



HOSPITALIZATIONS DUE TO ROAD TRAFFIC CRASHES INVOLVING MOTORCYCLES

Internações por acidentes de transporte terrestre envolvendo motocicletas

Ingresos hospitalarios por accidentes de transporte terrestre con bicicletas

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ABSTRACT

Objective: To analyze hospitalizations due to road traffic crashes involving motorcycles. **Methods:** A descriptive study of SUS-funded hospitalizations due to road traffic crashes (RTC) involving motorcycles in people living in the State of Rio Grande do Norte, Brazil, from 2008 to 2016. Data were obtained from the Hospital Information System of the Unified Health System (SIH/SUS). Hospitalization rates were stratified by gender, age group and health region. The proportion of hospitalization costs was also analyzed. **Results:** There were 15,233 RTC involving motorcyclists in the period analyzed, with a hospitalization coefficient of 4.38/1000 inhabitants. The hospitalization coefficient was higher among men (6:1). The most prevalent age groups were 20-34 years and over 70 years. The Metropolitan Region recorded the highest number of hospitalizations due to motorcycle accidents (n= 4,260), but the Santa Cruz Region presented the highest proportion of motorcycle accidents in relation to the RTC (75%). The State Government spent R\$ 17,916,327.90 on hospitalizations due to these accidents, which represents 66.16% of RTC expenses. **Conclusion:** There was a high proportion of hospitalizations due to motorcycle crashes in the state of Rio Grande do Norte in relation to road traffic crashes. The crashes involved mostly young men, with increased expenses due to these hospitalizations.

Descriptors: Accidents, Traffic; Motorcycles; Hospitalization; External Causes.

RESUMO

Objetivo: Analisar as internações por acidentes de transporte terrestre envolvendo motocicletas. **Métodos:** Estudo descritivo sobre internações por acidentes de transporte terrestre (IATT) envolvendo motocicletas com residentes do estado do Rio Grande do Norte, Brasil, no período de 2008 a 2016, pagas pelo SUS, a partir de dados do Sistema de Informação Hospitalar do Sistema Único de Saúde (SIH/SUS). Analisaram-se as taxas de internações por sexo, faixa etária e região de saúde, além da proporção dos gastos devido à internação. **Resultados:** No período analisado ocorreram 15.233 IATT envolvendo motociclistas, com coeficiente de internação de 4,38/1000 habitantes. Observou-se maior coeficiente de internação para o sexo masculino (6:1). Destacam-se as faixas etárias de 20-34 anos e acima de 70 anos. A Região Metropolitana registrou o maior número de internações por acidentes com motos (n= 4.260), porém a Regional de Santa Cruz apresentou a maior proporção de acidentes de motos relacionada às IATT (75%). O estado assumiu o gasto de R\$17.916.327,90 com a internação por esses acidentes, o que representa 66,16% dos gastos com IATT. **Conclusão:** Encontrou-se elevada proporção de internações por acidentes com motocicletas no estado do Rio Grande do Norte em relação às internações por acidentes de transporte terrestre, acometendo principalmente jovens do sexo masculino, com aumento de gastos nessas internações.

Descritores: Acidentes de trânsito; Motocicletas; Hospitalização; Causas Externas.



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RESUMEN

Objetivo: Analizar los ingresos hospitalarios por accidentes de transporte terrestre con motocicletas. **Métodos:** Estudio descriptivo sobre los ingresos hospitalarios por accidentes de transporte terrestre (IATT) con motocicletas con residentes del estado de Rio Grande do Norte, Brasil, en el período entre 2008 y 2016, pagados pelo SUS, a partir de los datos del Sistema de Información del Hospital del Sistema Único de Salud (SIH/SUS). Se analizaron las tasas de ingresos hospitalarios por el sexo, la franja de edad y la región de salud, además de la proporción de los gastos debido el ingreso. **Resultados:** En el período analizado ocurrieron 15.233 IATT con motociclistas, con coeficiente de ingreso hospitalario de 4,38/1000 habitantes. Se observó un mayor coeficiente de ingreso hospitalario para el sexo masculino (6:1). Se destacaron las franjas de edad entre 20-34 años y después de los 70 años. La región metropolitana ha registrado el mayor número de ingresos hospitalarios por accidentes con motos ($n= 4.260$) pero la Regional de Santa Cruz presentó la mayor proporción de accidentes con motos relacionada con los IATT (75%). El estado asumió el gasto de R\$17.916.327,90 con los ingresos por esos accidentes lo que representa el 66,16% de los gastos con los IATT. **Conclusión:** Se encontró elevada proporción de ingresos hospitalarios por accidentes con motocicletas en el estado del Rio Grande do Norte respecto los ingresos hospitalarios por accidentes de transporte terrestre que acometen principalmente a los jóvenes del sexo masculino con el aumento de gastos para los ingresos hospitalarios.

Descriptor: Accidentes de Tránsito; Motocicletas; Hospitalización; Causas Externas.

INTRODUCTION

External causes have gained relevance in the last decades due to the important impact of these diseases on health care, raising costs in the sectors and at the levels of care involved as well as having a great relevance in the morbidity and mortality of the population^(1,2). The services that are most overwhelmed by the high number of accidents and violence are mainly public emergency services, specialized care, physical rehabilitation, psychological rehabilitation and social welfare⁽³⁾.

The 10th revision of the International Classification of Diseases⁽⁴⁾ defines traffic accident as any vehicle accident occurring on the public highway. These accidents affect mainly people at younger and more productive ages, with enormous economic, social and emotional repercussions⁽⁵⁾.

By 2020, the number of deaths due to road traffic crashes (RTC) should reach 2.4 million and be the sixth leading cause of death in the world. Brazil ranks fifth in the number of road traffic deaths, behind only India, China, the United States and Russia. One of the characteristics of the epidemiological pattern of RTC in Brazil has been the increase in accidents involving motorcycles, higher mortality rates among men, and the highest incidence among young adults aged 20 to 39 years old⁽⁶⁾.

In emerging and developing countries, such as Brazil, there was a significant growth in the fleet of motorcycles, representing between 50.0 and 70.0% of the total vehicle fleet⁽⁷⁾. The causality of accidents involving motorcyclists is multifactorial and involves mainly the vulnerability due to the type of vehicle, the rapid growth of the fleet, road traffic safety, risk behavior, and the increasing use of this vehicle as a working tool without an approach aimed at occupational safety⁽⁸⁾.

The Ministry of Health (MOH) warned about the negative impact of these accidents on the health of the Brazilian population, the loss of disability-free life years, the reduction of the life expectancy of adolescents and young people, as well as the high social and economic costs imposed to the health and social security systems⁽⁹⁾. In 2014, in Brazil, 96,292 motorcyclists' hospitalizations were recorded, resulting in an expenditure of 26 million reais, which represented 52% of the hospitalization spending on RTC victims in the Unified Health System (*Sistema Único de Saúde – SUS*)⁽⁸⁾.

Despite the implementation of the National Traffic Code in 1998, with the establishment of legal norms to punish offenders and Law No. 11.705, of June 19, 2008, known as the Drunk Driving Law (*Lei Seca*), which establishes zero tolerance for drunk driving and imposes severe penalties to drivers driving under the influence of alcohol, traffic accidents still represent an important cause of early and preventable mortality in Brazil^(7,10-12).

In March 2010, the United Nations proclaimed the period 2011-2020 as the decade of action for road safety. In this context, Brazil launched the National Policy for Reducing Morbidity and Mortality from Accidents and Violence⁽¹³⁾, with an action plan focused on five intervention pillars: management strengthening, investment in road infrastructure, vehicle safety, road users' behavior and safety, and pre-hospital and hospital care for trauma⁽⁹⁾.

Given that, it is clear that there is a need for research on the subject. One of the information sources mostly used for monitoring the morbidity and mortality of these events in Brazil is the Hospital Information System of the SUS (*Sistema de Informações Hospitalares do SUS – SIH/SUS*)⁽¹⁴⁾, which provides information on hospital morbidity and expenses with these accidents and other information. Such information may help in the development of future studies and serve as a reference material for the implementation of intersectoral actions targeted at the management of health services and health promotion.

These actions to prevent accidents, especially those involving motorcycles, health promotion and peace culture are indispensable for the reduction of hospitalization and rehabilitation costs, especially in public health services.

The aim of the present study was to analyze hospitalizations due to road traffic crashes involving motorcycles.

METHODS

This is a descriptive study of hospitalizations due to road traffic crashes (RTC) involving motorcycles carried out with individuals living in the State of Rio Grande do Norte (RN) in the period from 2008 to 2016 whose hospital admissions were paid by SUS. The choice of period is justified by the possibility of conducting the temporal analysis over nine years in addition to reducing the possibility of error due to delay in data entry.

In 2016, the state of Rio Grande do Norte had an estimated population of 3,474,998 inhabitants, distributed among 167 municipalities and 8 health regions⁽¹⁵⁾. In that same year, the state hospital network consisted of 24 hospitals that provided 1,589 beds distributed among the eight health regions of the state as follows: 8 in the Metropolitan region, 3 in São José de Mipibu, 3 in Mossoró, 3 in Caicó, 3 in Açu, 1 João Câmara, 2 in Santa Cruz, and 1 in Pau dos Ferros⁽¹⁶⁾.

Data were collected from the Hospital Information System of the Unified Health System (*Sistema de Informações Hospitalares do Sistema Único de Saúde – SIH/SUS*), available on the website of the Department of Informatics of SUS (*Departamento de Informática do SUS – DATASUS*). We considered the main diagnosis of hospitalizations recorded in the SIH/SUS as road traffic crashes involving motorcycles (V20-V29) as a cause of hospitalization, according to ICD-10. The remaining hospitalizations for external causes and all-cause hospitalizations were considered for the analyses performed in this study.

We considered admissions by age group (0-19 years, 20-34 years, 35-49 years, 50-69 years, >70 years), by gender (men and women), and by health region where the accident took place in the state.

We calculated the RTC coefficient for motorcyclists (number of RTC involving motorcyclists living in Rio Grande do Norte divided by the population of the RN multiplied by one thousand inhabitants), the RTC coefficient (number of RTC of patients living in RN divided by the population of the RN multiplied by one thousand inhabitants), the coefficient of hospitalizations due to external causes (number of hospitalizations due to external causes of patients living in RN divided by the population of the RN multiplied by one thousand inhabitants), the coefficient of hospitalizations by gender (number of hospitalizations of motorcyclists due to external causes, RTC and RTC involving motorcyclists, by gender of patients living in RN divided by the population of RN multiplied by one thousand inhabitants) and the RTC coefficient by age group (number of RTC involving motorcyclists by age group in people living in RN divided by the population of RN by age group multiplied by one thousand inhabitants).

The following proportions were calculated: a) the proportion of RTC involving motorcyclists (number of RTC involving motorcyclists living in RN divided by the number of RTC of patients living in RN multiplied by 100) and b) the proportion of RTC (number of RTC involving people living in RN divided by the number of hospitalizations due to external causes of patients living in RN multiplied by 100).

The total cost of hospitalizations due to RTC was calculated in reais (R\$) considering the proportion of annual expenditure with the RTC involving motorcyclists (expenditure with RTC involving motorcyclists living in RN divided by the total expenditure with RTC involving people living in RN), the proportion of expenditures with RTC among the external causes (expenditure with RTC involving patients living in RN divided by the total expenditure with external causes of patients living in RN), and the proportion of expenditure with RTC among the total (expenditures with RTC involving patients living in RN divided by the total expenditure with hospitalizations of patients living in RN) on a three-year basis from 2008 to 2016. All coefficients and proportions were analyzed considering three-year periods: 2008-2010; 2011-2013; 2014-2016.

Calculations were made based on the hospital admission authorization (*Autorização de Internação Hospitalar – IAH*) of the SIH/SUS, which consists of a summary of the hospital discharges filled by SUS hospitals to receive hospitalizations. The data on the population were collected on the website of the Brazilian Institute of Geography and Statistics⁽¹⁵⁾.

The present research used secondary data available on official websites of the Ministry of Health of Brazil without identification of subjects; therefore, there was no need for appreciation by a research ethics committee, as established in Resolution 466/2012 of the National Health Council.

RESULTS

From 2008 to 2016, there were 99,369 hospitalizations due to external causes in the state of Rio Grande do Norte (RN), with the admission coefficient of 28.60/1000 inhabitants. The 2011-2013 triennium had the highest coefficient of hospitalizations due to external causes (10.23/1000 inhabitants), with a total of 35,555 hospitalizations.

As for the coefficient of hospitalization due to road traffic crashes, there were 22,197 hospitalizations in the period from 2008 to 2016, with the coefficient of 6.39/1000 inhabitants. In the period from 2011 to 2013, there were 8,546 hospitalizations, with the coefficient of 2.46/1000 inhabitants, the highest in the entire study period.

With regard to the coefficient of hospitalizations of motorcyclists injured in road traffic crashes (V20-V29) in the period from 2008 to 2016 in the state of Rio Grande do Norte, there were 15,233 hospitalizations and the hospitalization coefficient was 4.38/1000 inhabitants. The analysis of these data by trienniums showed that the period from 2011 to 2013 had the highest number of hospitalizations (n=6,133) and the coefficient of 1.76/1000 inhabitants (Figure 1). It should be noted that 22.3% (n=22197) of hospitalizations due to external causes involved RTC, and that 68.6% (n=15233) of hospitalizations due to RTC involved injured motorcyclists.

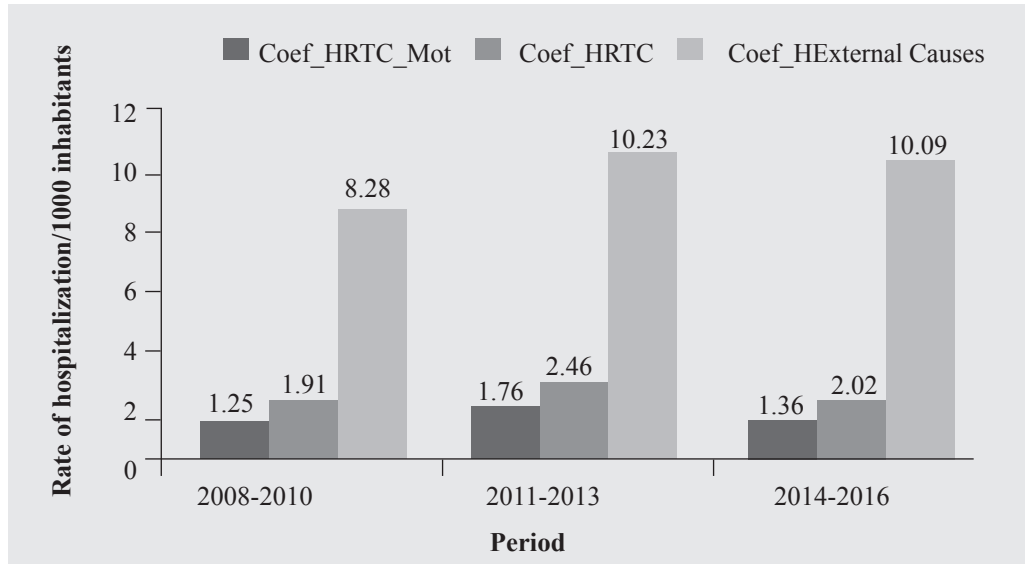


Figure 1 - Coefficients of hospitalizations due to external causes (Coef_HEExternal Causes), road traffic crashes (Coef_HRTC) and crashes involving motorcyclists (Coef_HRTC_Mot) by trienniums in the state of Rio Grande do Norte, Brazil, from 2008 to 2016.

As for the coefficient of hospitalizations due to external causes, RTC and RTC involving motorcyclists by gender between 2008 and 2016, higher coefficients were found for men in all the years. The year 2011 stood out with the coefficient of hospitalizations of 5.32/1000 men, coefficient of RTC of 1.60/1000 men and Coefficient of RTC involving motorcyclists of 1.17/1000 men (Table I).

Table I - Coefficient of hospitalizations due to external causes, road traffic crashes and crashes involving motorcyclists by gender and year in the state of Rio Grande do Norte, Brazil, from 2008 to 2016.

Year	Hospitalizations due to external causes		Hospitalizations due to road traffic crashes		Hospitalizations due to road traffic crashes – motorcycles	
	Men	Women	Men	Women	Men	Women
2008	3.92	1.42	0.90	0.19	0.58	0.09
2009	4.20	1.56	1.01	0.24	0.70	0.11
2010	5.08	1.74	1.55	0.32	1.12	0.18
2011	5.32	1.92	1.60	0.34	1.17	0.19
2012	5.19	1.83	1.49	0.31	1.12	0.17
2013	5.28	1.90	1.23	0.25	0.95	0.14
2014	5.22	2.02	1.21	0.25	0.87	0.14
2015	4.87	1.93	1.13	0.26	0.79	0.13
2016	4.54	1.93	0.86	0.22	0.61	0.12

The analysis of the coefficients of external causes, RTC and RTC involving motorcyclists by gender and age group between 2008 and 2016 found the highest coefficient of hospitalization due to external causes among women over 70 years old (8.89/1000 female inhabitants aged 70 years or over).

With regard to RTC, the highest coefficients were found among men in all age groups, with the highest coefficients at ages 20-34 (2.01/1000 men) and 35-50 years (1.53/1000 men). As for RTC involving motorcyclists, the highest coefficient was found among men aged 20-34 years – 1.60/1000 men (Figure 2).

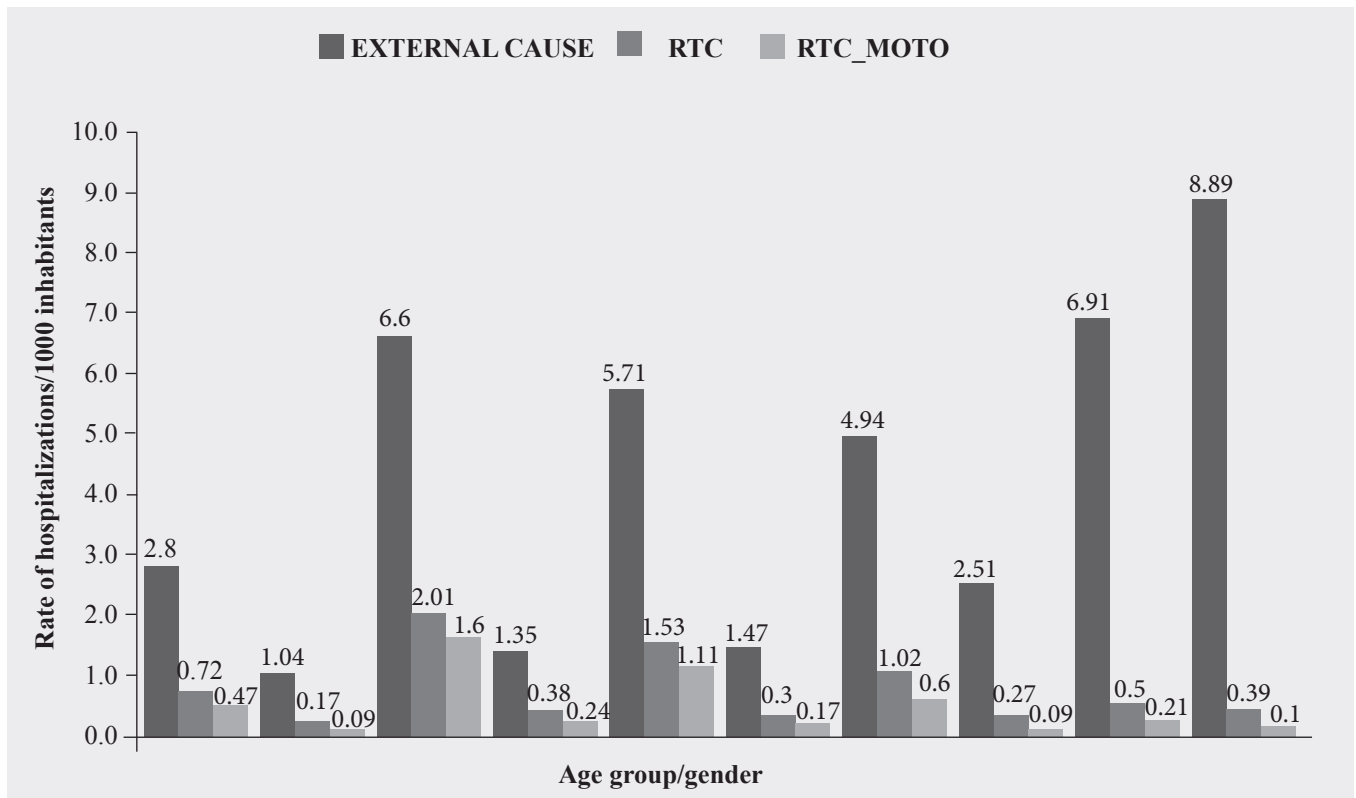


Figure 2 - Coefficient of hospitalizations due to external causes, road traffic crashes (RTC) and road traffic crashes involving motorcyclists (RTC_Moto) by gender and age group in the state of Rio Grande do Norte, Brazil, from 2008 to 2016.

The metropolitan region recorded the highest number of hospitalizations due to external causes, corresponding to 40.4% (n=40,185) of hospitalizations due to external causes in the state, followed by Mossoró, with 12,688 hospitalizations (12.8%), and Caicó, with 11,986 hospitalizations (12.1%). As for hospitalizations due to RTC involving motorcyclists, there were more hospitalizations in the metropolitan region, with 4,260 hospitalizations (28%), followed by Mossoró, with 3,468 hospitalizations (22.8%), and São José de Mipibu, with 1,617 hospitalizations (10.6%).

The proportion of hospitalizations due to RTC involving motorcyclists for each region of Rio Grande do Norte between 2008 and 2016 was higher in Santa Cruz (75%), followed by Caico (74.5%) and São José de Mipibu (73.1%). The analysis of all regions by trienniums showed that there was an increase in the proportion of RTC involving motorcyclists in the period from 2011 to 2013 compared with the period from 2008 to 2010; however, such proportion tended to decrease in the 2014-2016 triennium (Table II).

Table II - Proportion of hospitalizations due to crashes involving motorcyclists in relation to hospitalizations due to road traffic crashes by health region in the state of Rio Grande do Norte, Brazil, in the 2008-2010, 2011-2013 and 2014-2016 trienniums.

Health Region		Hospitalizations 2008-2010	% HRTC Moto/ HRTC	Hospitalizations 2011-2013	% HRTC Moto/ HRTC	Hospitalizations 2014-2016	% HRTC Moto/ HRTC	Total hospital	% Total HRTC Moto/ HRTC
São José de Mipibu	HRTC	683		831		698		2212	
	HRTC_ Moto	483	70.72	626	75.33	508	72.78	1617	73.10
Mossoró	HRTC	1458		2168		1921		5547	
	HRTC_ Moto	899	61.66	1503	69.33	1066	55.49	3468	62.52
João Câmara	HRTC	557		791		690		2038	
	HRTC_ Moto	377	67.68	590	74.59	516	74.78	1483	72.77
Caicó	HRTC	448		491		444		1383	
	HRTC_ Moto	322	71.88	372	75.76	337	75.90	1031	74.55
Santa Cruz	HRTC	409		509		433		1351	
	HRTC_ Moto	295	72.13	392	77.01	327	75.52	1014	75.06
Pau dos Ferros	HRTC	614		722		546		1882	
	HRTC_ Moto	432	70.36	546	75.62	423	77.47	1401	74.44
Metropolitan	HRTC	2076		2542		1837		6455	
	HRTC_ Moto	1268	61.08	1747	68.73	1245	67.77	4260	66.00
Açu	HRTC	393		492		444		1329	
	HRTC_ Moto	283	72.01	357	72.56	319	71.85	959	72.16
Total	HRTC	6638		8546		7013		22197	
	HRTC_ Moto	4359	65.67	6133	71.76	4741	67.60	15233	68.63

Source: DATASUS, Hospital Admission System, 2017.

Legend: HRTC: Number of hospitalizations due to road traffic crashes. HRTC_Moto: Number of hospitalizations due to road traffic crashes involving motorcyclists. % (HRTC_Moto/HRTC): proportion of HRTC involving motorcyclists; hospital: hospitalizations.

Regarding the annual expenditure with RTC involving motorcyclists, RTC and hospitalizations due to external causes of patients living in the state, there is an expenditure of R\$ 1,570,661,383.70 reais with general hospitalizations. Of this total, expenditures with hospitalizations due to external causes, RTC and RTC involving motorcyclists cost 109,718,203.42 reais, 27,080,848.59 reais and 17,916,327.90 reais, respectively. Proportionally, expenditures with RTC involving motorcyclists corresponded to 66.16% of the expenditure with RTC and 16.32% of the expenditure with hospitalizations due to external causes.

When analyzing the trienniums separately, we found an increase in the expenditures with general hospitalizations and hospitalizations due to external causes in 2008-2010, 2011-2013 and 2014-2016; however, with regard to expenditures with RTC and RTC_Moto, there was an increase in the 2011-2013 triennium, followed by a decrease in the 2014-2016 triennium (Table III).

Table III - Proportion of expenditures with hospitalizations due to road traffic crashes, RTC_Motorcyclist per RTC, RTC per external cause and RTC general hospitalizations in the state of Rio Grande do Norte, Brazil, from 2008 to 2016.

YEAR	EXPEND HRTC_Moto	EXPEND HRTC	EXPEND HEC	EXPEND HOSPITAL_RN	% HRTC_ Moto/ HRTC	% HRTC/ HEC	% HRTC/ HOSPITAL_RN
2008	1.011.817.51	1.743.419.85	7.885.102.22	126.218.767.93	58.04%	22.11%	1.38%
2009	1.301.378.95	2.174.782.59	9.347.473.96	147.840.025.01	59.84%	23.27%	1.47%
2010	2.254.182.48	3.427.232.94	11.094.603.03	161.573.885.55	65.77%	30.89%	2.12%
2008-2010	4.567.378.94	7.345.435.38	28.327.179.21	435.632.678.49	62.18%	25.93%	1.69%
2011	2.293.389.41	3.485.676.49	12.392.437.52	171.708.007.30	65.79%	28.13%	2.03%
2012	2.675.426.73	3.910.178.44	13.376.090.22	174.349.239.52	68.42%	29.23%	2.24%
2013	2.328.161.88	3.290.275.01	13.653.820.67	188.481.265.65	70.76%	24.10%	1.75%
2011-2013	7.296.978.02	10.686.129.94	39.422.348.41	534.538.512.47	68.28%	27.11%	2.00%
2014	2.268.170.30	3.216.442.18	13.998.033.14	197.374.848.98	70.52%	22.98%	1.63%
2015	2.189.304.42	3.282.051.39	14.541.618.22	212.521.040.44	66.71%	22.57%	1.54%
2016	1.594.496.22	2.550.789.70	13.429.024.44	190.594.303.32	62.51%	18.99%	1.34%
2014-2016	6.051.970.94	9.049.283.27	41.968.675.80	600.490.192.74	66.88%	21.56%	1.51%
Total	17.916.327.90	27.080.848.59	109.718.203.42	1.570.661.383.70	66.16%	24.68%	1.72%

Source: DATASUS, Hospital Admission System, 2017.

Legend: HRTC: Hospitalizations due to road traffic crashes. HRTC_Moto: Hospitalizations due to road traffic crashes involving motorcyclists. HEC: Hospitalizations due to external causes.

HOSPITAL_RN: Hospitalizations in the state of Rio Grande do Norte. % (HRTC_Moto/HRTC): proportion of HRTC involving motorcyclists. % (HRTC/HEC): Proportion of HRTC among external causes. % (HRTC/HOSPITAL_RN): Proportion of HRTC among all hospitalizations.

DISCUSSION

The results of the present study showed a high proportion of hospitalizations due to road traffic crashes involving motorcyclists in the state of Rio Grande do Norte, Brazil, affecting mainly young individuals and men living in Santa Cruz, Caicó and São José de Mipibu, with costs that exceed the Brazilian average.

The study that analyzed hospitalizations due to RTC-related injuries in Brazil in 2013 showed that there were 170,805 hospitalizations due to RTC, with rates of 85/100 thousand inhabitants. The highest rates of hospitalizations due to RTC were found among men aged 20 to 39 years. More than half of the hospitalizations due to RTC affected motorcyclists (51.9%), followed by pedestrians (25.8%)⁽¹⁷⁾. These results are similar to those found in Rio Grande do Norte, showing that the problem related to hospitalizations due to RTC involving motorcyclists in the state is not an exception in the national context.

The low cost of motorcycles and the easy financing are responsible for the expressive increase of its fleet⁽¹⁸⁾. Between 1996 and 2009, Brazil increased motorcycle accident mortality rates by 800%, with the highest rates in Northeastern states⁽¹⁹⁾. A study carried out in that region estimated that the potential years of life lost due to RTC involving motorcycles is, on average, 39.34 years⁽⁶⁾, which demonstrates the severity of this type of accident.

Male individuals aged 20-39 years are the most involved in RTC and external causes^(2,10,18). Data from the National Household Sample Survey (*Dados da Pesquisa Nacional por Amostra de Domicílios – PNAD*) conducted by IBGE in 200 pointed out that men are twice as likely to be involved in this type of accident as women⁽²⁰⁾. One of the probable explanations for this finding is that men culturally expose themselves more to situations of danger, such as drinking and driving.

In 2013, the Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases (*Sistema de vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico – VIGITEL*) and the National Health Survey (*Pesquisa Nacional de Saúde – PNS*) interviewed, respectively, 52,929 and 60,202 people aged over 18 years. Both studies found a 25% rate of adults who drove cars or rode motorcycles shortly after drinking, with this proportion being significantly higher among men and young individuals aged 18 to 29 years⁽²¹⁾.

RTC morbidity is a phenomenon of great magnitude and high complexity⁽⁶⁾, with several factors that can interfere with accidents and vary over the years. Risk factors for RTC include driving under the influence of alcohol, stress, fatigue, dizziness,

speeding, lack of use of safety equipment (mainly seatbelts and helmets), inadequate maintenance of vehicles and poor road infrastructure⁽²²⁾.

In the present study, we found a higher proportion of hospitalizations due to RTC in the 2011-2013 triennium, with a small decrease in the 2014-2016 triennium. However, an analysis of the trend of hospitalizations due to RTC between 2002 and 2012 in Brazil showed an increase in these rates, with a greater increase (250%) in hospitalizations of motorcyclists: 1.2 hospitalizations per 10 thousand inhabitants in 2002 and 4.2 hospitalizations per 10 thousand inhabitants in 2012⁽²³⁾.

The proportion of crashes involving motorcycles can vary considerably across Brazilian regions. Lower rates have been recorded in the Southeastern states compared with the findings of the present study^(24,25).

The strategy adopted in Brazil for RTC reduction in 2008 established a zero blood alcohol limit and more severe penalties for individuals who drive under the influence of alcohol⁽¹⁸⁾. In 2012, the new Drunk Driving Law (*Lei Seca*), Law No. 12.760/2012 improved the legislative framework and possibly contributed to the reduction of the act of driving under the influence of alcohol as it established other witness evidence and made the penalties to the offender more severe⁽²⁰⁾. However, there is no consensus in the literature regarding the immediate reduction in RTC after the implementation of the law.

Another action that may have influenced the reduction of the proportion of RTC in the 2014-2016 triennium in the state of Rio Grande do Norte include, in addition to inspections and health promotion actions, the implementation of the Life in the Traffic Project (*Projeto Vida no Trânsito*). The project was implemented in 2013 in the state's capital and consists of intersectoral actions such as socio-educational actions and actions to reduce risk factors for crashes.

The Northeast region is among the Brazilian regions with the highest RTC-related hospitalization rates, with motorcyclists being the victims with the longest hospital stay and the highest expenditure^(26,27). These data corroborate those of the present research, which showed high expenditure with hospitalization due to RTC compared with the amount of hospitalization expenditure in the state. Although hospitalizations due to RTC alone present a high proportion of expenditure, it is important to note that the damages caused to the victims are of physical and psychological nature and are not limited to hospital expenses, as observed in a study that demonstrated high values in services with other professionals in Brazil⁽¹⁷⁾.

The proportions of hospitalizations due to RTC in the health regions of Rio Grande do Norte, where there is a high proportion of RTC involving motorcycles in Santa Cruz, Caicó and Pau dos Ferros, show the intensification of traffic and vehicles in cities such as Santa Cruz, where the motorcycle is an important means of transportation. An aggravating factor is that in these cities there is little supervision on the use of protective equipment and the use of alcoholic beverages.

It should be noted that a significant proportion of the population affected by RTC may not require hospitalization⁽²⁾, which reveals the magnitude and urgency of carrying out actions to tackle RTC such as preventive intersectoral measures⁽⁶⁾, with promotion and prevention actions focused on motorcycle riders^(18,27). Despite the existing measures for the prevention of RTC, the health, education and care sectors should be more involved so that the population can have greater benefits from actions targeted at disease prevention and health protection and recovery.

The design of the present study does not provide detailed information about the causes of RTC and individual information, such as those about individuals that may remain hospitalized for long periods participating in the proportion of expenditures for more than one year, thus representing a limitation of the study. However, the nature of the data and the correct research procedures adopted strengthen the reliability of the results presented herein.

CONCLUSION

In the state of Rio Grande do Norte, there was a high proportion of hospitalizations due to crashes involving motorcycles in relation to the total number of hospitalizations due to road traffic crashes, involving mainly young men, with an increase in hospitalization expenditure in the 2011-2013 triennium.

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