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ORIGINAL ARTICLE

# Trend of traffic accident mortality rate among motorcyclists in the state of São Paulo, Brazil, from 2015 to 2020

## Tendência da taxa de mortalidade por acidentes de trânsito entre motociclistas no estado de São Paulo, Brasil, de 2015 a 2020

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## ABSTRACT

**Objective:** To assess the trend in motorcyclist mortality rate from traffic accidents in the state of São Paulo, Brazil, from 2015 to 2020. **Methods:** This is an ecological time series study with secondary data from the Traffic Accident Management Information System of the State of São Paulo (INFOSIGA), referring to motorcyclists' deaths due to road traffic injuries in the state of São Paulo, Brazil, from 2015 to 2020. The Annual Percent Change was calculated according to the Prais-Winsten regression model, using the Stata 14.0 software. **Results:** A total of 11,343 deaths of motorcyclists due to road traffic injuries were reported. The highest proportion of deaths occurred among men (88.1%), aged between 18 and 24 years (27.9%), in the two most populous and urbanized regions of the state. The distribution of mortality showed minimal variation in the analyzed period, from 4.22 to 4.42 deaths/100 thousand inhabitants. Among the analyzed sociodemographic variables, the mortality trend of motorcyclists was mostly stationary. **Conclusion:** The analysis of the mortality of motorcyclists due to road traffic injuries in the state of São Paulo showed a stationary trend.

**Keywords:** Accidents, traffic. Mortality. Motorcycles. Epidemiology.

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**CONFLICT OF INTERESTS:** nothing to declare.

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## INTRODUCTION

Worldwide, road traffic injuries (RTI) are responsible for 1.35 million deaths and over 50 million injured individuals annually[1]. Of these victims, 93% are from developing countries and the vast majority (73%) are young men under 25 years of age[1]. Brazil ranks among the ten countries with the highest mortality from RTI[2], totaling 208,687 deaths in the period from 2015 to 2020[3].

Deaths and injuries due to traffic accidents are a major socioeconomic concern with a significant impact on the gross domestic product (GDP) of around 5% in low- to middle-income countries[4]. The Institute for Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada* – IPEA) estimated annual national costs in 2014 of BRL 40 billion with RTI on highways and BRL 10 billion in urban areas, with a single fatal accident surpassing the value of BRL 600 thousand of damages to society.[5]. Physical, psychological, and family consequences resulting from RTI are also remarkable, as most victims do not resume normal population levels of quality of life[6]. The severity of RTI is closely related to physical dependence, mental disorders, and financial issues[6].

Despite the significant reduction in total RTI mortality observed in Brazil between 1990 and 2015, deaths involving motorcyclists did not show the same behavior[7]. The increase in the mortality rate in traffic accidents involving motorcyclists is mainly explained by the considerable growth of the national motorcycle fleet[7]. Motorcycles are a low-cost mode of transport and are often used as a work tool, especially for workers who provide freight and delivery services[8]. The presence of commercial motorcyclists is evident in urban centers of the country, considering that they meet the needs of speed and agility of the consumer society[9,10].

The vehicle's own characteristics place the driver at an increased risk of serious injuries and deaths when compared with other types of vehicles[5]. The instability of the vehicle, the conditions of conservation of the motorcycle, and the fact that motorcyclists frequently use the spaces between the roadways are also decisive in the occurrence of accidents[11,12].

In this context, there is an inevitable greater probability, enhanced by the frequency of inappropriate behavior among drivers (excessive speed, inexperience, negligence regarding the use of helmets, consumption of alcohol and illicit drugs), of the occurrence of RTI with the involvement of this group specifically[13]. When compared with car drivers and passengers, motorcyclists are subject to an up to 20 times greater risk of traffic accidents with fatal outcomes[8,14].

There are several efforts and public policies to reduce RTI throughout the world. The United Nations (UN) Global Plan for the Decade of Action for Road Safety 2021–2030 includes a goal of reducing deaths by at least 50%, focusing on low- and middle-income countries. The UN recommends, among some actions, multimodal transport, the reduction of maximum speeds, in addition to prioritizing pedestrians, cyclists and public transport users, discouraging the use of private vehicles in high-density urban areas[15].

In this study we aimed to evaluate the trend in the mortality rate due to RTI of motorcyclists in the state of São Paulo, Brazil, from 2015 to 2020. Detailed analysis of motorcyclists' mortality is essential so that conditions and related characteristics can be identified to develop and improve public policies both to support RTI and to prevent it. The obtained information contributes to actions specially aimed at the most vulnerable groups as well as to support traffic control strategies.

## METHODS

This is an ecological time series study, for which data from the Traffic Accident Management Information System of the State of São Paulo (*Sistema de Informações Gerenciais de Acidentes de Trânsito do Estado de São Paulo* – INFOSIGA) were used, in the period between January 1st, 2015 and December 31, 2020. INFOSIGA is a monthly updated database that integrates information from the 645 municipalities of the state, constituting a great advance, as it provides fundamental support for the effectiveness of public policies aimed at preventing traffic accidents, considering that other databases are only updated once a year[16]. In INFOSIGA, unlike the Department of Informatics of the Brazilian Unified Health System (DATASUS) and the Mortality Information System (*Sistema de Informação sobre Mortalidade* – SIM), the 10th Revision of the International Classification of Diseases (ICD 10) is not used; it is fed with data from incident reports from the Civil Police, the Military Police, and the Federal Highway Police.

By the online platform *Painel de Resultados* (available from http://www.infosiga.sp.gov.br), it is possible to access the INFOSIGA database, perform tabulations, obtain sociodemographic data on involved individuals and other characteristics of the accident, such as: day and time, accident mechanism, occurrence of deaths, vehicle and road specifications. Data collection was performed by two trained researchers designated by the authors, and a third investigator was responsible for correcting possible discrepancies.

The state of São Paulo, where the study was carried out, is a federative unit of Brazil with 46,649,132 inhabitants in an area of 248,219.485 km$^2$ and a human development index of 0.783. It is the Brazilian state with the highest concentration of motor vehicles, totaling 30,778,960 vehicles, of which 4,951,261 are motorcycles[17].

Deaths were estimated considering deaths from RTI involving motorcyclists reported in INFOSIGA. For the construction of mortality rates, data were collected from the population residing in the state of São Paulo, from the 2010 Census by the Brazilian Institute of Geography and Statistics (IBGE), and from intercensal projections for the years of the analyzed period (2015, 2016, 2017, 2018, 2019, and 2020), according to information provided by DATASUS[3].

All traffic accidents that occurred between 2015 and 2020, in the state of São Paulo, whose outcome was the death of a motorcyclist (driver and/or passenger) were included. Traffic accidents involving motorcyclists without deaths, as well as other accidents involving other vehicles and modes of transport, were excluded.

The variables of interest in the study were:

a) Year of death: 2015, 2016, 2017, 2018, 2019, and 2020;
b) Sex: man and woman;
c) Age group: 0–17, 18–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and 80 years or older;
d) Day of the week: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday;
e) Shift: early morning, morning, afternoon, and night;
f) Place of death: health facilities, road, and others;
g) Involvement of another vehicle: automobile, bicycle, truck, motorcycle, bus, pedestrian, others, and none;
h) Jurisdiction of the road: municipal, state, and federal;
i) Administrative region of the state of São Paulo: Araçatuba, Baixada Santista, Barretos, Bauru, Campinas, Central, Franca, Itapeva, Marília, Metropolitan Region of São Paulo, Presidente Prudente, Registro, Ribeirão Preto, São José do Rio Preto, São José dos Campos, and Sorocaba (Figure 1).

The analysis of trends in mortality rates was performed using the Prais-Winsten linear regression test, as proposed by Antunes and Cardoso[18], which provides for the correction of the first-order autocorrelation. This process considered the mortality rate as the dependent variable and the years of the historical series as the independent variable. The Annual Percentage Change (APC) was calculated considering the significance level of 95%, according to Equations 1, 2, and 3.

$$APC = (10^{\beta} - 1) \times 100\% \quad (1)$$

$$(95\%CI)_{ul} = (10^{\beta max} - 1) \times 100\% \quad (2)$$

$$(95\%CI)_{ll} = (10^{\beta min} - 1) \times 100\% \quad (3)$$

Where:
β: slope of linear regression;
*ul*: upper limit;
*ll*: lower limit of the confidence interval.

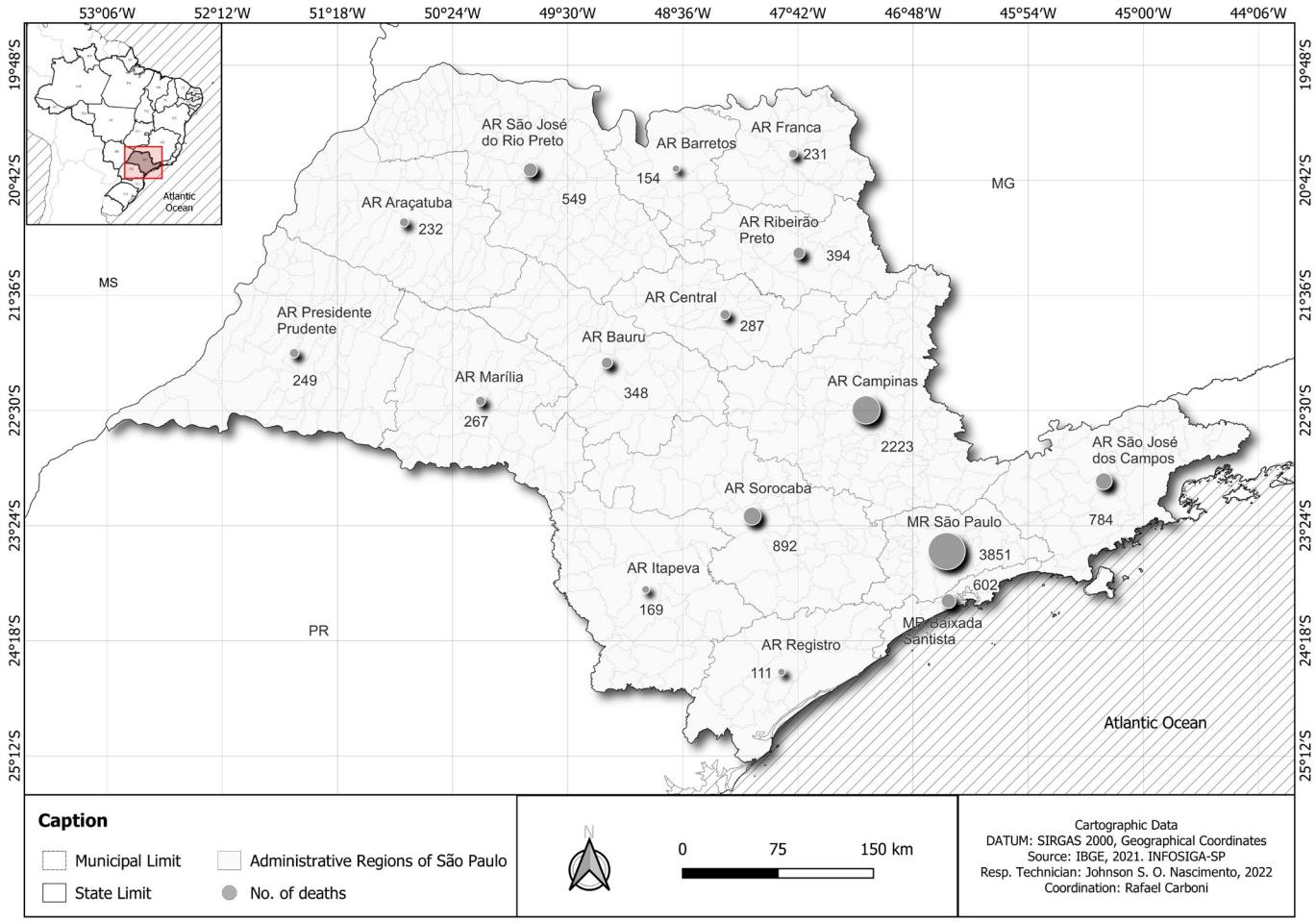


**Figure 1. Map of administrative regions of the state of São Paulo, Brazil, and absolute frequency of motorcyclists' deaths from road traffic injuries from 2015 to 2020.**

Mortality trends of motorcyclists from RTI and their variables were classified according to the APC value. Positive APC values were considered as upward trend; negative values, downward trend; and APC results with p>0.05, as stationary trend. All analyses were performed using the statistical program STATA 14.0 (College Station, TX, United States of America).

Finally, for the purpose of comparison between databases, another similar epidemiological survey was carried out with information available from the SIM. All deaths from external causes of morbidity and mortality that occurred in the same period, between 2015 and 2020, in the state of São Paulo were estimated. The considered categories of transport accidents, according to ICD 10, were:

V20–V29: Motorcycle rider injured in transport accident;

V30–V39: Occupant of three-wheeled motor vehicle injured in transport accident.

The present study involved only the description and analysis of secondary data. All these sources of information are in the public domain. Additional information that is not freely accessible was not collected. In particular, no personally identifiable information was obtained for this study.

According to Resolution No. 510/2016, of April 7, 2016, of the National Health Council of the Brazilian Ministry of Health, research using information of public access, pursuant to Law No. 12.527, of November 18, 2011, will neither be registered nor assessed by the Research Ethics Committees (CEP)/National Commission of Ethics in Research (CONEP) system.

## RESULTS

A total of 11,343 deaths of motorcyclists due to traffic accidents in the state of São Paulo were notified in INFOSIGA during the period from 2015 to 2020. This result was 25.6% higher than the 9,032 motorcycle deaths reported in SIM (Supplementary Table 2). Among the deaths reported in INFOSIGA, the highest proportion occurred among men (88.1%), aged between 18–24 years, and 67.52% of the cases were concentrated in the group of young adults aged 18–39 years. We observed that the largest share of deaths occurred from Friday to Sunday (56% of cases), with emphasis on the afternoon and night shifts, which totaled 54.6%. The lowest incidences of deaths were concentrated on Tuesdays and in the morning shift (Table 1).

Deaths that occurred on the road, that is, at the scene of the accident, were less frequent than those in health facilities, 39.6 and 55%, respectively. Occurrences in other locations totaled 5.4% of deaths. The municipal roads of the large population conglomerates of the state of São Paulo, administrative regions of Campinas and Metropolitan Region of São Paulo, were the main places of deaths from motorcycle accidents, concentrating 53.5% of the occurrences. The administrative regions of Barretos and Registro had the lowest occurrences of motorcyclist deaths, accounting for 2.4% of cases (Table 1) (Figure 1).

**Table 1. Absolute and relative frequencies of deaths, annual percentage change, and trend in motorcyclists' mortality from road traffic injuries in the state of São Paulo, Brazil, 2015 to 2020.**

| Variables | n | % | APC | 95%CI | | p-value | Trend |
|---|---|---|---|---|---|---|---|
| **2015–2020** | **11,343** | **100** | **-0.19** | **-0.99** | **0.63** | **0.55** | **–** |
| Sex | | | | | | | |
| Man | 9,989 | 88.1 | 0.32 | -0.43 | 1.07 | 0.307 | – |
| Woman | 1,201 | 10.6 | 4.66 | -0.72 | 10.34 | 0.075 | – |
| Unavailable | 153 | 1.3 | | | | | |
| Age group (years) | | | | | | | |
| 0 to 17 | 423 | 3.7 | -17.87 | -23.49 | -11.84 | 0.002 | ↓ |
| 18 to 24 | 3,166 | 27.9 | 1.30 | -1.34 | 4.02 | 0.246 | – |
| 25 to 29 | 1,708 | 15.1 | -2.31 | -4.71 | 0.15 | 0.06 | – |
| 30 to 34 | 1,519 | 13.4 | -2.16 | -3.42 | -0.89 | 0.009 | ↓ |
| 35 to 39 | 1,266 | 11.2 | 1.77 | -1.50 | 5.15 | 0.21 | – |
| 40 to 44 | 970 | 8.6 | 0.28 | -3.93 | 4.67 | 0.864 | – |
| 45 to 49 | 815 | 7.2 | 2.03 | 0.24 | 3.85 | 0.035 | ↑ |
| 50 to 54 | 527 | 4.6 | 4.29 | -5.27 | 14.82 | 0.291 | – |
| 55 to 59 | 369 | 3.3 | 6.78 | 3.42 | 10.24 | 0.005 | ↑ |
| 60 to 64 | 201 | 1.8 | 7.83 | -8.74 | 27.42 | 0.278 | – |
| 65 to 69 | 103 | 0.9 | 7.79 | -0.86 | 17.18 | 0.067 | – |
| 70 to 74 | 52 | 0.5 | 4.49 | -18.24 | 33.55 | 0.645 | – |
| 75 to 79 | 21 | 0.2 | 14.82 | -3.35 | 36.41 | 0.09 | – |
| 80 or over | 8 | 0.1 | 0.07 | -22.28 | 28.84 | 0.994 | – |
| Unavailable | 195 | 1.7 | | | | | |

Continue...

**Table 1. Continuation.**

| Variables | n | % | APC | 95%CI | | p-value | Trend |
|---|---|---|---|---|---|---|---|
| **2015–2020** | **11,343** | **100** | **-0.19** | **-0.99** | **0.63** | **0.55** | **–** |
| Day of the week | | | | | | | |
| Monday | 1,329 | 11.7 | 1.62 | -5.02 | 8.73 | 0.545 | – |
| Tuesday | 1,166 | 10.3 | 1.82 | -2.90 | 6.77 | 0.352 | – |
| Wednesday | 1,181 | 10.4 | 2.76 | -5.81 | 12.11 | 0.435 | – |
| Thursday | 1,318 | 11.6 | -3.43 | -5.32 | -1.49 | 0.008 | ↓ |
| Friday | 1,534 | 13.5 | 0.53 | -4.31 | 5.61 | 0.781 | – |
| Saturday | 2,312 | 20.4 | -0.15 | -1.31 | 1.02 | 0.742 | – |
| Sunday | 2,503 | 22.1 | -2.26 | -4.91 | 0.45 | 0.081 | – |
| Shift | | | | | | | |
| Early morning | 2,340 | 20.6 | -2.05 | -2.96 | -1.13 | 0.004 | ↓ |
| Morning | 1,999 | 17.6 | 0.46 | -1.19 | 2.13 | 0.486 | – |
| Afternoon | 2,512 | 22.1 | 0.97 | -2.43 | 4.50 | 0.478 | – |
| Night | 3,690 | 32.5 | 1.57 | 0.89 | 2.26 | 0.003 | ↑ |
| Unavailable | 802 | 7.1 | | | | | |
| Place of death | | | | | | | |
| Health facility | 6,237 | 55 | 1.81 | -2.22 | 6 | 0.285 | – |
| Road | 4,493 | 39.6 | -2.48 | -7.80 | 3.15 | 0.282 | – |
| Others | 506 | 4.5 | 5.81 | -9.39 | 23.55 | 0.369 | – |
| Unavailable | 107 | 0.9 | | | | | |
| Involvement of another vehicle | | | | | | | |
| Automobile | 2,671 | 23.5 | 80 | -2.61 | 232.71 | 0.057 | – |
| Bicycle | 37 | 0.3 | 50.16 | -20.11 | 182.24 | 0.133 | – |
| Truck | 1,043 | 9.2 | 100.78 | 4.84 | 284.51 | 0.041 | ↑ |
| Motorcycle | 497 | 4.4 | 69.72 | -3.19 | 197.55 | 0.059 | – |
| Bus | 429 | 3.8 | 84.36 | -7.40 | 267.07 | 0.069 | – |
| Pedestrian | 27 | 0.2 | 4.15 | -93.87 | 1669.29 | 0.885 | – |
| Others | 56 | 0.5 | -4.64 | -69.24 | 195.58 | 0.873 | – |
| No occurrence | 2,040 | 18.0 | 90.32 | 25.86 | 187.80 | 0.012 | ↑ |
| Unavailable | 4,543 | 40.1 | | | | | |
| Jurisdiction | | | | | | | |
| State | 3,491 | 30.8 | -2.49 | -6.34 | 1.52 | 0.157 | – |
| Federal | 391 | 3.4 | 2.59 | -2.37 | 7.80 | 0.225 | – |
| Municipal | 6,974 | 61.5 | 0.56 | -7.47 | 9.28 | 0.862 | – |
| Unavailable | 487 | 4.3 | | | | | |
| Administrative region | | | | | | | |
| Araçatuba | 232 | 2.0 | 2.36 | -4.28 | 9.47 | 0.389 | – |
| Baixada Santista | 602 | 5.3 | -1.58 | -6.29 | 3.38 | 0.42 | – |
| Barretos | 154 | 1.4 | 10.24 | -5.72 | 28.90 | 0.159 | – |
| Bauru | 348 | 3.1 | 1.18 | -9.09 | 12.60 | 0.777 | – |
| Campinas | 2,223 | 19.6 | 0.41 | -2.05 | 2.94 | 0.669 | – |
| Central | 287 | 2.5 | 4.71 | -4.35 | 14.63 | 0.231 | – |
| Franca | 231 | 2.0 | 0.01 | -5.65 | 6.02 | 0.995 | – |
| Itapeva | 169 | 1.5 | 2.23 | -20.18 | 30.93 | 0.816 | – |
| Marília | 267 | 2.4 | -3.63 | -8.14 | 1.09 | 0.098 | – |
| Metropolitan Region of São Paulo | 3,851 | 34 | -1.53 | -5.32 | 2.42 | 0.338 | – |
| Presidente Prudente | 249 | 2.2 | -4.76 | -8.08 | -1.33 | 0.019 | ↓ |
| Registro | 111 | 1 | -6.76 | -22.81 | 12.64 | 0.362 | – |
| Ribeirão Preto | 394 | 3.5 | -0.63 | -9.38 | 8.96 | 0.858 | – |
| São José do Rio Preto | 549 | 4.8 | 1.58 | -5.95 | 9.71 | 0.602 | – |
| São José dos Campos | 784 | 6.9 | -3.17 | -10.47 | 4.74 | 0.318 | – |
| Sorocaba | 892 | 7.9 | 4.16 | 0.55 | 7.90 | 0.033 | ↑ |

APC: Annual Percentage Change; 95%CI: 95% confidence interval; –: stationary trend; ↑: upward trend; ↓: downward trend.

Accidents involving other vehicles, mainly automobiles (23.5%) and trucks (9.2%), surpassed those without the involvement of other modes of transport (18%) or pedestrians (0.2%). In addition to these findings, a high percentage (40.1%) of missing data stands out specifically in this variable, described as "unavailable." Missing data added up to 7.1% in the "shift" variable; however, in the others, these data either remained below 5% or did not occur.

The distribution of deaths between 2015 and 2020 is homogeneous. The frequency of deaths per year did not show significant variations. This is confirmed by the minimal variation in the mortality rate in the analyzed period, from 4.22 to 4.42 deaths of motorcyclists per 100 thousand inhabitants (Figure 2) (Supplementary Table 3).

In Table 1 we present the results of the Prais-Winsten regression estimates on the mortality rate of motorcycle accidents in the state of São Paulo from 2015 to 2020. Among the analyzed variables, the trend in motorcycle mortality due to RTI was mostly stationary (Supplementary Table 4).

We observed an upward trend, that is, APC with positive values, in mortalities of the following variables: deaths that occurred during the night shift in the age groups of 45–49 and 55–59 years; in the administrative region of Sorocaba; accidents involving trucks; and those without the participation of another mode of transport or pedestrian. Conversely, we observed a downward trend, that is, APC with negative values, in the mortalities of the following variables: Thursday as the day of the week; early morning shift; administrative region of Presidente Prudente; and the age groups 0–17 and 30–34 years (Table 1).

## DISCUSSION

Our findings point to the temporal stability of the mortality rate of motorcyclists due to RTI in the state of São Paulo from 2015 to 2020. It is worth highlighting this stationary trend because, as it is an external cause of death that can be prevented (public policies, traffic education, improvement in road and working conditions), this indicator is expected to annually decrease. Despite this result, according to Aquino et al.[2], in the period between 2010 and 2016, the trend of motorcyclists' deaths in the state of São Paulo was upward.

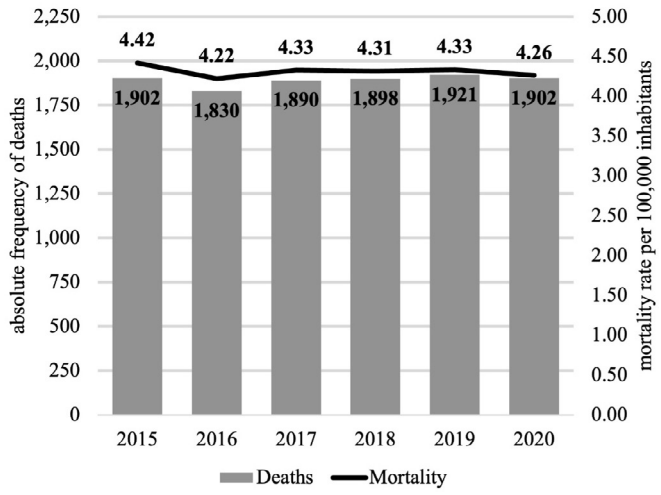


**Figure 2. Absolute frequency of deaths per year and mortality rate per 100 thousand inhabitants of motorcyclists resulting from road traffic injuries in the state of São Paulo, Brazil, from 2015 to 2020.**

Mortality of motorcyclists in the state of São Paulo was below the national rates and in the Midwest, North, and Northeast regions, Brazilian macro-regions that have the highest incidence of motorcycle deaths, with the city of Boa Vista, capital of the state of Roraima, as the Brazilian capital with the highest rate (16.1 deaths/100 thousand inhabitants)[2,8]. However, RTI mortality is higher than in countries such as the United States of America and Canada, which have averages below 1.5 deaths/100 thousand inhabitants[19].

These results can be considered consequences of multiple factors mainly present in urban centers, as over half of deaths occurred on municipal roads, in the two most populous and urbanized administrative regions of the state of São Paulo: Campinas and Metropolitan Region of São Paulo.

The increased traffic of motor vehicles, the use of motorcycles as a work tool, and constant demands inherent in professional practice also combine to maintain high mortality, reaching proportions close to 30% of all deaths related to traffic accidents[8]. The exposure of this group is further potentiated by long working hours, inexperience of the driver, and high speeds on the roads (above 80 km/h)[10,20].

Considering public actions in the city of São Paulo from 2010 to 2016, the reduction in maximum speed on public roads contributed to a sharp decline in RTI mortality. Among men, the mortality rate was from 18.46 to 10.99 deaths/100 thousand inhabitants. Conversely, among women, the reduction was from 3.66 to 2.80 deaths/100 thousand inhabitants[21].

Traffic accidents that result in the death of motorcyclists often involve another vehicle. Such information corroborates the reality of urban centers, characterized by greater concentrations of vehicles and traffic, faced with the need for agility in displacements for the most diverse activities[9,22]. A study carried out by the analysis of 378 traffic accidents involving motorcyclists in an urban center in India, with 3.8 million inhabitants, found involvement of other vehicles in 59% of the occurrences[23].

Another study, carried out in Iran between 2011 and 2017, which included deaths of motorcyclists, identified that, of the 122,682 deaths from RTI, 28,356 (23.1%) were motorcyclists, and in 80.2% there was involvement of another vehicle. Of these cases, 95.3% were men, with approximately 30% in the age group between 18 and 24 years[24]. Over half of the deaths had traumatic brain injury as the main cause, a fact closely related to the high mortality before the arrival at health services[23,24]. We identified that in the state of São Paulo, 39% of deaths occurred on

the road, enabling us to infer the high rate of serious injuries among motorcyclists.

Most deaths result from cranioencephalic or visceral trauma and occur at the accident scene or within 24 hours after its occurrence[25,26]. A study conducted between 2011 and 2015 in a trauma center in Malaysia, the country with the highest mortality from RTI in Southeast Asia, identified, after analyzing 1,653 patients undergoing treatment for injuries from motorcycle traffic accidents, traumatic brain injury as the main predictor of mortality, increasing the risk of death by about four times[27]. A cohort study with 7,813 motorcycle riders in urgent and emergency services indicated the use of helmets as being responsible for a 76% reduction in the occurrence of traumatic brain injuries and a 28% reduction in referrals to other services, hospitalizations, or deaths[28].

In the analyzed period, practically a third of the deaths occurred during the night shift. This distribution can be explained by fatigue at the end of the day, increased vehicle flow, variation in visibility, unmarked vehicles, reduced police inspection, excessive speeding, and the use of alcohol or drugs. The combination of use of narcotic substances and reckless driving of automobiles is more frequent on weekends[20,28], a fact that contributes to the higher concentration of deaths observed on these days. According to research carried out at the Legal Medical Institute of the state of São Paulo, in 2005, 42.3% of motor vehicle drivers who died from RTI had serum alcohol levels above 0.6 g/L. Among motorcyclists, levels above 0.1 g/L were identified in 27.6% of deaths. The authors also point out the early morning shift on Saturdays and Sundays as the most frequent period for fatal RTIs, with and without alcohol consumption[29].

Analysis of time series on the impact of Law No. 11.705 (Prohibition), of 2008, which punishes drivers caught under the influence of alcohol or any psychoactive substance, on mortality from RTI in the Brazilian federative units, indicated a considerable decrease only in the state of Santa Catarina and the Federal District, with stability in the state of São Paulo[30]. Another study on the impact of the implementation of the Brazilian Traffic Code (*Código de Trânsito Brasileiro* – CTB) and Law No. 11.705 on RTI mortality in the state of Paraná, Brazil, between 1980 and 2014 showed that after the implementation of the CTB there was a reduction of 9.69 deaths/100 thousand inhabitants per year for all categories of traffic accidents. The greatest impact was observed in the age group from 20 to 29 years. Nevertheless, after implementing Law No. 11.705, trends remained stationary for motorcycle riders[31].

Regarding the age of the victims, there was an upward trend in older age groups, from 45 to 49 and 55 to 59 years. Despite the lower incidence of traffic accidents, older age groups show higher concentrations of severe cases and, consequently, increased lethality, with a twice higher risk of death as an outcome in ages over 35 years[27,32].

Furthermore, there is a downward trend in two groups: young people aged 0 to 17 and 30 to 34 years. Similar to many deaths from violent causes, those resulting from motorcycle accidents mostly victimize young men, who exceed 70% of the occurrences in our study and in several others[20,29,32-35].

The higher prevalence of accidents in this age group has negative socioeconomic consequences for society, as these individuals are in full working age. Therefore, the various injuries, temporary or permanent, as well as deaths, interrupt work activities, failing to generate income and production for the economic system, in addition to causing high costs to the health system, with hospital admissions and rehabilitation[33].

Detailing the characteristics of the involved individuals, as well as the different conditions of the occurrences, is crucial for understanding the processes and planning of public actions. The use of time series, in this case, contributes to verify the results of preventive measures, that is, it points out the future projection resulting from measures currently or past adopted. Therefore, it becomes another important tool to assist in the adjustment, adequacy, investments, and innovation of public policies that result in the reduction of deaths from RTI.

We performed this study by analyzing a public domain database. The completion of data referring to the analyzed variables is not subject to our control, contributing to the presence of missing data. Furthermore, the information made available does not include the condition of motorcycle use (leisure, transport, commercial), use of alcohol or other drugs, nor the skin color and education of the victims, and it is not possible to measure such associations with RTI mortality in the state of São Paulo.

The analysis of motorcycle mortality from RTI in the state of São Paulo showed a stationary trend. This result reinforces the need for effective strategies and policies focusing on the younger and male population, as well as improving inspections to prevent RTI (reducing average speed, combating the use of alcohol and drugs), especially in urban areas of the state.

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## RESUMO

**Objetivo:** Avaliar a tendência da taxa de mortalidade de motociclistas decorrentes de lesões por acidentes de trânsito no estado de São Paulo, Brasil, nos anos de 2015 a 2020. **Métodos:** Estudo ecológico de delineamento de série temporal com dados secundários provenientes do Sistema de Informações Gerenciais de Acidentes de Trânsito do Estado de São Paulo (INFOSIGA), referentes aos óbitos de motociclistas decorrentes de lesões por acidentes de trânsito no estado de São Paulo, de 2015 a 2020. A variação percentual anual foi calculada pelo modelo de regressão de Prais-Winsten, utilizando o programa STATA 14.0. **Resultados:** Foram notificados 11.343 óbitos de motociclistas resultantes de lesões por acidentes de trânsito. A maior proporção de óbitos ocorreu entre indivíduos do sexo masculino (88,1%), entre 18 e 24 anos de idade (27,9%), nas duas regiões mais populosas e urbanizadas do estado. A distribuição da taxa de mortalidade apresentou mínima variação no período analisado, de 4,22 a 4,42 óbitos/100 mil habitantes. Entre as variáveis sociodemográficas analisadas, a tendência da mortalidade de motociclistas foi estacionária em sua maioria. **Conclusão:** A análise da taxa de mortalidade de motociclistas decorrentes de lesões por acidentes de trânsito no estado de São Paulo apresentou tendência estacionária.

**Palavras-chave:** Acidente de trânsito. Mortalidade. Motocicletas. Epidemiologia.

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