Trends in hospitalizations due to motorcycle accidents involving men aged 20 to 39 years in the state of Santa Catarina - Southern Brazil

Ione Jayce Ceola Schneider¹,²,³, Marcelo Vargas Schütz², Nazaré Otília Nazário², Ameg Dalpiaz³, Alexandre Márcio Marcolino¹,³, Rafael Inácio Barbosa¹,³

Abstract

Introduction: Motorcycles accidents are responsible for most of the injuries due to external causes and consequent high hospitalization rates. Objective: This study aimed to analyze the temporal trend in motorcycle accident morbidity among young male adults in the State of Santa Catarina. Methods: This is an ecological study on motorcycle accident morbidity in men aged 20 to 39 years in the State of Santa Catarina between 1998 and 2012. Data from the Hospital Information System of the Brazilian Unified Health System were used in the study. Specific hospital morbidity rates adjusted for age, age group and geographical region, were calculated to analyze the temporal trend in the State through regression model estimates obtained using the Joinpoint program. Results: A total of 19,889 hospital admissions for motorcycle accidents occurred in the State of Santa Catarina in the period studied, with a significant increase of 10.9% per year. In the studied age groups, the 20-29 year old group increased 9.7% per year, whilst the 30-39 year old group increased 13.7%. Except for Foz do Rio Itajaí, all geographical regions of the state showed a significant increase of morbidity. Conclusion: There has been an increasing trend of morbidity for motorcycle accidents in State of Santa Catarina. These results show the need for improvement of policies to reduce the causes of this type of accident.

Keywords: external causes; motorcycle accidents; epidemiological studies.

Resumo


Palavras-chave: causas externas; acidentes motociclísticos; estudos epidemiológicos.

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INTRODUCTION

In the last decades, diseases and injuries due to external causes, which include traffic accidents, falls, burnings and self-inflicted, interpersonal or collective violence, have been one of the leading causes of deaths and sequelae in the world population, with serious damage to individuals, their families, and society.1–6

In comparison to other countries, Brazil has high mortality rates, and external causes rank first among the main events leading to death in the age group of 1 to 39 years and third among the general population, only behind cardiovascular and neoplastic diseases.3,7,8

Traffic accidents stand out among the external causes of mortality. They have become a public health problem of global dimension and a challenge for managers, due to their growing incidence.1–3,9 These accidents generally involve a series of events and environmental factors often linked to the users, the vehicles, and the roads.3,5,8,10

A growing trend of motorcycle use in Brazil has been observed as a consequence of facilitated purchase, credit access, and extended payment deadlines; these factors attract an increasing number of customers.11 Besides being a low cost means of transport, it has been increasingly used in recent years as a work instrument, either for transportation of people or goods. Associated with this trend, the occurrence of accidents has also increased and become a major cause of injury, physical disability and death.7,11

Report from National Institute of Science and Technology about the evolution of the Brazilian fleet of motor vehicles between 2001 and 2012 showed that, while the number of cars increased by around 50%, the number of motorcycles increased more than 400%, reaching 19.9 million motorcycles.12 This increase in the number of motorcycles is clearly linked to demand for the provision of service with speed and agility and this trend seems irreversible, especially if the quality of the public transportation system does not improve as the proposal of the adopted model. This context of a society based on consumption, need of agility and increasingly chaotic traffic result in a high risk of exposure to traffic accidents.3,11

Studies have shown that the profile of people involved in motorcycle accidents is predominantly represented by men aged between 15 and 44 years, corresponding to the productive portion of the population.13–16

Accidents involving motorcycles are among the major public health problems and create a worrying scenario, with numbers that do not stop growing.16–18 The number of fatalities due to motorcycle accidents increased about tenfold between 1996 and 2006, from 2% to 20%19. Death rates for motorcycle accidents increased 820% from 1996 to 2007, 0.5 to 4.2 per 100,000 inhabitants.20

In addition to the high mortality rates, an increase of hospitalization due to these injuries is noticeable. From the total number of hospitalizations due to traffic accidents in Brazil from 2001 to 2010, 30.7% were due to motorcycle accidents. During this period, hospitalization rates due to this cause increased at an approximate total cost of 380 million Brazilian Reals and average cost of R$1,073.75 per admission.21

When death does not occur, temporary or permanent deficiencies cause disability in this important part of the population.22 The probability and severity of multiple injury is often higher than other types of vehicle accidents, because motorcycle drivers and passengers have greater portions of the body exposed in the event of an accident.23 The body areas more frequently affected are lower limbs, hip, and upper limbs, followed by head and neck area; traumatic brain injury is the main cause of death24,25. In third place are the maxillofacial injuries; motorcycle accidents are responsible for 51.1% of this kind of injury, with predominance of coronary and mandibular fractures.24 The victims of motorcycle accidents assisted in a reference rehabilitation center in Santa Catarina were mostly young men with injuries predominantly classified as very serious (lower limb amputation), followed by serious (lower limb fractures), and by extremely serious (traumatic brain injury and spinal cord injury).26

In view of the above, and considering the importance of the costs that traffic incidents with motorcycles leading to injuries imply to health and security services, because of both the incidence and severity of the events, this study aims to estimate the temporal tendency of morbidity of motorcycle accidents among young male adults in the State of Santa Catarina.

METHODS

The present study is an ecological time series of morbidity by motorcycle accidents performed in Santa Catarina, a state in the south region of Brazil. This state has nine health macroregions.27 The population of Santa Catarina in 2010, according to the Brazilian Institute of Geography and Statistics (IBGE), was 6,248,436 inhabitants.27 The Human Development Index (HDI) is 0.774.28

Data from the Hospital Information System of the Brazilian Unified Health System (SIH-SUS) were used in the study. The system is managed by the Ministry of Health through the Health Assistance Secretariat along with state health departments and local health departments, and data are processed by the Department of Health Information System (Datasus), the Ministry of Health’s Executive Secretariat.37

The hospitalizations due to motorcycle accidents registered in the Hospital Information System of the Unified Health System (SIH-SUS) in the state of Santa Catarina that occurred in the period from 1998 to 2012 with men aged 20 to 39 years,
declared in the morbidity list per group of causes from the International Classification of Diseases – 10th Edition (ICD-10) as V20 to V2927, were included in the study. Hospitalizations of individuals with unknown age and sex were excluded from the sample. The information about the number of inhabitants were obtained from IBGE’s database, also available on Datasus27.

Initially, the specific rates of hospital morbidity were calculated as the ratio between the number of hospitalizations due to motorcycle accidents and the estimated population at July 1st in each year in the series. Later, the specific morbidity rates were standardized per age, by the direct method, and this value was used as default to the standard world population.

The calculated rates were used to analyze the trend of morbidity in the different macroregions of the state, based on the estimated regression models. The historical series was filtered using a moving average algorithm centered in five terms. Therefore, the period analyzed corresponds to the years from 2000 to 2010.

The software Joinpoint 4.1.0 (Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute, United States of America) was used to calculate the annual variation of morbidity in the period studied.

This study was approved by the Research Ethics Committee from Unisul under CAAE: 27849814.0.0000.5369.

**RESULTS**

In the period studied, 422,387 hospitalizations for external causes occurred in Santa Catarina, of which 19,889 were motorcycle accidents. Among these accidents, 84.43% of the involved victims were male. The age groups 20 to 29 years and 30 to 39 years were represented in a total of 10,564 hospitalizations; 7,039 and 3,475, respectively. The hospitalization rate due to motorcycle accident in the state of Santa Catarina, overall and per age group, is shown in the Figure 1. The hospitalization rate in 2000, beginning of the period, was 10.91 hospitalizations per 100,000 inhabitants and in 2010, 29.95 hospitalizations per 100,000 inhabitants. When analyzing the annual variation of percentage of the hospitalization rate due to motorcycle accident in Santa Catarina during the studied period (2000-2010), an overall increase of 10.9% per year was observed. There were two periods of variation in this trend, both of significant increase: from 2000 to 2004, 14.9% per year, and from 2004 to 2010, 8.7% per year (Table 1).

As for age-specific morbidity rate, the group of 20 to 29 years had higher rates, with a significant growth of 9.7% per year and two periods of variation. In turn, the group 30 to 39 years had an increase of 13.7% per year, without variation in the trend.

Figures 2, 3, and 4 show the trends of hospitalization per macroregions. All macroregions, except Foz do Rio Itajaí, had significantly increasing hospitalization rates throughout the period studied, 2000-2010, as shown in Table 1.

When analyzing the periodical variation in each macroregion, it was noticed that Planalto Norte and Serra Catarinense had no variation in admission rates. The Nordeste and Vale do Itajaí macroregions had slight significant reductions in admissions in the beginning of the period, and afterwards, significant increase in admissions. Grande Oeste showed two distinctive periods of increase (2000-2006; 2006-2010). Although the Grande Florianópolis and Sul macroregions presented two periods of variation, only the former had a significant increase in the hospitalization rate. The Meio Oeste macroregion had two periods of variation in the hospitalization rate. However, only the variation in the period from 2003 to 2010 was significant, besides also having an increasing trend.

![Figure 1. Trend of overall and age-specific morbidity rate due to motorcycle accidents among men aged 20 to 39 years, Santa Catarina, 2000-2010](image-url)
Table 1. Annual percentage change in the overall, age-specific and macroregion morbidity rate due to motorcycle accidents among men aged 20 to 39 years, Santa Catarina, 2000-2010

<table>
<thead>
<tr>
<th>Variables</th>
<th>Annual Average Percentage Change (IC95%) (2000-2010)</th>
<th>Period</th>
<th>Annual Percentage Change (IC95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>10.9 (9.6; 12.2)</td>
<td>2000-2004</td>
<td>14.3 (10.7; 18.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004-2010</td>
<td>8.7 (7.3; 10.1)</td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 to 29 years</td>
<td>9.7 (8.1; 11.3)</td>
<td>2000-2004</td>
<td>13.6 (9.3; 18.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004-2010</td>
<td>7.2 (5.5; 8.9)</td>
</tr>
<tr>
<td>30 to 39 years</td>
<td>13.7 (12.7; 14.6)</td>
<td>2000-2010</td>
<td>13.7 (12.7; 14.6)</td>
</tr>
<tr>
<td>Macroe region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grande Oeste</td>
<td>27.0 (22.8; 31.2)</td>
<td>2000-2006</td>
<td>21.4 (14.4; 28.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006-2010</td>
<td>35.8 (28.8; 43.3)</td>
</tr>
<tr>
<td>Foz do Rio Itajai</td>
<td>-4.4 (-9.6; 1.2)</td>
<td>2000-2002</td>
<td>-26.2 (-45.9; 0.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002-2010</td>
<td>2.0 (-2.1; 6.3)</td>
</tr>
<tr>
<td>Grande Florianópolis</td>
<td>11.4 (9.4; 13.5)</td>
<td>2000-2005</td>
<td>24.8 (20.2; 29.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2005-2010</td>
<td>-0.6 (-3.2; 2.2)</td>
</tr>
<tr>
<td>Meio Oeste</td>
<td>17.2 (6.0; 29.6)</td>
<td>2000-2003</td>
<td>-23.3 (-47.7; 12.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2003-2010</td>
<td>40.6 (30.8; 51.2)</td>
</tr>
<tr>
<td>Nordeste</td>
<td>11.6 (6.1; 17.5)</td>
<td>2000-2005</td>
<td>-16.0 (-24.1; -7.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2005-2010</td>
<td>48.4 (37.2; 60.4)</td>
</tr>
<tr>
<td>Planalto Norte</td>
<td>8.4 (5.8; 11.1)</td>
<td>2000-2010</td>
<td>8.4 (5.8; 11.1)</td>
</tr>
<tr>
<td>Serra Catarinense</td>
<td>29.0 (18.2; 40.7)</td>
<td>2000-2010</td>
<td>29.0 (18.2; 40.7)</td>
</tr>
<tr>
<td>Sul</td>
<td>9.2 (7.4; 10.9)</td>
<td>2000-2004</td>
<td>25.2 (20.0; 30.7)</td>
</tr>
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<td></td>
<td></td>
<td>2004-2010</td>
<td>-0.4 (-2.1; 1.4)</td>
</tr>
<tr>
<td>Vale do Rio Itajai</td>
<td>3.2 (0.5; 6.0)</td>
<td>2000-2006</td>
<td>-5.9 (-9.4; -2.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006-2010</td>
<td>18.6 (11.4; 26.2)</td>
</tr>
</tbody>
</table>

Figure 2. Trend of morbidity rate due to motorcycle accidents among men aged 20 to 39 years in Sul, Grande Florianópolis, and Serra Catarinense macroregions, Santa Catarina, 2000-2010
DISCUSSION

This study sought to estimate the temporal trend of morbidity rate for motorcycle accidents among men aged 20 to 39 years in the state of Santa Catarina, which had an overall increase and in all macroregions, except Foz do Rio Itajaí. This is a pioneer study in the state of Santa Catarina and one of the few in Brazil to analyze this kind of event, which limits the comparison of the data found. An example of this limitation can be found in Mascarenhas et al. In this study, the authors were not able to include the data from Santa Catarina about traffic accidents involving motorcycles.

The number of motorcycles in Brazil has increased and this may have contributed to the number of traffic accidents. Between the period of 2004 and 2014, the number of motorcycles increased from 7 million to 23 million in Brazil. This difference represents an increase of 18.2% to 26.6% in the total number of vehicles in Brazil.

The involvement of young male adults in motorcycle traffic accidents is due to a few factors, such as the way of driving, the vulnerability of drivers and passengers, and the social and economic factors. The increased fleet of motorcyclists can be attributed to the precariousness of public transportation, phone-delivery services, possibility of work for young people, and the ease of buying a motorcycle.
cultural behavior of males that includes the exposure to risks such as alcohol consumption and aggressiveness in traffic.\textsuperscript{32-34} The ease of implementation, speed in obtaining results, and the fact of being a low cost method stand out as a strong point of ecological designs. In addition to that, the data obtained from the Datassus system provided quality and credited reliability to the findings.

One of the limitations of the study is related to the accuracy and quality of the data used in the study. Because secondary data were used in the analysis, there may be variation in accuracy and quality of data, such as inadequate or incorrect information, or underreporting of admission data. A study that analyzed the coverage and quality of information about hospitalizations for external causes of morbidity and mortality in the SIH-SUS, based on the medical records from this data source, concluded that there may be underreporting of information.\textsuperscript{15} This suggests that the estimates presented here may be underestimated, what worsens the situation of hospital morbidity due to motorcycle accidents.

In the present study, there was an increase of more than 10% per year in the overall rate of hospitalization. This information is corroborated by the Brazil’s Violence Map – 2013, which in the period of 1998 to 2008 showed an increase of 10% per year.\textsuperscript{36} In 2000, traffic accidents were responsible for 18.2% of the hospitalizations for external causes, involving mainly male victims.\textsuperscript{57} A review conducted by Bacchieri and Barros\textsuperscript{3} that described the situation of traffic accidents in Brazil between the years 1998 and 2010 observed a growth of 9% in hospitalizations resulting from traffic accidents, the majority involving motorcyclists. This increase in traffic accidents, mostly involving motorcycles, is in agreement with the increase of hospitalizations found in the present study.

Hospitalization rates due to traffic accidents involving motorcycles and 20 to 49-year-old men in the state of São Paulo from 2005 to 2009 had an average of 18.6 per 100,000 inhabitants, with more than 50 admissions per 100,000 inhabitants in some microregions.\textsuperscript{38} In the Vale do Paraíba, the hospitalization rate due to motorcycle accidents in the period from 2001 to 2005 reached 48 per 100,000 inhabitants, directly related to the fleet’s size in the studied city.\textsuperscript{31} The hospitalization rate found in Santa Catarina was lower than in the Vale do Paraíba in all the period studied, with the limitation that this study did not evaluate the relation between hospitalizations and the motorcycle fleet in the state.

A study that analyzed the factors associated to the risks of injuries in motorcyclists in Maringá showed that 78.8% of the victims presented injuries, and more than half of the injured was referred to tertiary hospitals.\textsuperscript{44} Accidents involving motorcycles have four-fold higher chance of injury, and eight-fold higher chance of death when compared to car accidents.\textsuperscript{39} In a motorcycle accident, the hospitalization rate can reach 11.7%, and lethality can reach 1.7%. More than 40% of the victims who die from motorcycle accidents receive assistance in emergency rooms, and approximately 35% die during the hospitalization.\textsuperscript{40}

An analysis of the trend of mortality from motorcycle accidents in the period from 1996 to 2009 showed that the highest growth rates of mortality were found in the North, Northeast, and Midwest regions of Brazil.\textsuperscript{41} These accidents caused in Brazil in 2003 more than 20% of the deaths due to ground transportation accidents among 20 to 39-year-old men. According to the temporal trend of mortality due to traffic accidents in Brazil from 1980 to 2002, a substantial increase in the mortality rate due to motorcycle accidents took place since 1995, especially among men aged 20 to 29 years.\textsuperscript{42}

Mascarenhas et al.\textsuperscript{30} showed that young people between 20 and 39 years of age and males are the main victims of accidents involving motorcyclists, according to data from urgency and emergency SUS services selected in state capitals and the Federal District. The results of this national study corroborate the present study and both endorse relevance of the problem of accidents involving motorcycles, as well as the need for more effective public policies targeting this population.

In Brasília, over 90% of the deaths due to transport accidents involving motorcycles were men, and 70% of them were aged 20 to 29 years. Furthermore, the mortality rate increased 36% per year.\textsuperscript{43} In a study conducted in six cities of Bahia in 1996-2007, the percentage of fatalities resulting from motorcycle accidents ranged from 5.8% to 14% and affected mostly young adults.\textsuperscript{44}

The age group of 20 to 39 years is the most affected by traffic accidents.\textsuperscript{2,15,16,42} Researches that investigated the profile of victims of motorcycle traffic accidents admitted to a hospital in Porto Alegre\textsuperscript{45} and Goiania\textsuperscript{46} pointed out that the majority were young and male adults.

In relation to age-specific hospitalization rate, there was a lower annual increase among the age group of 20 to 29 years than among the group of 30 to 39 years. In Maringá, over 70% of the motorcycle accidents involved young adults aged 20 to 39 years, with predominance of the group of 20 to 29 years, with a sex ratio of 4.2:1.\textsuperscript{45} In Rio Branco-AC, there was an increase of 42% in the rate for motorcycle accidents from 2005 to 2008, with higher incidence among males and among the age group of 20 to 39 years.\textsuperscript{46} This was also found in Fortaleza, Brazil.\textsuperscript{47,48}

Based on the confluence of all the literature about the predominance and involvement of young adults, this study has raised critical data about this type of injury. This predominance is also found in the analyses of pre-hospital care in urgency and emergency services. The analysis of pre-hospital care provided to traffic accident victims in Londrina, Brazil, from 1997 to 2000 showed about 70% cases involving men, and the most affected
age group was 20 to 29 years, more than 40% resulting from motorcycle accidents. 

Victims from motorcycle accidents in Teresina, Brazil, treated at an emergency service were predominantly male (87.4%); in 85.6% of the cases, the victims were the drivers, mostly in the age group of 15 to 34 years. 

The cases of provision of assistance to men admitted due to external causes in the São José dos Campos Municipal Hospital-SP from January to June 2003 were 10.3% due to motorcycle accidents and the most affected age group was 20 to 29 years, followed by 30 to 39 years. Another study held in São Paulo from June 2008 to August 2009 compared motorcyclists involved in traffic accidents and victims of other trauma mechanisms. The study found out that males were significantly more affected by the former, with predominance of young adults aged 28.9 years on average. Study held in Tubarão, SC, with traffic accident victims treated in the local hospital found that 78.2% were male, and 74.3% of the injured victims used motorcycles. 

The predominance of accidents involving motorcycles among young male adults found in the literature is worrisome, because it increased significantly in the statistics in both age groups. The literature points out that traffic accidents involving young adults may be associated with particular behaviors such as the search for strong emotions, pleasure and sensation of risk, alcohol or drug abuse, as well as impulsiveness and inexperience. In addition, being a young male adult and driving a motorcycle are risk factors for traffic accidents. 

As for the analysis per region, there was a significant increase in all regions, with exception of Foz do Rio Itajaí. However, no data was found in the literature to justify the noticed difference. This increase in the rate may be related to the increase of the motorcycle fleet in the state of Santa Catarina from 167,198 to 733,187 in 2012. Furthermore, the road network, the quality of hospital care performed, or the joint effect of these factors may have contributed to the increase. Another possible reason for the stabilization of hospitalization rates in some macroregions is the reduction or stabilization of the number of hospital beds per 1000 inhabitants in the State of Santa Catarina from 2006. The data found may help in future prevention policies, specific to each macroregion, and can be enhanced with specific studies for each geographical region. 

From 1990 to 2010, there was a 30% increase in the disability-adjusted life years (DALY) due to the traffic accidents in Brazil. The increasing number of vehicles and the complexity of the traffic, besides the fast urbanization, seems to be key factors for the growth in the number of injuries resulting from traffic accidents. 

The growth of accidents involving motorcycles requires joint action of public entities and drivers, promoting educational activities to prevent these accidents. Besides prevention, it is necessary that the vigilance of traffic accidents be improved to ensure the quality of care from the health sector. 

Another research supports this hypothesis by stating that the detailed study of accidents can help developing preventive strategies to these injuries. Only inter-sectoral preventive and coordinated action will be able to reduce morbidity and mortality caused by traffic accidents. It has been proposed that the assistance to survivors during pre-hospital, hospital and rehabilitation care be expanded and improved. 

In conclusion, there was an increase in the morbidity trend of motorcycle accidents by 10.9% per year, obtaining the rate of 30 hospitalizations per 100,000 inhabitants. Based on these considerations, it is clear the concern about traffic accidents, especially involving motorcycles. Researches such as the present one, with the survey of government information system data, enable the creation and implementation of strategies for prevention and reduction of traffic accident consequences. It is expected that the observed results serve as a stimulus for further research aimed at assessing, for example, the post-hospital mortality rate, percentage of partial and permanent disability, as well as the costs arising from these admissions.

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