

ORIGINAL ARTICLE

Traffic accident mortality of motorcyclists, pedestrians and hospital costs in the city of São Paulo

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Abstract

Introduction: the United Nations recognizes traffic accidents as a serious public health problem all over the world, because they are accompanied by a high morbidity and mortality rate. Traffic causes the death of approximately 1.3 million people and the disability of millions more.

Objective: to evaluate mortality from traffic accidents among motorcyclists, pedestrians and hospital costs that occurred in the city of São Paulo, Brazil, from 1999 to 2019.

Methods: this is a retrospective time series study with official micro data, collected by place of occurrence among motorcycle drivers, pedestrians and hospital costs from 1999 to 2019, in the city of São Paulo, SP, Brazil.

Results: in the city of São Paulo, from 1999 to 2019, there were 144,186 thousand deaths resulting from land transport accidents, projecting 5,293 thousand deaths specifically with motorcyclists. Proportional mortality from was higher in the mean age group of 29 years, predominantly in males, with emphasis on white race/skin color. The costs per death stand out for motorcyclists with an average of R\$: 49,078.18, with regard to deaths by sex, male predominated in relation to female.

Conclusion: there was a high death rate, both in motorcyclists and pedestrians, with the latter having a higher average. Thus, these findings provide relevant information on the magnitude of the public health problem to guide us on control strategies for these causes.

Keywords: accidents traffic, motorcycles, pedestrians, hospital costs, mortality.

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Authors summary

Why was this study done?

This study was carried out to analyze the mortality, incidence, and associated factors in traffic accidents among motorcyclists and pedestrians. Thus, contributing to public health policies.

What did the researchers do and find?

A retrospective time series study was carried out with official data from the Mortality Information System (SIM), Hospital Information System (SIH/SUS) and the Violence and Accident Surveillance Information System (SIVVA). Data were collected by place of occurrence among motorcycle drivers, pedestrians and hospital costs from 1999 to 2019, in the city of São Paulo, SP, Brazil, including the Hospitalization Authorization (AIH). And a direct relationship was found between the reasons for accidents, such as high speed, drunkenness, poorly signaled roads, among other factors, a high death rate was presented, both in motorcyclists and pedestrians, with the latter having a higher average. In this population, the majority were male, single and of working age, and consequently the high hospital costs for the city of São Paulo.

What do these findings mean?

It is one of the most problematic topics for public health in the world. It is essential to understand the behavior of people involved in traffic accidents related to pedestrians and motorcyclists, the most vulnerable population in traffic accidents in Brazil.

Highlights

. As main findings, we identified a predominant proportional mortality in the most active age group (29 to 49 years), with a majority of males. The majority of this population was single. As for hospital costs per death, the highlight was clearly motorcyclists. Regarding the deaths by sex, the male predominated substantially in relation to the female, as well as the variable race/skin color stood out black, and the maximum evidence of these deaths were the days Friday, Saturday and Sunday at night.

INTRODUCTION

For several years, the United Nations Organization (UNO) has recognized urban traffic accidents as a serious public health problem worldwide, since they are accompanied by a high rate of morbidity and mortality¹.

Traffic causes the death of approximately 1.3 million people and the disability of millions more. About 90 percent of road traffic deaths and injuries occur in low- and middle-income countries. For several years, both the United Nations and its member WHO states have recognized that road traffic injuries and deaths are a major problem².

Traffic accidents are the third leading cause of death in the world; in the last decades, great transformations have occurred in Brazil, mainly in the advances in the automobile industries that generate multiplying effects of urban and social transformations. The unsatisfactory quality of public transportation has led people to opt for individual means of transportation, culminating in traffic problems in large cities³.

It is known that these accidents represent a relevant global public health problem and are associated with behavioural factors, vehicle maintenance, precariousness of urban space, and traffic control. They are configured as important causes of morbidity and mortality due to the increasing number of vehicles, changes in lifestyle, and risk behaviours in the general population⁴.

Land transport accidents (ATT) are a serious public health problem, since they are responsible for a high mortality rate and temporary and permanent disabilities, and there are many more non-fatal or disabled victims, especially in emerging countries. The WHO estimates a 40% increase in global mortality from this group of causes by 2030 if effective preventive measures are not taken⁵.

Several Brazilian studies point out that mortality from ATT is high among men, especially young men (more than 50% of deaths occur between 15 and 44 years of age) and the proportion of motorcyclists among these victims is relevant, ranging from 30% to 50%^{6,7}.

It is estimated that, every year, 50 million people worldwide suffer injuries and sequelae from traffic accidents. About 60% of the deaths occur in ten countries; Brazil occupies the fifth position, preceded by China, India, Russia, and the United States. Thus, accidents must be approached from the perspective of Public Health, which integrates aspects of the health of the inhabitants of the attributes of the built environment⁷.

In Brazil, the number of deaths and serious injuries exceeds 150 thousand victims/year, with annual expenditures of around 28 billion Reals, besides the high social costs resulting from the assistance, material losses, social security expenses and the immeasurable suffering of the victims and their families⁷.

The World Health Organization (WHO) estimates that the annual losses due to traffic accidents exceed US\$ 500 billion. In Brazil, the number of deaths and serious injuries exceeds 150,000 people and the Institute of Applied Economic Research (IPEA) estimates that the total costs of traffic accidents are approximately R\$ 28 billion per year. Considered one of the countries with the most violent traffic in the world in recent years, Brazil is trying to contain the high number of accidents and reduce hospital expenses⁸.

The city of São Paulo experienced the most dramatic increase in fatalities involving motorcyclists; in 2007, the number of fatalities involving motorcyclists exceeded by a wide margin (66%) the total number of fatalities involving occupants of other vehicles, an unprecedented fact in the city's history. Fatalities involving motorcyclists are still higher than those involving pedestrians⁹.

Among the fatalities involving motorcyclists in 2005, 40% occurred without the interference of another vehicle, *i.e.*, they were related only to the motorcycle and its driver. Among those killed, 37% were motorcycle couriers working in the delivery of goods. Finally, motorcycles were responsible for the death of 85 pedestrians (10% of the total). In 2007, 20% of the fatalities occurred with

people between 10 and 19 years old, and 72% occurred with people between 20 and 39 years old, that is, 92% of those killed on motorcycles were at most 39 years old⁹.

Another important variable to highlight is that in Brazil, in 2013, there were 170,805 hospitalizations resulting from (ATT) recorded in the (SIH/SUS), representing a rate of 85 hospitalizations per 100,000 inhabitants. The highest rates of hospitalization due to (ATT) were observed in male individuals (134.5 hospitalizations per 100,000 men) and in the 20 to 39 age group (123.9 hospitalizations per 100,000 inhabitants of that age). More than half of the hospitalizations for ATT were for motorcyclists, followed by pedestrians¹⁰.

The total expenditure on hospital admissions resulting from (ATT) in 2013, under the Unified Health System (SUS), was R\$ 231,469,333.13, of which R\$ 188,025,095.94 corresponded to expenditure on hospital services and R\$ 43,361,377.01 on professional services. The average value of hospitalization per (ATT) in the studied period was R\$1,355.17¹⁰.

Motorcyclists were the victims with the longest hospital stay (546,024 days) and the highest total expenditure (R\$114,810,444.93). However, the highest average hospitalization cost was represented by truck occupants (R\$ 1,902.79), who also accounted for the longest average hospital stay (7.2 days), followed by pedestrians (6.8 days)¹⁰.

Studies on traffic accidents (AT) in Brazil are scarce, prevention and control actions are just beginning, and little is known about driver and pedestrian behavior, road and vehicle safety conditions, traffic engineering, the human and environmental costs of motor vehicle use, and the traumatic consequences resulting from these accidents¹¹.

Therefore, this study addressed the associated factors on mortality from traffic accidents with motorcyclists and pedestrians, as well as, analyzed the hospital costs of these injuries in the capital city of São Paulo, in the period and 1999-2019.

METHODS

Study Design

Retrospective time series study with official data from the Mortality Information System (SIM), Hospital Information System (SIH/SUS), and the Violence and Accident Surveillance Information System (SIVVA). Data were collected by place of occurrence among motorcycle drivers, pedestrians, and hospital costs from 1999 to 2019 in the city of São Paulo (SP), Brazil.

Study Location and Period

It was the object of this research motorcyclists and pedestrians residing in the city of São Paulo, Brazil, in the period from 1999 to 2019. Considering the last update of the Brazilian Institute of Geography and Statistics (IBGE), in 2018¹² the São Paulo capital registered 45,538,936 people, its demographic density is 166.23 hab/km², its territorial unit area is 248,219,481km² and a total of 29,057,749 vehicles, of these 18,230,138 cars, 678,933 trucks, 159,712 buses and 4,634,274 are motorcycles.

The city of São Paulo has the 10th largest GDP in the world, representing, alone, 11% of all Brazilian GDP,

34% of the state's GDP, as well as 36% of all its production of goods and services, besides being home to 63% of the multinationals established in Brazil, being responsible for 28% of all national scientific production in 2005, and for more than 40% of all patents produced in the country¹².

Target Population

A motorcyclist is anyone who rides a motorcycle, and a pedestrian is anyone who walks or is on foot.

We considered deaths in the city of São Paulo, of residents of the same city, whose cause of death was classified as Road Traffic Accident (ATT).

Legal and ethical aspects

The project of this research was not submitted to the Research Ethics Committee, because it is research with secondary databases from the Mortality Information System (SIM) of the SUS Department of Informatics (DATASUS), Hospital Information System (SIH/SUS) and the Violence and Accidents Surveillance Information System (SIVVA). Fully respecting what is recommended by resolution 466/2012 and its institutional prerogatives.

Database

We considered all deaths in the city of São Paulo, of residents of the same city, whose underlying cause of death was classified as Road Traffic Accident (ATT). The information was extracted from the SIM base document, which registers, analyses, processes, and makes available data on deaths from natural causes and external causes. The population data was obtained through estimates made by the SEADE Foundation and the Brazilian Institute of Geography and Statistics of Brazil¹².

Study Variables

Data on deaths from Road Traffic Accidents (ATT) were collected using the 10th revision of the International Classification of Diseases (CID-10) chapter XX (External Causes of Morbidity and Mortality), grouped for pedestrians (V01-V09) and motorcyclists (V20-V29) and stratified according to sex, race/skin color, education, marital status, place of occurrence, age group, and hospital costs.

Exclusion Criteria

Deaths under one year of age and those not residing in the city of São Paulo, Brazil, were excluded from the study.

Statistical Analysis

The study consisted of deaths from traffic accidents. We calculated the mortalities by age group using the World Health Organization world standard population from 2000-2025 for total population, as well as presenting the deaths according to sex, race/color, education, marital status, place of occurrence, age group and hospital costs.

To analyse the temporal trend of the grievance, we will use mortality measures to build time series through the Prais-Winsten regression model, which will allow us to correct first-order autocorrelation in the analysis of series of values organized in time. Thus, the following values

were estimated: angular coefficient (β) and respective probability (p); coefficient of determination (r^2), and 95% confidence interval. All analyses were performed in the SPSS program, (Statistical Package for the Social Science).

RESULTS

In the city of São Paulo, from 1999 to 2019, there were 144,186 thousand deaths resulting from land transport accidents (ATT), projecting 5,293 thousand deaths specifically with motorcyclists, an average of 252.04, and 10,903 thousand deaths involving pedestrians with an average of 519.04 (table A1).

Still in table A1, the proportional mortality was

higher in the age group of 29 years old on average (174.61), 39 years old on average (125.00), followed by individuals between 49 years old on average (102.33), predominantly males, with an average of 605.04 deaths, highlighting the race/color of the white skin with an average of 465.19, followed by the brown skin at 238.18.

As for education, the individuals with up to 7 years of schooling, average of 262.23, and up to 11 years, average of 227.91, stood out. As for the marital status variable, singles predominated, with a mean of 418.77, followed by married people, mean of 180.01. The place of occurrence was hospitals, mean (551.48), and public roads, mean (189.71) (table A1).

Table 1: Characterization by mean, standard deviation and minimum and maximum, of deaths by traffic accident with motorcyclists and pedestrians, in the city of São Paulo, in the period 1999 - 2019

VARIABLES	AVERAGE (SD)	MINIMUM - MAXIMUM
OBITS		
Pedestrian	519.19 (173.44)	126-777
Motorcyclist	252.04 (148.69)	2-468
SEX		
Masculine	605.04 (209.80)	158-908
Feminine	166.04 (53.02)	43-248
RACE/COR		
White	465.19 (167.17)	97-679
Black	52.66 (18.94)	15-87
Yellow	9.47 (4.99)	1-18
Brown	238.18 (94.10)	74-364
Indigenous	0.38 (0.49)	0-1
SCHOOLING		
No	32.71 (15.78)	9-80
a 3 years	94.33 (40.48)	31-179
a 7 years	262.23 (89.43)	53-392
a 11 years	227.91 (110.18)	52-396
or more	52.38 (22.52)	11-88
CIVIL STATE		
Single	418.77 (146.54)	117-612
Married	180.01 (60.29)	40-250
Widower	55.80 (20.33)	11-89
Judicially Separated	40.00 (18.79)	8-75
Another	11.80 (10.84)	0-43
PLACE OF OCCURRENCE		
Hospital	551.48 (204.66)	123-805
Other Locations Health	6.67 (7.15)	0-24
Domicile	5.76 (3.43)	0-11
Public Way	189.71 (66.12)	51-269
Another	16.23 (27.09)	4-46
AGE RATE		
Minor 1 year	0.57 (0.06)	0-2
a 4 years	8.57 (4.86)	2-21
a 9 years	12.14 (7.08)	2-26

Continuation - Table 1: Characterization by mean, standard deviation and minimum and maximum, of deaths by traffic accident with motorcyclists and pedestrians, in the city of São Paulo, in the period 1999 - 2019

VARIABLES	AVERAGE (SD)	MINIMUM - MAXIMUM
a 14 years	14.29 (7.08)	3-27
a 19 years	63.48 (27.09)	12-103
a 29 years	174.61 (74.49)	39-292
a 39 years	125.00 (43.63)	40-187
a 49 years	102.33 (35.85)	29-158
a 59 years	82.19 (27.36)	27-118
a 69 years	64.09 (24.67)	16-102
a 79 years	62.90 (22.91)	14-101

Source: MS/SVS/CGIAE - Mortality Information System (SIM). 2021.

In table A2, when linear regression was used for mortality, the following variables were statistically significant ($p < 0.005$): education, with “no education” and “more than 11 years of education”, both statistically

significant, with 0.003 and 0.040, respectively; place of occurrence, with “other healthcare facilities”, with 0.044; age, involving “4, 9 and 14 years of age”, with 0.000, 0.000 and 0.001, respectively.

Table 2: Characterization by linear regression analysis of deaths by traffic accidents with motorcyclists and pedestrians, in the city of São Paulo, in the period 1999 - 2019

Variables	Mortality (Linear regression)		
	β	p	r ²
OBITS			
Pedestrians	-11.22	0.071	0.16
Motorcyclist	12.86	0.12	0.76
SEX			
Masculine	2.62	0.75	0.01
Feminine	-0.98	0.619	0.01
RACE/COR			
White	-4.35	0.48	0.02
Black	.3.11	0.66	0.01
Yellow	-3.16	0.077	0.15
Brown	6.01	0.075	0.16
Indigenous	.0.16	0.36	0.04
SCHOOLING			
No	-1.55	0.003	0.37
a 3 years	1.87	0.204	0.08
a 7 years	-1.62	0.626	0.03
a 11 years	4.87	0.229	0.07
Or more	1.63	0.04	0.16
CIVIL STATE			
Single	3.13	0.556	0.01
Married	-2.29	0.302	0.05
Widower	-8.42	0.26	0.06
Judicially Separated	9.2	0.179	0.09
Another	0.64	0.102	0.13

Continuation - Table 2: Characterization by linear regression analysis of deaths by traffic accidents with motorcyclists and pedestrians, in the city of São Paulo, in the period 1999 - 2019

Variables	Mortality (Linear regression)		
	β	p	r ²
PLACE OF OCCURRENCE			
Hospital	-1.15	0.88	0
Other Locations Health	-5.1	0.044	0.19
Domicile	0.7	0.584	0.16
Public Way	3.4	0.108	0.08
Another	-4.48	0.153	0.1
AGE RATE			
Minor 1 years	-0.31	0.209	0.08
a 4 years	-5.2	<0.001	0.44
a 9 years	-8.77	<0.001	0.59
a 14 years	-7.22	0.001	0.42
a 19 years	6.42	0.524	0.02
a 29 years	1.97	0.475	0.27
a 39 years	7.37	0.651	0.01
a 49 years	0.46	0.972	<0.001
a 59 years	0.8	0.937	<0.001
a 69 years	-2.46	0.789	<0.001
a 79 years	-5.55	0.515	0.02

Source: MS/SVS/CGIAE - Mortality Information System (SIM). 2021.

In table A3, when we characterize the costs per death, the highlight is motorcyclists with an average of R\$49,078.18. Regarding deaths by sex, the male predominated substantially in relation to the female, with an average of R\$43,691.92 and the female with R\$13,25885. In the race/skin color variable, the blacks stood out with an average of R\$ 410,170.60, followed

by the yellows with an average of R\$ 170,012.90. In this context, the value for the ignored variable with an average of R\$ 119,817.30 calls our attention. As for the age bracket variable, we noticed that the average age bracket was 50-59 years old (R\$ 6,863,341.31), followed by 20-29 years old (R\$ 3,178,251.00).

Table 3: Characterization with mean, standard deviation, minimum and maximum in relation to costs of traffic accident deaths with motorcyclists and pedestrians, according to the variables studied on death in the city of São Paulo, in the period 1999 - 2019.

VARIABLES	AVERAGE (SD)	MINIMUM - MAXIMUM
COSTS		
Motorcyclists	49.078.18 (21.69)	15.051.02-75.377.93
Pedestrians	42.071.52 (11.69)	28.281.25-65.7424.40
SEX		
Masculine	43.691.92 (16.40)	23.260.89-84.291.68
Feminine	13.258.85 (33.52)	8.7265.47-19.072.93
RACE/SKIN COLOR		
White	33.412.31 (30.54)	0-7239521
Black	410.170.60 (38.19)	0-1043975
Yellow	170.012.90 (16.60)	0-4068316
Brown	21.319.41 (24.49)	0-83132.36
Indigenous	9.643.02 (24.21)	0-77578.36
Ignored	119.817.30 (11.17)	0-2863248

Continuation - Table 3: Characterization with mean, standard deviation, minimum and maximum in relation to costs of traffic accident deaths with motorcyclists and pedestrians, according to the variables studied on death in the city of São Paulo, in the period 1999 - 2019.

VARIABLES	AVERAGE (SD)	MINIMUM - MAXIMUM
AGE RATE		
Younger 1 years	93.581.72 (53-66)	2.521.18 - 18.338.64
from 10-14 years	89.023.78 (57-66)	109.859.60 – 195.842.40
from 15-19 years	1.155.401.00 (44.65)	541.616.10 – 1.958.611.00
from 20-29 years	3.178.251.00 (11-26)	15.557.808 – 4.839.287
from 30-39 years	1.845.398.00 (7465)	7.899.992.30 – 29.541.07
from 40-49 years	1.142.519.00 (45.51)	469.199.4 – 18.323.31
from 50-59 years	6.863.341.30 (27.38)	28.999.90 – 126.053.90
from 60-69 years	426.846.50 (17.06)	170.089.00 – 683.484.00
from 70-79 years	265.525.60 (11.33)	93.017.31 – 525.755.20
from 80 more years	119.943.80 (51.00)	43.786.02 – 241.337.60

Source: MS/SVS/CGIAE - Mortality Information System (SIM). 2021.

Taking into consideration tables A4 and A5, a statistical difference $p < 0.005$ was identified in almost all the variables analyzed in relation to costs. Differences were observed in all of them (gender, race/color, age group, table

A4), which coincides with table A5 that gave a difference in the two variables (pedestrian and motorcyclist cost, table A5).

Table 4: Characterization by linear regression analysis of deaths from traffic accidents involving motorcyclists and pedestrians according to each variable, in the city of São Paulo, in the period 1999 - 2019

VARIABLES	MORTALITY (LINEAR REGRESSION)		
	β	p	r2
COSTS			
Motorcyclists	305.435.30	0	0.76
Pedestrians	85.113.61	0.04	0.2
SEX			
Masculine	-23.536.59	0.701	0
Feminine	25.708.19	0.029	0.13
RACE/SKIN COLOR			
White	378.367.10	<0.001	0.59
Black	54.564.63	<0.001	0.78
Yellow	221.424.70	<0.001	0.68
Brown	1.777.56	0.041	0.2
Indigenous	11.97	0.989	0
Ignored	132.271.30	<0.001	0.51
AGE RATE			
Younger 1 years	165.58	0.398	0.03
from 10-14 years	5.524.66	0.007	0.16
from 15-19 years	50.480.63	<0.001	0.49
from 20-29 years	127.081.40	<0.001	0.49
from 30-39 years	92.102.34	<0.001	0.58
from 40-49 years	58.173.36	<0.001	0.62
from 50-59 years	35.544.36	<0.001	0.64
from 60-69 years	212.106.58	<0.001	0.64
from 70-79 years	5.819.26	0.159	0.1
from 80 more years	4.641.05	0.008	0.31

Source: MS/SVS/CGIAE - Mortality Information System (SIM). 2021.

For the linear regression in the cost variable (table A5) for cause (V20-V29) pedestrians with (R\$: 1+817,525.00) and pedestrians (V01-V09) with (R\$: 588,094.10) both predominated with a -p value >0.005.

In relation to the variable hospital costs by cause of death, motorcyclists stood out, with an average of R\$19,598,878.50 million. We highlight in this analysis the sale of motorcycles in this period, which reached an average of R\$ 1,188,244.10 (table A6).

Table 5: Characterization by linear regression analysis of deaths from traffic accidents involving motorcyclists and pedestrians in relation to hospital costs, in the city of São Paulo, in the period 1999 - 2019

VARIABLES	MORTALITY (LINEAR REGRESSION)		
	β	p	r ²
COSTS			
Cost cause Pedestrian (V01-V09)	588.094.10	0.009	0.3
Cost Causes Motorcycles (V20-29)	1.817.525.00	<0.001	0.97

Source: MS/SVS/CGIAE - Sistema de Informações sobre Mortalidade (SIM). 2021.

Table 6: Characterization with mean, standard deviation, minimum and maximum in relation to costs of traffic accident deaths with motorcyclists and pedestrians, according to cause of death in the city of São Paulo, in the period 1999 - 2019

VARIABLES	AVERAGE (SD)	MINIMUM - MAXIMUM
COSTS		
Pedestrian Cause (V01-V09)	11.692.934.05	7.510.179.27 - 17.180.361.25
Motorcycle Cause (V20-29)	19.598.878.50	4.931.104.49 - 37.397.873.09
Motorcycles for sale	1.188.244.10	444.536.00 - 2.044.533.00

Source: MS/SVS/CGIAE - Mortality Information System (SIM). 2021.

DISCUSSION

Proportional mortality was predominant in the most active age group (29 to 49 years), with the majority being male. The majority of this population was single. As for the costs per death, motorcyclists stood out, with an average of R\$ 49,078.18. Regarding deaths by sex, the male predominated substantially in relation to the female, with an average of R\$ 43,691.92 and the female with R\$ 13,258.85. In the race/skin color variable, the blacks stood out with an average of R\$ 410,170.60. In this context, the value for the ignored variable with an average of (R\$ 119,817.30) calls our attention. As for the age bracket variable, the average age was 50-59 years with an average of (R\$ 6,863,341.31).

In the world traffic accidents kill more and more people all over the planet, with 1.35 million deaths a year, warns the World Health Organization (WHO), worried about the lack of security measures in the poorest countries. In its world report on road safety, the WHO also states that traffic accidents are currently the leading cause of death among children and young people between 5 and 29 years old. In recent years, the number of road deaths around the world has steadily increased, with 1.35 million deaths recorded in 2018².

A study by Conceição and collaborators (2021)¹³, states that according to the World Health Organization (WHO), speed is one of the most important factors in determining a traffic accident and the severity of the injury is particularly critical for the most vulnerable users, such as pedestrians, cyclists, and motorcyclists, as well as for children and the elderly.

Land Transport Accidents (LTAs) are a serious public health problem, not only in Brazil, where the

development and quality of roads have not kept up with the significant increase in demand for cargo flow, but also worldwide. They generate high morbidity and mortality rates, in addition to high costs to the health system and social security benefits¹⁴.

In the city of São Paulo, from 1999 to 2019, there were 144,186 thousand deaths resulting from land transportation accidents (ATT), projecting 5,293 thousand deaths specifically with motorcyclists (V20-V29) and 10,903 thousand deaths involving pedestrians (V01-V09), specifically, not to mention other modalities of transportation.

The improvement in safety for motorcyclists and pedestrians is less than that for people in other types of vehicles. In a recent research by Leitão *et al.*, (2022)¹⁵, they observed that the highest mortality rate occurs among men, aged 26 to 35 years old, as well as data on the safety of vulnerable road users, who are not protected in traffic accidents, such as pedestrians, cyclists, motorcyclists and moped riders, corroborating the findings, which showed higher mortality among men of the same age, occurring by place of residence in the city of São Paulo, in the studied period.

Mendonça *et al.*, (2017)¹, conducted an ecological study through secondary data on urban traffic accidents of the SAMU in Recife, where it was evidenced the predominance of male victims between 20 to 29 years of age. These events are associated on a high scale due to the irregular traffic culture; greater male and young exposure, thus they are more exposed to the risks of driving (high speed, dangerous manoeuvres, alcohol consumption). In these findings corroborate in part, because in the same way, the age group that predominated the most was 29 years to

39 years, being male and single. This shows that the more active age is more susceptible to accidents with mortality.

In a fourteen-year time series in Brazil, there were 48,879 hospitalizations for pedestrian collisions in the city of São Paulo. Pedestrian collisions occurred mainly by automobiles (21.0%), motorcycles (10.1%), buses (4.0%) and bicycles (1.5%). During the years analysed, there was an increase in pedestrian collisions, with 70.1% being male. Lower limb injuries are the most frequent. Therefore, the prevention of traffic accidents is essential in view of the morbidity and mortality and the costs they cause¹⁶.

Motorcyclists were the most frequently attended victims in the emergency department, outnumbering victims of pedestrian accidents, falls, car accidents, and physical aggression. In Brazil, accidents involving motorcyclists are frequent, often serious, and have their own characteristics. Among traffic accident victims, research has found pedestrians to have the highest fatality rates⁹.

A study conducted in the Midwest and Northeast regions of the country revealed that this profile of hospitalized patients generated public spending of more than R\$ 230 million in an average length of stay of one week¹⁰.

These divergences in the literature corroborate the findings of this research, which brings us important values, approximately R\$103 million, about R\$10.5 million per year for the motorcycle category, and for pedestrians about R\$88.5 million, almost R\$4.5 million per year, with values higher than R\$4.5 million for males, only in the city of São Paulo, during the studied period, *i.e.*, a time lapse of 20 years.

When evaluating the hospital costs of victims based on race/skin color in this study, it was noted that there is a prevalence of black skin, however, there is many ignored which becomes suggestive of a failure in the adequate recording of patient data. Leading to notifications with absence of information and inconsistent data for better studies of the profile of the victims.

In a study conducted in the United States of America (USA), it was identified that advances can be made to reduce ATT mortality rates, as well as in other developing countries, because most injuries caused by accidents are predictable and preventable¹⁷.

Furthermore, there is no doubt that the public health problems generated by the unbridled consumption of alcohol, besides directly affecting mortality rates, data associating the use of alcohol to certain events, among them traffic accidents⁶.

Studies identify the use of alcohol associated with motorcycle driving, with an increase in accidents on weekends. In addition to post-accident traumas, due to the absence of helmets, which leads to head trauma, besides other injuries on the body (Santos *et al.*, 2008)¹⁸. Golias *et al.*, (2013)¹⁹ infer that the instability of motorcycles, greater exposure of the body, difficulties of viewing and inappropriate behaviour of riders are contributing factors to traffic accidents.

Additionally, the difficulty of viewing motorcycles by other drivers, the greater exposure of the body, and the negligence in the use of protective equipment place these

users in an especially susceptible category. The resulting injuries suffered by motorcyclists are usually more severe, often to the head and upper and lower limbs, resulting in long hospital stays and severe, sometimes fatal, sequelae⁵.

Therefore, the existence of ignored information and/or information that is difficult to access in the public information platforms (Big Data's), should be considered for decision making, and thus contribute to the politicians and/or public managers, plan, create strategies and public policy actions, as a priority in reducing land accidents and with a clear reduction of deaths in the city of São Paulo, especially in Brazil.

CONCLUSION

It is evident that, although we did not mention the direct relation between the reasons for the accidents, such as high speed, drunkenness, poorly signalled roads, among other factors, there was a high rate of deaths, both in motorcyclists and pedestrians, the latter having a higher average. In this population, the majority were male, single and of working age, and, consequently, the hospital costs were high for the city of São Paulo.

Thus, these findings provide relevant information of the magnitude of the public health problem to guide us on control strategies for these causes.

Author Contributions

Conceptualization, Leitão, F.N.C.; methodology, Jastrow, J.M.B.; Rodrigues, DM.; software, Morais, M.J.D.;Guarnieri C; validation, Bezerra, I.M.P, Araripe, S.C.F.; formal analysis: Sousa, L.V.A.; investigation, Riera, ARP.; resources, Leitão, F.N.C.; writing—original draft preparation, writing—review and editing, and Morais, M.J.D.; Guarnieri C; visualization, Leitão, F.N.C.; Guarnieri C and Jastrow, J.M.B.; supervision, Rodrigues, DM.; and Jastrow, J.M.B.; project administration, Riera, ARP.; and Leitão, F.N.C.; funding acquisition, Leitão, F.N.C.;All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors report no conflict of interest.

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Resumo

Introdução: a Organização das Nações Unidas reconhece os acidentes de trânsito urbano como um sério problema de saúde pública em todo o mundo, em virtude de serem acompanhados por elevado índice de morbimortalidade. O trânsito causa a morte de aproximadamente 1,3 milhão de pessoas e a incapacitação de milhões de outras.

Objetivo: avaliar a da mortalidade por acidentes de trânsito entre motociclistas, pedestres e custos hospitalares ocorridos na cidade de São Paulo, Brasil, no período de 1999 a 2019.

Método: trata-se de estudo de séries temporais retrospectiva com micro dados oficiais, foram coletados por local de ocorrência entre condutores de motocicletas, pedestres e custos hospitalares no período de 1999 a 2019, na cidade de São Paulo, SP, Brasil.

Resultados: na cidade de São Paulo, no período de 1999 a 2019, ocorreram 144.186 mil óbitos decorrentes de acidente de transporte terrestre, projetando 5.293 mil óbitos especificamente com motociclistas. A mortalidade proporcional por foi mais elevada na faixa etária de 29 anos média, predominando no sexo masculino, destacando-se a raça/cor da pele branca. Os custos por óbitos o destaque aparece para os motociclistas com média de R\$: 49.078,18, com relação aos óbitos por sexo, o masculino predominou substancialmente em relação ao feminino.

Conclusão: apresentou-se um alto índice de óbitos, tanto em motociclistas como em pedestres, tendo este último uma média mais elevada. Assim, estes achados fornecem informações relevantes da magnitude do problema de saúde pública para guiar-nos sobre estratégias de controle para esta causas.

Palavras-chave: acidente de trânsito, motocicletas, pedestres, custos hospitalares, mortalidade.

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