

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*

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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 GDP¹. 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 worldwide¹.

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)².

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^{1,3} and the increasing use of this vehicle as a work instrument without a work safety-oriented approach⁴.

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 events⁵⁻⁷.

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^{6,7}.

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, sidecar or a trailer attached to this vehicle, including drivers or passengers. The analysis was restricted 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 (gender, age group in years, self-reported race / skin color, schooling years of study, paid work, health insurance plan, disabilities - physical, mental, visual, 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 estimates 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 evaluated 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 accompanying persons, when under 18 or if they were unconscious victims.

Results

The 2014 VIVA Survey recorded 15,433 ATT-related emergency attendances, of which 9,673 (gross percentage = 62.7%) were due to motorcycle accidents. It was observed that motorcyclist-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 afternoon, 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 attendances. Regarding sociodemographic aspects, the largest proportion of attendances was observed among patients aged 20-39 years (65.7%), a statistically significant difference between genders ($p < 0.001$). There was a predominance of self-declared black/brown patients (73.6%), especially among men (74.7%), people with nine years of schooling and over (59.2%), where the highest proportion was observed among women (66.7%), and mention of paid work occurred in 76.4% of patients, with a higher proportion of men (80.9%). Some kind of reported disability was higher among men (1.9%). These variables were statistically significant different in their distribution among genders ($p < 0.001$). Less than 10% of the victims had a health insurance plan and 1% of them identified themselves as people in vulnerable situations, with no significant difference between genders.

Regarding event characteristics, 80.9% were drivers and 19.1% passengers. The proportion of drivers was significantly higher in males (90.4%), while women were more passengers (52.7%). As for the other party involved in the accident, car came first (44%), followed by motorcycle (13.8%), with no difference between genders. Injuries such as cuts, lacerations, fractures, amputations and traumas were more common in males, while light injuries were predominant in females ($p < 0.001$). Most injuries affected lower limbs; this location was significantly most often affected among female victims, while the proportion of upper limbs injuries was significantly higher in males (Table 2).

Helmet use at the time of the accident was reported by 79.1% of patients, with similar distribution among genders (Table 2). The lowest proportions of reference to helmet use were observed in patients treated in selected services in Teresina (55.8%), Belém (61.5%), Rio de Janeiro (64.0%), Natal (64.8%), Manaus (65.7%), João Pessoa (66.8%), Fortaleza (67.8%), Aracaju (67.8%), Maceió (71.0%) and Recife (71.8%). The highest proportion of reference to helmet use was observed among patients treated in selected services in Belo Horizonte (97.2%) (Figure 2).

Reference to alcohol use in the six hours before the event was significantly higher among men (14.8%) compared to women (8.2%), totaling 13.3% for all the emergency services includ-

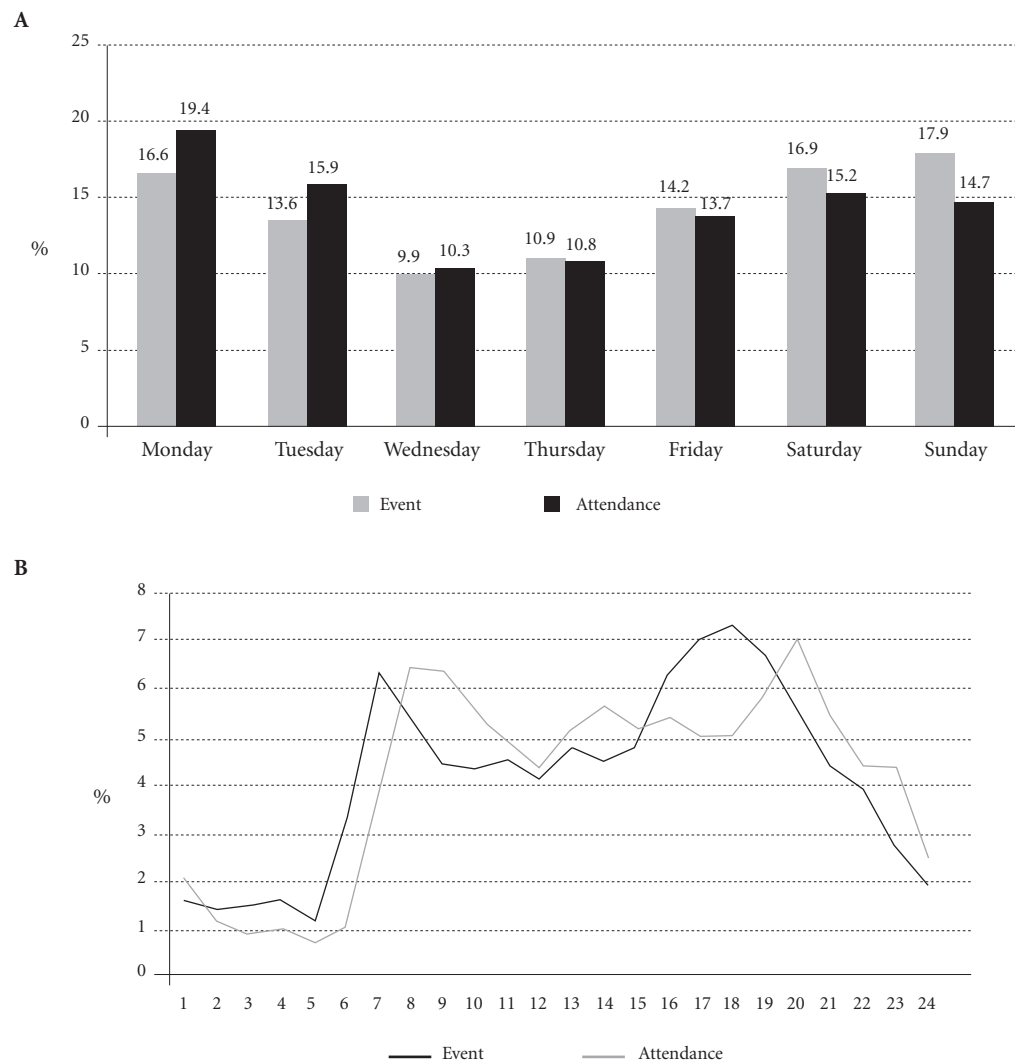


Figure 1. Distribution of urgent and emergency care for motorcycle road traffic accidents by day (A) and time (B) of event and attendance. Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

Source: Ministry of Health, Secretariat of Health Surveillance, Violence and Accident Surveillance System –VIVA, 2014 Survey.
* Except Florianópolis/SC and Cuiabá/MT.

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-

Table 1. Urgent and emergency care for motorcycle road traffic accidents, by sociodemographic characteristics and gender – Selected services in 24 capitals** and the Federal District, Brazil, from September to October, 2014.

Sociodemographic characteristics	Gender**						p##
	Male (n = 7,355)		Female(n = 2,318)		Total (n = 9,673)		
	n	%#	n	%#	n	%#	
Age group (years)							< 0.001
0 to 9	61	0.7	53	2.2	114	1.0	
10 to 19	1,034	13.7	438	18.8	1,472	14.9	
20 to 39	4,763	66.1	1,477	64.2	6,240	65.7	
40 to 59	1,352	17.6	323	13.8	1,675	16.8	
60 and over	145	1.9	27	1.0	172	1.7	
Race/skin color							< 0.001
White	1,401	23.3	536	27.1	1,937	24.1	
Black/Brown	5,760	74.7	1,697	69.6	7,457	73.6	
Yellow / Indigenous	177	2.1	77	3.3	254	2.3	
Years of schooling							< 0.001
0 to 8	3,026	43.0	731	33.3	3,757	40.8	
9 and over	3,774	57.0	1,444	66.7	5,218	59.2	
Performs paid work							< 0.001
No	1,480	19.1	959	39.8	2,439	23.7	
Yes	5,578	80.9	1,269	60.2	6,847	76.4	
Has health insurance plan							0.210
No	6,575	91.3	2,076	90.1	8,651	91.0	
Yes	516	8.7	176	9.9	692	9.0	
Has some kind of disability ^a							0.002
No	7,073	98.1	2,260	99.2	9,333	98.4	
Yes	142	1.9	25	0.9	167	1.7	
Vulnerable population ^b							0.358
No	7,140	99.0	2,260	99.3	9,400	99.0	
Yes	71	1.0	21	0.7	92	1.0	

Source: Ministry of Health, Secretariat of Health Surveillance, Violence and Accident Surveillance System –VIVA, 2014 Survey.

* Except Florianópolis/SC and Cuiabá/MT. ** The number of attendances for some variables diverged due to missing data

(unknown / blank). # Percentage weighted for sample design. ## Chi-square association test (Rao-Scott). ^a Includes physical, mental, visual, hearing impairments and other disabilities / syndromes. ^b Includes gypsy, Quilombola, villager, people living in the streets and other.

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^{6,7}, 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, while 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.

Characteristics	Gender**						p ^{##}
	Male (n = 7,355)		Female (n = 2,318)		Total (n = 9,673)		
	n	% [#]	n	% [#]	n	% [#]	
Of the event							< 0.001
Victim type							
Driver	6,657	90.4	1,161	47.3	7,818	80.9	
Passenger	713	9.6	1,159	52.7	1,872	19.1	
Other party involved							0.317
Car	2,984	44.0	916	43.8	3,900	44.0	
Motorcycle	1,003	13.5	347	14.6	1,350	13.8	
Bus / Minibus	166	2.5	52	2.4	218	2.5	
Bicycle	93	1.1	32	1.4	125	1.2	
Fixed object	469	6.8	127	5.8	596	6.6	
Animal	375	4.8	100	3.7	475	4.6	
Other	1,858	27.3	613	28.3	2,471	27.5	
Nature of injury							< 0.001
No injury	184	2.3	98	4.1	282	2.7	
Bruise/sprain/strain	1,990	30.8	789	38.4	2,779	32.5	
Cut/laceration	2,544	31.0	746	27.4	3,290	30.2	
Fracture/amputation/traumas ^a	2,397	33.4	591	27.2	2,988	32.0	
Other ^b	153	2.5	68	3.0	221	2.6	
Body part affected							0.004
Head / neck	717	9.8	171	8.7	888	9.5	
Chest / abdomen / pelvis	451	6.5	121	5.9	572	6.4	
Upper limbs	1,535	21.1	407	17.7	1,942	20.4	
Lower limbs	2,554	37.5	944	42.7	3,498	38.7	
Multiple organs / parts	1,928	25.1	576	25.0	2,504	25.1	
Helmet use							0.442
No	1,414	20.7	439	21.7	1,853	20.9	
Yes	5,694	79.3	1,791	78.3	7,485	79.1	
Alcohol consumption							< 0.001
No	5,920	85.2	2,048	91.8	7,968	86.7	
Yes	1,197	14.8	201	8.2	1,398	13.3	
Work-related event							< 0.001
No	3,849	56.4	1,296	67.1	5,145	58.6	
Yes	2,409	43.7	512	32.9	2,921	41.4	
Of the attendance							
Transport to hospital							0.519
Walking / bus / minibus	296	6.1	74	5.2	370	5.9	
Private car	3,123	43.3	1,030	44.6	4,153	43.6	
SAMU / ambulance / rescue	3,636	46.7	1,128	46.8	4,764	46.7	
Other ^c	257	3.9	68	3.3	325	3.8	
Previous care in another facility							0.225
No	5,410	72.8	1,788	74.4	7,198	73.2	
Yes	1,851	27.2	508	25.6	2,359	26.9	
Outcome							< 0.001
Discharge	4,871	67.7	1,679	73.5	6,550	69.0	
Hospitalization ^d	1,726	24.9	435	19.9	2,161	23.8	
Outpatient referral	497	6.0	142	5.6	639	5.9	
Other ^e	80	1.4	17	1.1	97	1.3	

Source: Ministry of Health, Secretariat of Health Surveillance, Violence and Accident Surveillance System –VIVA, 2014 Survey.
^{*} Except Florianópolis/SC and Cuiabá/MT. ^{**} The number of attendances for some variables diverged due to missing data (unknown / blank). [#] Percentage weighted for sample design. ^{##} Chi-square association test (Rao-Scott). ^a Includes head trauma, dental trauma and polytrauma. ^b Includes poisoning, burns and other. ^c Includes police car and other. ^d Includes hospitalization and referral to other service. ^e Includes evasion / escape, death and other.

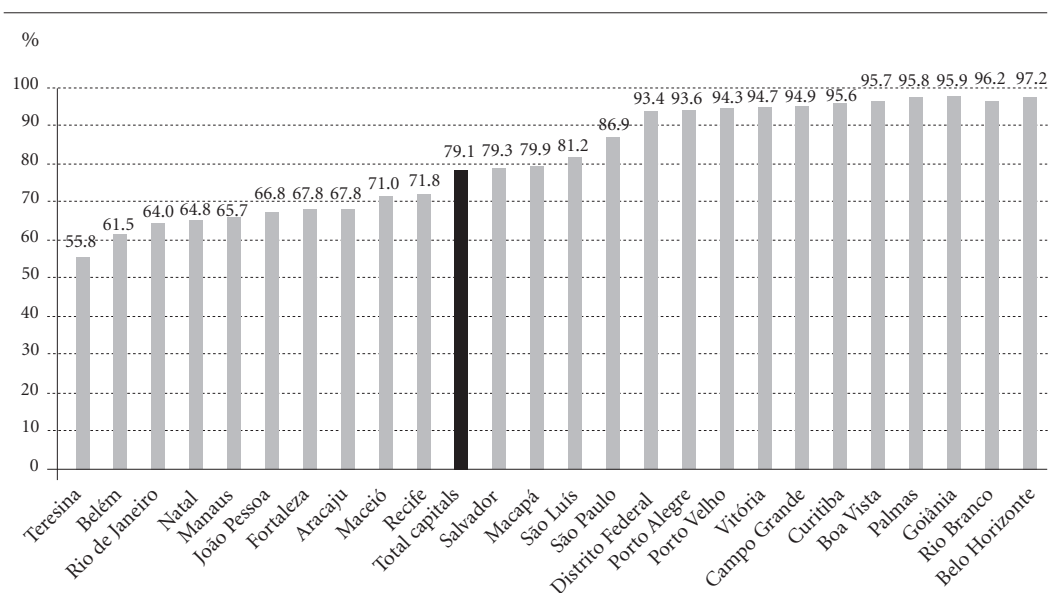


Figure 2. Self-declared helmet use among urgent and emergency care for motorcycle road traffic accidents – Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

Source: Ministry of Health, Secretariat of Health Surveillance, Violence and Accident Surveillance System –VIVA, 2014 Survey.
*Except Florianópolis/SC and Cuiabá/MT.

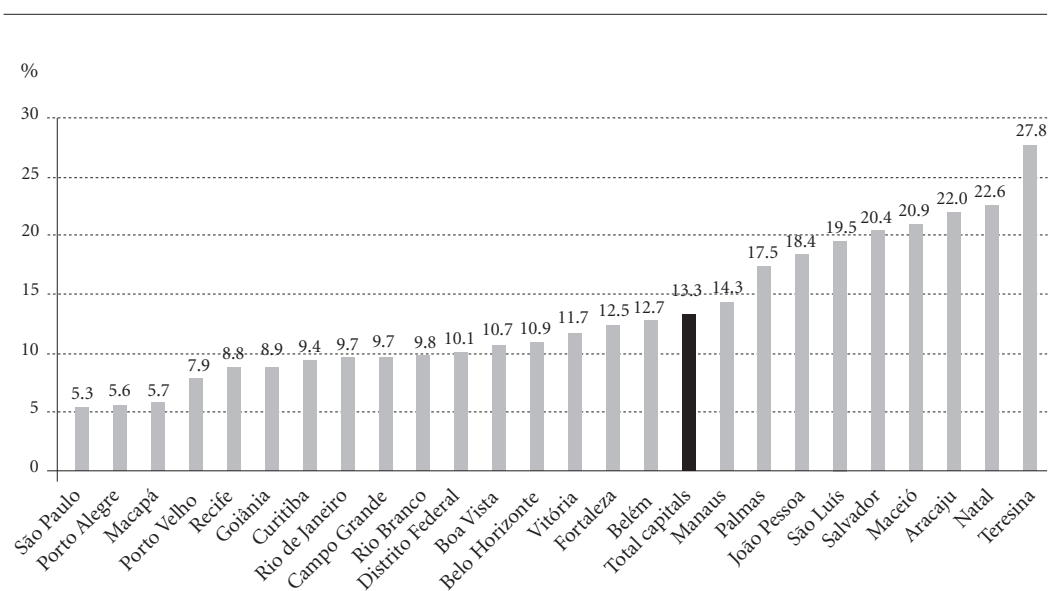


Figure 3. Self-declared consumption of alcoholic beverages among urgent and emergency care for motorcycle road traffic accidents –Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

Source: Ministry of Health, Secretariat of Health Surveillance, Violence and Accident Surveillance System –VIVA, 2014 Survey.
*Except Florianópolis/SC and Cuiabá/MT.

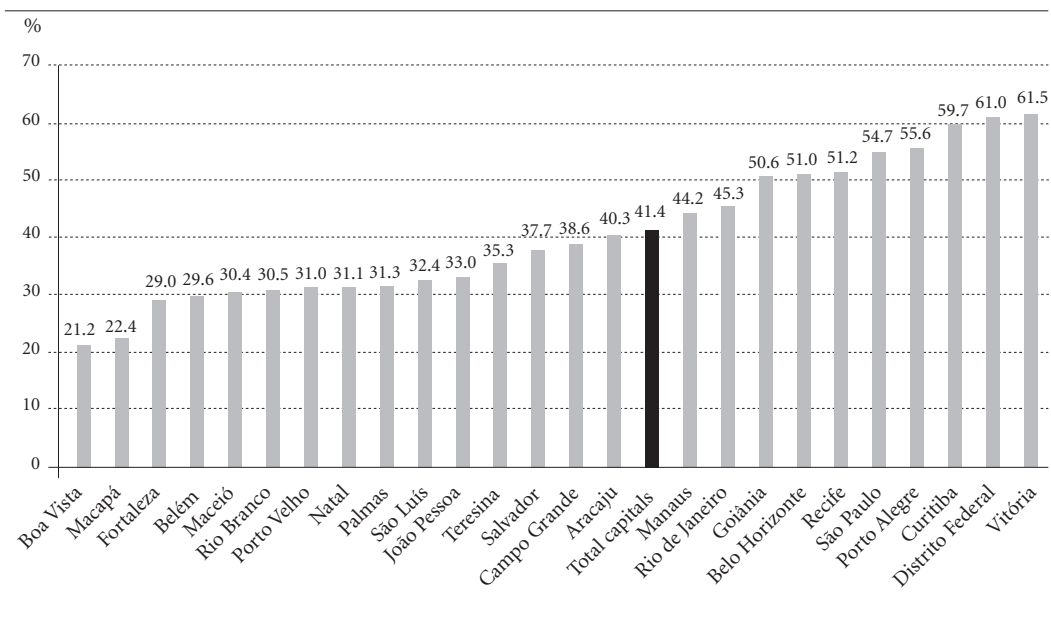


Figure 4. Proportion of work-related events among urgent and emergency care for motorcyclist road traffic accidents –Selected services in 24 capitals* and the Federal District, Brazil, from September to October, 2014.

Source: Ministry of Health, Secretariat of Health Surveillance, Violence and Accident Surveillance System –VIVA, 2014 Survey. * 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 injuries⁸. 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 accidents⁹.

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 traumas¹⁰. In fact, unlike cars, motorcycles are not equipped with structure and protection devices, which highly exposes its occupants¹¹, and motorcycle accidents result in a risk of death 30 times higher when compared to occupants of other motor vehicles^{12,13}.

Causality of motorcycle accidents is multifactorial¹⁴ 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 helmets⁸, drinking and

driving, speeding, vehicle vulnerability, among others^{15,16}.

Analysis evidenced a very 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^{4,17}. The National Health Survey identified that 30% of accidents were due to commuting to work¹⁷. 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^{4,18}. 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 vision¹⁵. 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 capitals¹⁹.

Another highlight is the increased fleet of vehicles, especially motorcycles, reflecting the deterioration of road traffic conditions and increased traffic¹⁴. Motorcycle's participation 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 North²⁰.

Factors such as increased fleet and less supervision in the North and Northeast may explain the higher mortality rates in these regions²⁰. 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 locations¹⁷.

From 2004 to 2013, motorcyclists' risk of death increased from 2.8 to 6.0 deaths per 100,000 inhabitants²¹. 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 vehicles²².

A study analyzing the profile of motorcyclists' polytrauma events attended by the Mobile Emergency Service (SAMU)²³ 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 study²⁴ 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 drugs²⁵⁻²⁷.

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.

References

1. World Health Organization (WHO). *Global status report on road safety 2015*. Geneva: WHO; 2015.
2. Brasil. Ministério da Saúde (MS). Departamento de Informática do Sistema Único de Saúde. *Informações de Saúde*. Sistemas e Aplicativos [Internet]. Brasília: MS; 2016. [acessado 2016 jun 30]. Disponível em: <http://www.datasus.gov.br>
3. Talving P, Teixeira PG, Barmparas G, Dubose J, Preston C, Inaba K, Demetriades D. Motorcycle-related injuries: effect of age on type and severity of injuries and mortality. *J Trauma* 2010; 68(2):441-446.
4. Diniz EPH, Assunção AA, Lima FPA. Prevenção de acidentes: o reconhecimento das estratégias operatórias dos motociclistas profissionais como base para a negociação de acordo coletivo. *Cien Saude Colet* 2005; 10(4):905-916.
5. Gawryszewski VP, Silva MMA, Malta DC, Mascarenhas MDM, Costa VC, Matos SG, Moraes Neto OL, Monteiro RA, Gazal-Carvalho C, Magalhães ML. A proposta da rede de serviços sentinela como estratégia da vigilância de violências e acidentes. *Cien Saude Colet* 2006; 11(Supl.):1269-1278.
6. Brasil. Ministério da Saúde (MS). Secretaria de Vigilância em Saúde. Departamento de Análise de Situação de Saúde. *Viva: vigilância de violências e acidentes, 2008 e 2009*. Brasília: MS; 2010.
7. Brasil. Ministério da Saúde (MS). Secretaria de Vigilância em Saúde. Departamento de Análise de Situação de Saúde. *Viva: vigilância de violências e acidentes, 2009, 2010 e 2011*. Brasília: MS; 2013.
8. Organização Mundial da Saúde (OMS). *Capacetes: manual de segurança no trânsito para os gestores e profissionais de saúde*. Brasília: OMS; 2007.
9. Departamento Nacional de Trânsito (DENATRAN). *Código de Trânsito Brasileiro: instituído pela Lei nº 9.503, de 23-9-97*. 3ª ed. Brasília: DENATRAN; 2008.
10. Golias ARC, Caetano R. Acidentes entre motociclistas: análise dos casos ocorridos no estado do Paraná entre julho de 2010 e junho de 2011. *Cien Saude Colet* 2013; 18(5):1235-1246.
11. Keall MD, Newstead S. Analysis of factors that increase motorcycle rider risk compared to car driver risk. *Accid Anal Prev* 2012; 49:23-29.
12. National Highway Transportation Safety Administration. *Traffic Safety Facts 2010 Data: Motorcycles* (Report No. DOT HS 811 639). NHTSA, National Center for Statistics and Analysis, Washington, DC, [cited 2015 Mar 20]. Available from: <http://www.nrd.nhtsa.dot.gov/Pubs/811639.pdf>
13. Instituto de Pesquisa Econômica Aplicada (IPEA). *Acidentes de trânsito nas rodovias federais brasileiras: caracterização, tendências e custos para a sociedade - relatório de pesquisa*. Brasília: IPEA; 2015.
14. Organização Mundial da Saúde (OMS). *Prevenção de lesões causadas pelo trânsito: manual de treinamento*. Genebra: OMS; 2011.
15. Organização Mundial da Saúde (OMS). *Beber e dirigir: manual de segurança viária para profissionais de trânsito e de saúde*. Genebra: OMS; 2007.
16. Organização Pan-Americana da Saúde (OPAS). *Gestão da velocidade: um manual de segurança viária para gestores e profissionais da área*. Brasília: OPAS; 2012.
17. Instituto Nacional de Pesquisa e geografia (IBGE). *Pesquisa nacional de saúde: 2013: acesso e utilização dos serviços de saúde, acidentes e violências: Brasil, Brasil Grandes regiões e unidades da federação*. Rio de Janeiro: IBGE; 2015.
18. Veronese AM, Oliveira DLLC. Os riscos dos acidentes de trânsito na perspectiva dos moto-boys: subsídios para a promoção da saúde. *Cad Saude Publica* 2006; 22(12):2717-2721
19. Brasil. Ministério da Saúde (MS). Secretaria de Vigilância em Saúde. Departamento de Vigilância de Doenças e Agravos não transmissíveis e Promoção da saúde. *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico-VIGITEL*. Brasília: MS; 2015.
20. Departamento Nacional de Trânsito (Denatran). *Frota de veículos*. Brasília: Denatran; 2016. [acessado 2016 jun 29]. Disponível em: <http://www.denatran.gov.br/frota.htm>
21. Moraes Neto OL, Montenegro MMS, Monteiro RA, Rodrigues FR, Botacin CF, Beniz LAF. Perfil e evolução da morbimortalidade de acidentes de transporte terrestre – Brasil, 2004-2013. In: Brasil. Ministério da Saúde (MS). Secretaria de Vigilância em Saúde. *Saúde Brasil 2014: uma análise da situação de saúde e das causas externas*. Brasília: MS; 2015. p. 345-372.
22. Montenegro MMS, Bahia CA. Acidentes de transporte envolvendo motociclistas: um panorama da situação da morbidade hospitalar e mortalidade do Brasil. In: Brasil. Ministério da Saúde (MS). Secretaria de Vigilância em Saúde. *Saúde Brasil 2014: uma análise da situação de saúde e das causas externas*. Brasília: MS; 2015. p. 375-393.
23. Barros MAS, Furtado BMASM, Bonfim CV. Características clínicas e epidemiológicas de motociclistas com trauma crânio-encefálico atendidos em hospital de referência. *Rev Enferm UERJ* 2015; 23(4):540-547.
24. Lima MLC, Cesse EAP, Abath MB, Oliveira Júnior FJM. Tendência de mortalidade por acidentes de motocicleta no estado de Pernambuco, no período de 1998 a 2009. *Epidemiol Serv Saúde* 2013; 22(3):395-402.
25. Rezende Neta DS, Alves AKS, Leão GM, Araújo AA. Perfil das ocorrências de politrauma em condutores motociclistas atendidos pelo SAMU de Teresina-PI. *Rev Bras Enferm* 2012; 65(6):936-941.
26. Vieira RCA, Hora EC, Oliveira DV, Vaez AC. Levantamento epidemiológico dos acidentes motociclistas atendidos em um Centro de Referência ao Trauma de Sergipe. *Rev Esc Enferm USP* 2011; 45(6):1359-1363.
27. Brasileiro BF, Vieira JM, Silveira CES. Avaliação de traumatismos faciais por acidentes motociclistas em Aracaju/SE. *Rev Cir Traumatol Buco-Maxilo-fac* 2010; 10(2):97-104.

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