) assigned the highest frequency of accidents during the weekend, the large number of festive events, alcohol consumption, exceeding speed limit, risky maneuvers and decreased enforcement during these days.

Another study revealed that motorcyclists are three times more likely to be involved in accidents from Thursday through Sunday, when there is increased consumption of alcohol, than between Monday through Wednesday, when such consumption decreases. In the survey, over 40% of attendances occurred at night. A number of factors can explain this, namely: accumulated fatigue, increased flow of vehicles, varying visibility limited by the range of headlights, vehicles without signals, less police supervision, disregarding traffic signs, excessive speed and use of alcohol or drugs.

Among the limitations of the study, we mention the sole inclusion of public urgent and emergency services, leaving out emergency units of private hospitals. We chose to use public services to be references to accidents and violence in Brazilian cities, which already follow consolidated emergency service flows, from pre-hospital care to inpatient services. Another limitation refers to the inability to provide population estimates, although most public services focus on emergency care for external causes.

**Conclusion**

Knowledge of the profile of attendance demanded by motorcycle accidents in urgent and emergency services and some features of these events are crucial to design strategies to tackle this public health problem. It is necessary to understand the size and characteristics of the problem to promote health and prevent road traffic injuries and deaths through intersectoral actions. This study contributes to reveal characteristics of the problem and support the implementation of public policies of prevention and promotion of health and peace in traffic and traffic victims' care. It is essential to strengthen road traffic laws and develop road safety actions for the sake of human mobility.
Collaborations

MDM Mascarenhas, RMCV Souto and DC Malta participated in the preparation of the study design, literature review and wording of the preliminary version; MMA Silva and CM Lima contributed to the wording and critical analysis of the text; MDM Mascarenhas and MMS Montenegro tabulated and analyzed the data; all authors approved the final version.
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