

FRACTURES CAUSED BY MOTORCYCLE ACCIDENTS

FRATURAS PROVOCADAS POR ACIDENTES DE MOTOCICLETA

Reinaldo Da Silva **Barboza Junior** ^{*} , Andrey Rogério Campos **Golias** 

UNINGÁ - Centro Universitário Ingá, Maringá, PR, Brazil.

*reinaldo.juniorbm@hotmail.com

ABSTRACT

Injuries and trauma caused by motorcycle accidents continue to have an important economic and social impact. Therefore, this study aimed to estimate the prevalence of fractures stemmed from traffic accidents, involving motorcycles, which occurred in Maringá, Paraná's third largest city, in 2018, according to the Serviço Integrado de Atendimento ao Trauma em Emergência (SIATE). A descriptive exploratory study of a quantitative character was conducted, which utilized the website of the Fire Department of Paraná, and data was collected on the quantity and type of accidents, number of victims, gender, age, and severity of the injury. The total number of motorcycle accidents was 2312 (67.4% of the total), with 2758 victims. Of these, 453 suffered fractures (16.4%), the majority of whom were men (72.8%). Fractures occurred more often in Lower Extremities (LEs) (43.5%) and Upper Extremities (UEs) (40.0%). Thus, it's necessary to implement actions and policies aimed at preventing accidents of this nature, particularly protective equipment to reduce the fracture severity in the limbs and spine.

Keywords: Accidents. Fractures. Motorcycles.

RESUMO

As lesões e os traumas advindos dos acidentes de moto continuam provocando um importante impacto econômico e social. Por isso, o objetivo do estudo foi estimar a prevalência de fraturas advindas de acidentes de trânsito, com o envolvimento de motocicletas, ocorridos em Maringá, terceira maior cidade do Paraná, no ano de 2018, segundo a avaliação dos socorristas do Serviço Integrado de Atendimento ao Trauma em Emergência (SIATE). Tratou-se de um estudo descritivo exploratório de caráter quantitativo, que utilizou o sítio eletrônico do Corpo de Bombeiros do Paraná, sendo que foram coletados dados sobre o número e o tipo de acidentes, números de vítimas, gênero, idade e gravidade da lesão. O total de acidentes com moto foi de 2312 (67,4% do total), com 2758 vítimas. Destas, 453 sofreram fraturas (16,4%), sendo a maioria homens (72,8%). As fraturas ocorreram mais em Membros Inferiores (MMII) (43,5%) e Membros Superiores (MMSS) (40,0%). Assim, faz-se necessário a implantação de ações e políticas voltadas à prevenção de acidentes dessa natureza, especialmente equipamentos de proteção individual para diminuir a gravidade das fraturas em membros e na coluna vertebral.

Palavras-chave: Acidentes de Trânsito. Fraturas. Motocicletas.

INTRODUCTION

As stated by the World Health Organization (WHO), traffic accidents (TAs) are responsible for a significant number of injuries and deaths, and by December 2018, around 1.35 million people died due to recklessness in traffic, with approximately 50 million left living with sequelae (WHO, 2018). In 2016, Brazil had more than 207.7 million inhabitants and, moreover, 37,345 traffic deaths were recorded in the country (82% men and 18% women). The highest number of deaths (28%) took place with users of vehicles with 2 or 3 wheels, as is the case of motorcycles (WHO, 2018).

The United Nations (UN) acknowledges the lessons learned from the first Decade, which occurred between 2011 and 2020, in which governments around the world pledged to take measures to prevent traffic accidents and reduce them by up to 50%, but there is a need to keep promoting an integrated approach to road safety. Thus, for the years 2021 to 2030, the Second Decade of Action for Road Safety is proposed, which seeks to reduce traffic deaths and injuries by at least 50% worldwide. Additionally, it reinforces that a large part of deaths and serious injuries caused by traffic are preventable and, even with some improvements in many countries, remain emphasized as a public health problem and have broad social and economic consequences (PORTAL DO TRÂNSITO E MOBILIDADE, 2020).

TAs are conceptualized like any disastrous event, whether accidental or not, capable of causing physical and material damage, including vehicles, people, or animals on public roads (FEIJÓ, 2011). Furthermore, they represent one of the main causes of death worldwide, which shows a serious public health problem, not only to the detriment of the lives taken and the resulting sequelae, but also by the direct and indirect costs in relation to care and victims hospitalized, creating a substantial burden to society. There is also the fact that the forwardness with which these deaths occur provokes suffering and inconvenience to the families involved (IUNES, 1997; BASTOS; ANDRANDE; JUNIOR, 1999).

In 2018, SUS registered 183,400 hospitalizations of victims involved in TAs, causing a cost of R\$265 million. Additionally, these accidents occupy a considerable part of hospital admissions, and the majority of consultations are of urgency and emergency. Furthermore, it is highlighted that in every ten TA occurrences, eight involve motorcyclists (MINISTÉRIO DA SAÚDE, 2019).

A data survey made by the Sociedade Brasileira de Ortopedia e Traumatologia (SBOT), in 2015, showed that over 90% of TAs with motorcycle involvement happened during the day (morning and afternoon). Furthermore, the majority of patients admitted to hospitals are young men, aged between 18 and 30 years, who, in most cases, undergo more difficult surgical procedures, as they have suffered fractures and even damage to the spine and nervous system. (PORTAL DO TRÂNSITO E MOBILIDADE, 2015).

The use of motorcycles as an agile means of transport is connected to the growth of urban and rural mobility and the low investment in public transport, which makes people opt for this type of vehicle that offers a lower purchase, maintenance and fuel cost to perform daily activities (MARTINS; BOING; PERES, 2013).

According to Matos, Nascimento and Silva (2014), in accidents involving motorcycles, traumas are usually associated with speed and energy, which leads to high morbidity and mortality. In such type of accident, there may be the presence of fractures, whether closed or open, on the head, trunk and limbs, which can contaminate the injured area and pose a risk of infections due to exposure of soft tissues and other structures to the external environment, with emphasis on Cranioencephalic Trauma, which further aggravates the condition when contaminated, increasing human suffering.

The city in which the study was conducted, Maringá, is currently the third largest and most populous of the main cities in the state of Paraná, and has the greatest prospect of population growth, with an estimated 423,666 inhabitants on July 1, 2019, as stated by the Instituto Brasileiro de Geografia e Estatística (2019). Furthermore, the city has continuously received interventions seeking the improvement of traffic safety with awareness campaigns on various news networks, by

public agencies, such as the City Hall and the Municipal Traffic Department, which end up registering, on a daily basis, facts involving TAs (MARINGÁ, 2014).

The municipal fleet of motorcycles and scooters has increased by 16.4% in the last nine years, totaling approximately 9 thousand more vehicles traveling on the roads (DETRAN, 2020). Although the study is local, implemented only in Maringá, it's possible to make inferences on a larger scope, since the transit phenomenon is national. Additionally, the available epidemiological control systems do not allow for broader studies with a focus on fractures.

The Paraná Fire Department (CBPR, 2006) is a pioneer in organizing a Pre-Hospital Assistance Service (SvAPH) at the time it established the Integrated Service of Trauma Emergency Assistance (SIATE), which, since 1990, served as a model for the restructuring of the Pre-Hospital Assistance Service with the creation of the Programa de Enfrentamento às Emergências e Traumas (PEET) by the Ministry of Health, which had reducing morbidity and mortality rates as its focus (MARTINS; PRADO, 2003).

The assistance offered by the SIATE teams confirms that the type of traffic occurrence most often answered in daily life involves motorcycles, wherein it isn't always possible to highlight the main factors leading to this kind of accident. Therefore, this study seeks to contribute information for the prevention of TAs involving motorcycles and fractures, proposing a better direction for actions which aim to improve the drivers' awareness, and attempt to decrease the number of accidents of this nature. Consequently, the present study aimed to estimate the prevalence of fractures resulting from TAs involving motorcycles that occurred in Maringá, in 2018, according to the assessment of the SIATE rescuers.

MATERIAL AND METHODS

This was an exploratory, descriptive research, with a quantitative approach, developed based on the on the TAs occurrences answered by SIATE, in 2018, in the city of Maringá/PR. Authorization for the command was obtained from the Military Firefighter institution to use the electronic database, as published in the institution's internal bulletin in January 2019.

Currently, the refereed city has two pre-hospital care services (APH): SIATE, whose services are focused on trauma situations and the Mobile Emergency Care Service (SAMU), which concentrates its interventions on occurrences of any nature, be it traumatic, clinical, pediatric, surgical, gynecological-obstetric and psychiatric of the population (BRASIL, 2008).

For each service request via 193 (SIATE), the bureaucratic form is filled by the fireman, who electronically screens the occurrence at the Regional Emergency Center (CRE), installed in the Fire Department, and records the data request containing information about the location, the opening time and the type of occurrence. After the assistance, this information is complemented by the rescuer report, named the Rescuer Assistance Report (RAS), which contains information about the victim, the vehicles and the situation on the spot, thus feeding the institution's electronic database (CBPR, 2020).

Geared towards guiding the referral to the individual's care organs (a hospital of reference, for example), SIATE's first responders categorize the injuries of accident victims as unharmed (there's no injury and the trauma kinematics was not important), code 1 (minor injuries such as bruises or abrasions), code 2 (some type of fracture or indication of fracture, extensive skin injuries that are not life-threatening), code 3 (serious fractures, life-threatening brain injuries) and code 4 (already has or will die) (CBPR, 2006).

In order to determine the presence of fractures, rescuers consider those in which some bone segment is in contact with the external environment or there is a deviation from the individual's normal anatomical structure, which does not mean that in other places there are not fractures unidentified by visual observation or touch. Closed fractures are characterized when the skin does not rupture and open fractures are those that occur when the skin is broken and at least part of the bone exposes itself to the external environment (CBPR, 2006).

The population subjected to the study, thus, was composed of 2758 victims of TAs assisted by SIATE, with motorcycles necessarily involved in the accident, whether they were caused by collisions, falls, shocks against screens or being run over, in which the victim is a driver, passenger or third party involved, in the urban area of the city of Maringá/PR, in 2018, the data of which was saved in Excel electronic tables.

Clinical and epidemiological variables were utilized for the analysis and structure of the study. The clinical variables generated information related to victims of TA, those being: sex, age, severity of the injury, total number of deaths and fracture location. Regarding the epidemiological variables, information was collected such as: the total number of ATs, fractures in motorcycle ATs, type of accident and type of vehicle involved with the motorcycle.

Considering it is a system for recording occurrences, it was possible to specifically filter the type of search to be carried out. The analysis was made by simple statistical treatment, using percentages and the results were presented in tables.

It is worth mentioning that the study was approved by the Research Ethics Committee of the Centro Universitário Ingá - UNINGÁ, 3.324.556, in accordance with the Resolutions 466/12 and 510/2016 of the National Health Council.

RESULTS AND DISCUSSION

In total, there were 3430 TAs in Maringá, in 2018, with 4243 victims. Of that total, 2312 (67.4%) involved motorcycles, which caused 2758 victims (65.0%) (Table 1).

It is possible to identify that male victims, in addition to being more involved in TAs in general, are also involved in motorcycle accidents. Of the 2758 motorcycle victims assisted, 453 (16.4%) suffered fractures and men accounted for 72.8% (Table 1), being also the ones who most often died.

Table 1 - Absolute number distribution and percentage of the total number of TA victims, victims of motorcycle TAs and victims with motorcycle and fractures, by sex, in Maringá, 2018

Sex	TA victims total		Motorcycle TA victims		TA motorcycle victims with fractures	
	N	%	N	%	N	%
Male	2792	65,8	1894	68,7	330	72,8
Female	1441	34,2	864	31,3	123	27,2
TOTAL	4243	100	2758	100	453	100

Source: CBPR, 2018.

Of the TA total, two types stand out: the collision between vehicles and the fall of a vehicle (characterized by the fall of a motorcycle and/or bicycle), which represent 87% of a total of 3430 occurrences of TAs. With regard to TAs with motorcycles, the occurrences most answered by SIATE involved a collision between a car and a motorcycle, accounting for 60.2% and a motorcycle fall with 27.2% of a total of 2312 of this nature, with collisions representing 67,2% of the TAs total (Table 2).

Table 3 shows the injury severity in the total TA victims, motorcycle TAs and motorcycle with fracture TAs. Thus, in addition to other injuries, fractures in victims of TA with motorcycles are included in codes 2 and 3, that is, of a total of 742 victims within this classification, 453 suffered fractures, which represents 61.05% in this type of injury. Regarding victims with fractures by injury code, 75.7% of them were classified in code 2 and 24.3% in code 3, which means that most fractures that occurred in TAs with motorcycles are classified in code 2, that is, injuries considered serious, without immediate risk to life.

Table 2 - Absolute number distribution and percentage of total TA types and TAs with motorcycle involvement that occurred in Maringá, 2018

Variables	N	%
Type of accident TOTAL		
Running over	239	6,9
Vehicle overturning	50	1,8
Crash against bulkhead	129	3,8
Collision	2235	67,2
Collision of multiple vehicles	3	0,1
Vehicle fall	761	19,8
Lane exit	5	0,1
Vehicle tipping	8	0,2
TOTAL	3430	100,0
Type of accident with MOTORCYCLE		
Car x Motorcycle	1392	60,2
Car x Motorcycle x Others*	10	0,4
Motorcycle Fall	629	27,2
Motorcycle x Motorcycle	172	7,4
Motorcycle x Bicycle	30	1,3
Motorcycle x Caminhão	58	2,5
Motorcycle x Truck	20	0,94
Motorcycle x Cart	1	0,06
TOTAL	2312	100,0

Notes: Others* - other vehicles involved with the car and motorcycle, which are: bicycle, truck, bus and agricultural tractor.

Source: CBPR, 2018.

Table 3 - Absolute number distribution and percentage of total TA victims, motorcycle accident victims, and motorcycle accident and fracture victims according the severity of the injury and age in Maringá, 2018

Severity of Injury	Total victims (%)	Motorcycle victims (%)	Motorcycle and fracture victims (%)
Code 1	2715 (64,0)	1863 (67,5)	0 (0,0)
Code 2	914 (21,5)	623 (22,6)	343 (75,7)
Code 3	174 (4,1)	119 (4,3)	110 (24,3)
Code 4	31 (0,8)	14 (0,6)	0 (0,0)
Unharméd	409 (9,6)	139 (5,0)	0 (0,0)
TOTAL	4243 (100,0)	2758 (100,0)	453 (0,0)
Age Group			
0 to 9	110 (2,6)	25 (0,9)	5 (1,1)
10 to 19	450 (10,7)	277 (10,0)	42 (9,3)
20 to 29	1540 (36,3)	1201 (43,5)	163 (36,0)
30 to 39	894 (21,1)	607 (22,0)	96 (21,3)
40 to 49	543 (12,8)	331 (12,0)	69 (15,2)
50 to 59	357 (8,4)	195 (7,1)	44 (9,7)
Over 60	332 (7,8)	118 (4,4)	32 (7,0)
N/I*	17 (0,3)	4 (0,1)	2 (0,4)
TOTAL	4243 (100,0)	2758 (100,0)	453 (100,0)

Notes: (*) = Not Informed – Data not entered in the age field when filling in the occurrence.

Source: CBPR, 2018.

In respect to the age group, the percentage of fractures caused by TA with a motorcycle accounted for 72.5%, considering that the group most affected by such injury is between 20 and 49 years of age. The total number of deaths due to TAs was 31, 14 of which were involved with

motorcycles, representing 45.2% of this amount. It is also noteworthy that, of these 14 deaths, 10 were male.

Given that the fractures are classified as code 2 and 3, it was possible as well to determine the number of fractures that each victim had when involved in TAs with a motorcycle. In total, the majority suffered one fracture (87.9%) and the male sex was suffered this type of injury most often (72.8%).

Of the total number of TA victims with motorcycles who suffered fractures, in 2018, in the city of Maringá, 75.4% of them were closed and 24.6% opened. Furthermore, the male sex presented 70.8% of closed fractures and 79.3% of open fractures (Table 4), confirming that this gender, in addition to being more involved in TAs, is also the one to suffer most fractures.

Table 4 - Total number and percentage of victims with fractures that came into contact with the external environment by sex in TAs with motorcycles and the most affected body region, in Maringá, 2018

Variables			
N Victims with Fracture/N fractures/sex	N (%)	Male (%)	Female (%)
1 Fracture	398 (87,9)	289 (72,6)	109 (27,4)
2 Fractures	48 (10,6)	37 (77,1)	11 (22,9)
3 or more	7 (1,5)	4 (57,1)	3 (42,9)
Total	453 (100,0)	330 (72,8)	123 (27,2)
N victims/external contact/sex			
Closed	342 (75,4)	242 (70,8)	100 (29,2)
Open	111 (24,6)	88 (79,3)	23 (20,7)
Total	453 (100,0)	330 (72,8)	123 (27,2)
N of fractures/body region			
Lower Extremities	223 (43,2)		
Upper Extremities	207 (40,0)		
Face	33 (6,4)		
Thorax	31 (6,0)		
Cranium	11 (2,1)		
Pelvis	7 (1,3)		
Back	5 (1,0)		
Total	517 (100,0)		

Source: CBPR, 2018.

TAs are considered the second largest cause of external deaths in Brazil, generating a burden for urgent and emergency services of the Sistema Único de Saúde (SUS), causing an increase in the number of hospitalizations. In 2017, 182,838 TAs were registered, bringing costs to approximately 260.7 million reais, with 78.2% of hospital vacancies occupied by males (BRASIL, 2016).

The current study noted the prevalence of men both in the TAs' total (65.8%) and in TAs with motorcycles (68.7%). Additionally, with regard to the age group, victims aged between 20 and 49 years were the ones who suffered the most TAs (70.2%) and motorcycle TAs (77.5%).

A study made in Guaratinguetá/SP, also found a higher prevalence of men in accidents, such as the one which was carried out with 87 motorcycle accident victims received by the Municipal Health Rescue Service, 77% (67) of whom were male (FARIAS *et al.*, 2009). Corroborating the research executed in Teresina/PI, in 2006, which revealed that 369 (85.81%) were male (SANTOS *et al.*, 2008). Another survey carried out in Natal/RN, from October to December 2007, showed an even higher rate in the male population, with 328 (88.4%) cases of motorcycle accidents (BARROS, 2008), a prevalence similar to the one obtained in the present study.

A research implemented in Petrolina/PE, with 101 victims of TAs with motorcycles, between December 2008 and June 2009, evidenced that males were present in 98% of cases, which may be associated with more aggressive behavior and socio-cultural factors. The fact that men, in

Brazil, have premature contact with motorcycles (usually before coming of age) may be associated to this predominance (REZENDE *et al.*, 2017). The higher proportion of male victims may be connected to a greater exposure (greater number of men who use motorcycles), which makes the change of proportion observed when analyzing sex understandable, assuming that even the female sex has already shown a considerable increase when using a motorcycle, it is still a smaller number or more prudent when driving.

In respect to the age group, a national survey in 1989, with patients involved in TAs admitted to a hospital in São Paulo, showed that about 70% of the victims were between 10 and 39 years old, being in the group of teenagers and young adults (KOIZUMI, 1992). In Teresina/PI, young people are the most affected by these events, as 74.4% of the injured drivers were in the 15 to 34 years old age group. Thus, this data proposes consideration about socio-cultural patterns in relation to gender issues, which are still perpetuated in today's society and end up leading to high rates of morbidity and mortality in young male adults, in their main phase of life, causing thus, considerable economic losses to the nation (SANTOS *et al.*, 2008).

Sado, Morais and Viana (2009) argue that motorcyclists are the most affected by TAs, as they are more vulnerable and exposed on public roads. Given this context, they represent the main victims who die, with numbers that exceed more than 50%, as well as causing various physical problems and sequelae that can last a lifetime, with the majority of these young people being male.

TAs connected to motorcycles create numerous public health problems in developed countries. On the other hand, WHO portrays Brazil as the leader in TAs. In such context, several factors contribute with this reality. Firstly, the significant increase in circulating vehicles, in addition to the lack of stricter laws, impunity, the lack of adequate supervision, the advanced age of the fleet and the lack of structure on public roads which create problems associated to road signaling. Also, it is linked to low prices, flexibility and cost savings, as well as to the maintenance of this type of vehicle, which has caused a very large growth in the motorcycle fleet in recent years (WHO, 2018).

Still in accordance, the authors Silva, Soares and Andrade (2008) carried out a research with motorcycle couriers, in Londrina/PR, in 2018 and observed that, in accidents that happened during work, the highest proportion was of those involving a motorcycle collision against another vehicle (65%), followed by motorcycle falls (22%), that is, regardless of the reason why the motorcycle is used, the incidence of this type of accident was important in the aforementioned surveys.

The current study estimated that 16.4% of motorcycle accident victims suffered fractures, with men being 72.8% of the total. Most of the fractures were classified by the Fire Department professionals as code 2, that is, serious injuries without immediate risk to life, characterizing 75.7% of this kind of trauma. Additionally, most were closed (75.4%), that is, with no exposed structures, bones and soft tissues to the external environment, and the most fractured body parts were the UEs and LEs, representing 83.2% of the fractures total.

Despite the percentage of open (exposed) fractures being lower (24.6%), this injury, due to its exposure to the external environment, can cause higher damage to the victim, such as infections, muscle and ligament injuries, amputation and a longer hospital stay, generating impacts not only for the victim and his/her family, but also to the health and economic services.

The motorcycle driver is more vulnerable to TAs, as he does not have the same protection that is offered in four-wheel vehicles. In the case of the motorcyclist, he absorbs most of the impact on his body, be it by motorcycle objects, other vehicles' structures or bulkheads, being more susceptible to polytrauma and more serious injuries, which are located more often in the region of the head, back and extremities such as, for example, UEs and LEs (BASTOS; ANDRADE; SOARES, 2005).

According to the study by Goliath and Caetano (2013), in what refers to the categorization of the case severity, it is executed by the rescuer, given that they have specific knowledge and training for a first and secondary approach after the victim's immobilization and positioning inside the assistance vehicle. Thus, injuries classified by the codes 1, 2 and 3 are appraised, above all,

according to their external appearance and general signs, and it is possible that some victims have their conditions considered to be of lesser or greater severity than they really are, in addition to those who need medical support before starting the trip to the hospital and, for the code 4 classification, the presence of a doctor is necessary to certify the death.

In regards to the body parts affected by accidents, Debieux *et al.* (2010), in creating an updated research on motorcycle accidents, in respect to the incidence of injuries and considering the body segment, the following results were reported: higher frequency of involvement with LEs (53.9%), followed by UEs (41.1%), head (31.1%) and spine (2.8%). As for the type of injury, there were more injuries (39.8%), contusions (31.8%), followed by fractures (21.5%), most of which were closed (156 compared to 56 exposed), in addition to less frequent ones, such as dislocations, vascular injuries, sprains, torn ligaments, tendons and nerves (DEBIEUX *et al.*, 2010).

Ascari *et al.* (2013) emphasize that the higher number of injuries reported by victims of accidents involving motorcycles are of LEs, followed by skull and face, despite the use of a helmet. Petek *et al.* (2019) performed an analysis of the medical records of 373 motorcycle accident patients (pilot or passenger), who had some kind of fracture, being those 330 men with an average age of 30.8 years and 43 women with an average age of 32 years.

As such, 450 fractures were identified with an average of 1.2 fractures per patient. The most recurrent fractures were reported to the distal forearm (53), followed by ankle fractures (50) and thirdly, fractures involving the hand and carpus, being described by 49 occurrences (10.88%). Fractures of the femoral shaft corresponded to 34 and those of the tibial shaft represented 45 (10%).

Lima *et al.* (2004) carried out a survey for the epidemiology and treatment for substantial losses due to trauma in LEs with 119 patients involved in TAs with a motorcycle and analyzed the types of surgical procedures performed and the recovery of function. As such, they obtained as a result that men (76.4%), with an average of 29 years, were responsible for most injuries (37.8%) and the most often required surgical treatment was skin graft (62.1%), followed by a fasciocutaneous, muscular or microsurgical flap (37.9%).

After six months of post-surgical treatment, 35.3% of the patients still utilized locomotion aids. Thus, it is presumed that orthopedic trauma with bone fracture, bone exposure and the presence of an external fixator were significantly associated with a greater risk of functional impairment of the traumatized limb.

Palle *et al.* (2019) evaluated the research carried out in the Republic of Cameroon in 2005, emphasizing that the segments most affected were also the LEs, due to the vulnerability in TAs with motorcycles. In this study, 411 victims were evaluated, 68% of whom had LEs fractures, the highest rate. On the other hand, in this assessment, the issue that was most importantly assessed was the lack of infrastructure in the region, due to poorly signaled and unkept roads, in addition to bad weather, being referred to as the biggest factors.

In England, a study developed between 1997 and 2002, in relation to TAs with a motorcycle, evidenced an increase in the number of accidents of this kind and, like other studies already presented, the LEs and UEs are more often affected by injuries and fractures, due to being more exposed. In respect to the factors that cause TAs in this region, the climate and the instability of vehicles were pointed out; due to a colder atmosphere, skidding is more frequent, and may generate a greater number of TAs (CLARKE *et al.*, 2007).

Orsati *et al.* (2004), in their study, interviewed 18 patients who suffered fractures in motorcycle TAs and were admitted to the ward of the Department of Orthopedics and Traumatology of the Santa Casa Hospital of São Paulo, in 2003, and obtained that 77.7% (14) of the fractures were in males. These results reinforce the predominance of men in occurrences of this nature, as well as the fact that they were the ones who suffered the most fractures.

Therefore, in order to reduce the severity of these injuries, particularly fractures, the Personal Protection Equipment (PPE) appear, and they are already strongly established in the work environment (CRAIG; SLEET; WOOD, 1983). In the case of protection for motorcyclists, the use of a helmet and the reliability of its protection are established (HADDON, 1995).

Veronese and Oliveira (2006) highlight that, in regards to the use of PPE, the helmet is appointed as one of the main ones, even though it is understood that most accidents cause physical injuries. Demarco *et al.* (2010) developed a comparison between types of helmets, mainly with regards to brain protection. The ones that cover the whole head are more efficient when an impact occurs, if compared to open helmets. The research also points out that the thickness of the foam on the inside of the helmet can influence safety. Another factor that can interfere is the poor buckling of the equipment, because, when used loosely, it reduces safety, in some cases it may even be pulled from the driver's head in an eventual TA.

After many analyses about the effectiveness of using a helmet as a safety device, it has been shown that this feature can reduce damage to the skull by about 69%. Regarding the risk of death, it can decrease 42%. That is why helmet use is encouraged in many places around the world (BRASILEIRO; VIEIRA; SILVEIRA, 2010).

A research carried out in Sorocaba – SP, in 2008, which analyzed 1157 motorcycle TAs, showed a very peculiar scenario in which the helmet was the only means of protection that represented a rigid characteristic, evidencing that it actually protects the structure to which it relates, in this case, the skull, by 16.3%; though other regions are left unprotected. The LEs, for example, are affected in 66.8% of accidents, followed by UEs in 45.8%. However, due to the shape of some helmets, or the fact that a portion of motorcyclists drive with their visor open, the incidence of facial injuries is increased (RODRIGUES *et al.*, 2010).

Therefore, the need for products that protect the limbs and spine increases. Protective clothes, which would include reinforced shoes, leg and spine protectors, in a way, would provide less severe damage and, consequently, reduce the injury rate (CRAIG; SLEET; WOOD, 1983; HADDON, 1995).

Ndiaye, Coquillat and Martin (2019), after evaluating 951 questionnaires answered by injured motorcyclists between 2010 and 2014, revealed that 67% suffered injuries due to motorcycle TAs. The most often used PPE were: gloves (76%); jackets (59%); long boots or anklets (37%); back protection (23%) and airbag (0.3%).

According to the study, the use of such equipment resulted in a lower risk, especially when used in pairs, because it is the first contact for the motorcyclist when they collide with an abrasive surface or with sharp corners, and thus prevents these injuries from being more severe. On the other hand, in relation to fractures, they were not as efficient, but significantly reduced lacerations and abrasions (DEMARCO *et al.*, 2010).

The Prehospital Trauma Life Support (PHTLS), which is a course developed by the National Association of Emergency Medical Technicians (NAEMT), in the United States, aimed at those who provide pre-hospital care to the injured person, whether they are doctors, nurses, assistants, health technicians, nurses, firefighters or rescuers, reports that, when a motorcyclist is involved in an accident, some factors influence the severity of the injury, that is, the physics of the trauma, which is the speed, direction and distance at which the individual and vehicles encounter or move after the collision or fall (PHTLS, 2017).

As such, it is suggested that the traffic laws be more stringent, regarding these factors, since maintaining the compliance to, mainly, these three fundamental elements for traffic safety, it is possible to expect a reduction in the number of accidents.

Aside that, as connected to the PPE use and, mainly, to the mandatory use of a helmet, it is necessary to be prepared to suffer damage when someone fails to comply with such. Thus, a solution found to minimize the severity of injuries is in the way the driver behaves, in the motorcyclist case, who, on the verge of an incident, will be able to separate from the motorcycle, tipping the motorcycle on its side and dragging a leg on the ground.

Such action will decrease the rider's speed in relation to the motorcycle, so that it will separate from the driver because it is at a higher speed, leaving them behind and thus preventing them from getting between the vehicle and any object that it reaches, even if the driver suffers

abrasions and small fractures, they are then able to avoid serious injuries associated with other types of impact when compared to direct contact (PHTLS, 2017).

In order to be able to perform this type of maneuver, there must be some changes to the process of acquiring a driver's license, so that specific equipment and training in appropriate and safe locations can be offered. On the other hand, a barrier that can be found is the client's lack of interest in investing and dedicating themselves to the training process, since many believe that driving school is all the same and end up not valuing those that offer different forms of learning (PORTAL DO TRÂNSITO E MOBILIDADE, 2016).

Among the mobility and strategic actions established by WHO (WHO, 2018), in partnership with other agencies for the reduction of TAs in the present decade, it is presupposed that the main group of interest in adopting these actions (drivers and pedestrians) is still unaware of the harm that not using them does to everyone involved. Thus, it is important to maintain and create new actions and strategies, so that the proposals to reduce these accidents can continue more and more.

In the present study, the information used in order to obtain the results referred to the year of 2018, and was obtained in the CBPR system, registered by the SIATE rescuers, however, this does not show that SAMU has not answered to occurrences involving motorcycles or even that other victims of TAs with a motorcycle have not been referred by their own means or with the help of third parties to the hospitals, without getting into contact via emergency agencies.

Therefore, the data presented by the current study is not the total number of accidents, considering the existence of underreporting. Additionally, firefighters identify the presence of fractures in a subjective way, as they do not have image resources (radiographs) inside the vehicles that can confirm these injuries. And so, some injuries not initially considered as fractures by these professionals may have been found in the hospital environment.

CONCLUSION

The present study addressed a preminent topic in the worldwide scientific literature: accidents involving motorcycles and fractures resulting from them. Events of this nature that occurred in Maringá, for a period of twelve months, brought the particularities in the occurrences and victims involved, representing a segment that cannot be overlooked in the city's traffic scenario, as the number of motorcycles traveling day by day is notable. Characteristically, this type of occurrence is influenced by variables common to all kinds of motorcycle accidents: gender, age, number and type of vehicles, as well as the severity of the injury.

Based on the obtained results, the study identified that TAs with motorcycles, answered by SIATE in Maringá, mostly affected the male sex, and mainly adults from 20 to 39 years old, reaching, thus, an age group considered economically active and that, in their majority, suffered fractures in the LEs and UEs. These injuries were considered mild but also serious when the bones were fractured, for example, with the possibility of requiring long periods of hospitalization and recovery, as well as several surgical interventions.

Even though it is an exploratory and locoregional research, the analyses performed should provoke thoughtful consideration, since motorcycles have been used more and more, both for work and leisure. Therefore, it is important to monitor the evolution of the data in order to seek specific interventions in different areas of activity that contribute to a better and safer traffic.

In that manner, it is inferred that traffic injuries can be avoided and government officials need to adopt measures for a comprehensive approach to traffic safety, including various sectors such as: transport, public safety, health, education and actions that deal with road safety, vehicles and their users. Therefore, the information present in this study should contribute and reinforce, in a global context, the development of more proposals for a better traffic, aiming to reduce accidents that involve not only motorcycles, but also other motor vehicles.

With specific regard to TAs and fractures, this study reinforces the need to integrate the bodies responsible for identifying this kind of event and injury, particularly regarding the use of

PPE that can act to reduce damage in relation to the severity of fractures in limbs and spine, in addition to developing and implementing new strategies in order to reach these risk groups.

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