Original article

Trends in mortality due to road traffic accidents in the municipality of Goiânia, Brazil, 2006-2014*

doi: 10.5123/S1679-49742018000400015

Érika Carvalho de Aquino[1] – orcid.org/0000-0002-5659-0308
Carlos Magno Neves[2]
Otaliba Libânio Morais Neto[1]

[1]Universidade Federal de Goiás, Instituto de Patologia Tropical e Saúde Pública, Goiânia, GO, Brasil
[2]Universidade Federal de Santa Catarina, Departamento de Saúde Pública, Florianópolis, SC, Brasil

Abstract

Objective: to estimate mortality trends for Road Traffic Accidents (RTA) in Goiânia (2006-2014). **Methods:** this was an ecological study with Mortality Information System data and population data from DATASUS and Goiânia City Government. We analyzed the time series for mortality from standardized RTA. **Results:** 3,347 deaths were included. We found significant mortality trends: pedestrians (average percentage annual increment rate - %AIR: -4.7; 95%CI -8.2;-1.1) and automobiles (%AIR: 2.6; 95%CI0.2;5.1) in Goiânia as a whole, pedestrians (%AIR: -11.3; 95%CI-20.7;-0.8), motorcycles (%AIR -13.5; 95%CI -19.0;-7.7) and automobiles (%AIR: 12.9; 95%CI2.6;24.2) in the city's Southern District, pedestrians (%AIR: -7.8; 95%CI-14.0;-1.2) in the Western District and automobiles (%AIR: -7.4; 95% 95%CI -13.8;-0.5) in the Campinas-Center District. The other time series remained stationary. **Conclusion:** The RTA mortality rate in Goiânia as a whole reduced for pedestrians and increased for automobiles. In the city's health districts, the rate reduced for pedestrians/motorcycles and increased for automobiles in the Southern District. The rate reduced for pedestrians and automobiles in the Western and Campinas-Center Districts respectively.

Keywords: Accidents, Traffic; Mortality; Time Series Studies; Information Systems.

*This article is derived from the final course assignment entitled "Trends in mortality due to road traffic accidents in the municipality of Goiânia, Brazil: 2006-2014', submitted by Érika Carvalho de Aquino as part of the Postgraduate Specialization Course in Analysis of the Health Situation, at the Institute of Tropical Pathology and Public Health, Federal University of Goiás, on 23 November 2016.

Correspondence:
Érika Carvalho de Aquino – Rua A20, Quadra 13, Lote 1 ao 31, No.113, Ed. Village dos Alpes, apto. 602, Torre 3, Vila Alpes, Goiânia, Goiás, Brazil. Postcode: 74.310-210.
E-mail: ecaquino@hotmail.com

Introduction

In March 2010 the United Nations (UN) officially proclaimed that the period 2011-2020 would be the "Decade of Action for Road Safety", urging member countries to achieve targets to stabilize and reduce road traffic deaths.[1]

This effort is justified by the fact that road traffic accidents (RTA) are currently the main cause of non-natural deaths in several countries. This type of accident is the third most frequent cause of death in the 1-14 years age group and the leading cause of death in the 15-29 years age group.[2] Approximately 1.2 million deaths are estimated to occur every year due to RTA, corresponding to 12.0% of all deaths on the planet.[2]

In 2011, global RTA costs were estimated at US$ 518 billion, corresponding to 1.0% to 2.0% of the gross domestic product (GDP) of low- and middle-income countries that year.[3] In the health sector, their impact is considerably significant. This type of accident results in between 30.0% and 86.0% of all hospitalizations, leading to health care services being overburdened.[3]

> *Goiânia is among the Brazilian cities having the highest Road Traffic Accidents hospitalization and mortality rates.*

In Brazil, the RTA mortality rate grew continually until 1997, reaching its peak in the 1990s.[4] With effect from the enactment of the Brazilian Traffic Code in 1998, a reduction was seen in the RTA rate until the beginning of the 2000s. With effect from the mid 2000s, the RTA rate tended to grow again until 2013.[5,6]

Goiânia is among the Brazilian cities having the highest RTA hospitalization and mortality rates.[7] Similar to what occurs in other urban centers, in Goiânia there has also been an increase in the use of private motor vehicles, mainly automobiles and motorcycles. A consequence of the change in the pattern of mobility are the associated negative externalities, such as injuries and deaths caused by RTA.[8]

Given that the reduction of injuries and deaths caused by RTA is currently one of the greatest challenges faced by Brazil, studies that estimate mortality magnitude and trends in urban areas are essential to identify population groups at risk and guide traffic safety interventions.

The objective of this study was to estimate RTA mortality trends in Goiânia, Brazil, 2006-2014.

Methods

This was an ecological time-series study using RTA death data on people resident in Goiânia, Brazil, for the period from January 2006 to December 2014.

The municipality of Goiânia, located 209 kilometers from Brasilia, is part of the Brazil's Midwest Mesoregion and part of the Goiânia Microregion. It is located on the Central Plateau, where the Brazilian federal capital is also located.[9] Goiânia is situated at the center of one of the world's largest mixed farming regions. This fact, together with the status of being the state capital, makes the city's current economy very dynamic.[10]

Goiânia was planned to be inhabited by 50,000 people. However, the Brazilian Institute of Geography and Statistics (IBGE) estimated that the capital had 1,448,639 inhabitants in 2016.[9] It is the second most populous city in the Midwest region after Brasilia. Demographic density in 2010 was 1,776.7 people per square kilometer.[9] Primary health management in Goiânia is fully decentralized from the federal and state levels, while specialized care is available through federal, state, municipal and private hospital facilities.[11]

The capital is divided into seven health districts: Southwest, Southern, Midwest, Eastern, Northern, Northwest and Campinas-Center. Table 1 shows the demographic characterization of Goiânia's health districts according to data from the 2010 Demographic Census.[9]

The data related to mortality were obtained from the Mortality Information System (SIM), provided by the Goiás State Health Department, including the neighborhood of residence of RTA victims. Deaths caused by RTA were considered to be those marked on the SIM system with codes V01 to V89, in accordance with the International Statistical Classification of Diseases and Related Health Problems (ICD-10).

The number of inhabitants residing in Goiânia in 2010 was obtained based on data from the 2010 Demographic Census; for the remaining years, population size was based on projections and estimates available on the Brazilian National Health System IT Department (DATASUS) website.[8] The population

Table 1 – Resident population according to health district, Goiânia, 2010

Health District	Population 2010	%
Campinas-Center	221,464	17.01
East	172,436	13.24
South	221,925	17.04
Southwest	223,027	17.13
West	152,189	11.69
Northwest	164,283	12.62
North	146,677	11.27
Goiânia	1,302,001	100.00

residing in each health district, in 2010, was obtained from the Goiânia Municipal Planning and Urbanism Department (SEPLAM) website.[10] Based on this information, we calculated the population of each Health District as a percentage of the total population of Goiânia in that year. These proportions were applied to each of the other years in order to estimate the resident population by health district for each year.

The data collected were tabulated using Microsoft Excel. The statistical analyses were performed using Stata 13 (Stata Statistical Software: Release 13. College Station, TX: StataCorp LP).

The underlying cause of death recorded on the death certificate was categorized according to the mode of transport: 1 - Pedestrian; 2 - Driver or passenger of a motorcycle or motor tricycle; 3 - Driver or passenger of automobiles, vans and pickup trucks. This categorization did not include deaths of people when using bicycles, buses and heavy trucks, for example, as they account for a small number of deaths. These types of death were, however, included in the analyses of mortality per RTA (aggregated total victim conditions).

To avoid bias caused by garbage codes, unspecified deaths (V89, V99 and Y32-Y34) were redistributed to the specific groups (pedestrians, motorcyclists, occupants of automobiles and other means of transport). Redistribution of garbage codes related to traffic accidents is recommended by other studies to correct for underestimation of the rates of accidents with specific causes.[12,13] Deaths were also categorized according to the victim's health district of residence (South, Southwest, West, North, West, East, Campinas-Center).

We calculated the annual RTA mortality rates per 100,000 inhabitants, standardized by age from January 2006 to December 2014. In this way, the mortality rates in Goiânia and its districts are comparable between each other in the different years studied. Standardization was done using the direct method, taking the standard population to be the municipal population in the year 2010. Using the same procedure, we calculated the yearly RTA mortality rates per 100,000 inhabitants, standardized by age and using the mean population for the period. Triennial rates were used to show, in a summarized way, the magnitude of RTA mortality. In turn, the annual rates were used for trend analysis.

Given that the statistical tests to be applied to check the trend of the time series depend on the existence or not of seasonality in these series, we used the Kruskall-Wallis test[14] to check this parameter. As such, the mortality rates for the years included in each time series were compared in order to verify whether the medians were significantly different. We rejected the null hypothesis of equal distribution between the years, when K obtained by the statistical test was greater than the critical K value taking a significance level of $\alpha = 0.05$.

The Prais-Winsten method for generalized linear regression was used to quantify the trends for each health district and also for the municipality of Goiânia as a whole, thus enabling comparison between the different time series being studied. This method was preferred rather than simple linear regression because it is a generalized linear regression analysis procedure especially designed for data that may be influenced by serial autocorrelation, which often occurs in population data metrics. According to Antunes and Cardoso,[15] linear autocorrelation is contrary to one of the main assumptions of simple linear regression analysis: namely the independence of residuals. Through Prais-Winsten

regression we were able to obtain the *b* value in relation to the slope of the line. Statistical significance was given by comparison between the P-value and the value given by the standard normal curve (*t*) and by the 95% confidence interval (95%CI).

We calculated the rate of mean annual increment for each of the series, in order to facilitate comparison between them. This rate refers to the percentage difference between the RTA mortality rate for two subsequent years and indicates the rate of growth (or decline) of mortality in the population studied. We also calculated the lower limits (LL) and upper limits (UL) of the 95% confidence interval of this rate.

There was no need to submit this study to a Research Ethics Committee, since it is a study that uses secondary data, with no identification of participants. National Health Council Resolution (CNS) No. 466 of 12 December 2012 was complied with.[17]

Results

3,347 RTA deaths were registered in Goiânia in the period from 2006 to 2012. Of these, 115 had incomplete information about the neighborhood of residence of the victim or this information had not been entered on the death certificate. These cases were not considered in this study.

Of the victims with adequate information about the neighborhood of residence (n=3,232), after reallocation of deaths in which the underlying cause was an unspecified traffic accident (5.2 of the total), 887 (27.4%) were classified as pedestrians, 1,118 (34.6%) as motorcycle or motor tricycle drivers or passengers, and 840 (26.0%) as drivers or passengers of automobiles, vans or pickup trucks. We also identified 222 deaths of bicyclists and 165 deaths involving other means of transport. These two categories were not analyzed in this study.

The highest mortality rate per RTA (all types of victim) was found in the Northwest District (9.57 deaths/100,000 inhabitants in 2012/2013/2014) while the lowest was found in the Eastern District (1.33 deaths/100,000 inhab. in 2006/2007/2008) (Table 2).

Mortality rates involving motorcycle and motor tricycle occupants were higher than those related to the other modes of transport evaluated, except in the Southern District in the 2009/2010/2011 and 2012/2013/2014 three-year periods, the Northern District (2006/2007/2008) and the Northwest District (all of the three-year periods) (Table 3).

Pedestrian mortality rates ranged between 3.81 deaths/100,000 inhab. (Southern District in 2012/2013/2014) and 11.59 deaths/100,000 inhab. (Northwest District in 2006/2007/2008). Mortality rates due to RTA involving motorcycles and motor tricycles ranged between 3.82 and 15.18 per 100,000 inhab. (Southern District in 2012/2013/2014; and Western District in 2012/2013/2014, respectively). Automobile occupant mortality rates ranged between 3.93 (Southern District in 2006/2007/2008) and 18.16/100,000 inhab. (Northwest District in 2012/2013/2014). None of the time series in the study showed significant seasonality.

Table 2 – Magnitude and trend of road traffic accident mortality rates per 100,000 inhabitants, according to health district, Goiânia, 2006-2014

Health District	Road Traffic Accidents Mortality rate			Prais-Winsten							Trend
				95% Confidence Interval				95% Confidence Interval			
	2006/2007/2008	2009/2010/2011	2012/2013/2014	b	Lower limit	Upper limit	P-value	AIR%	Lower limit	Upper limit	
Goiânia	6.82	6.93	6.97	-0.02	-0.06	0.02	0.253	-0.05	-13.42	4.88	stationary
South	1.50	1.51	1.43	0.01	-0.01	0.02	0.399	0.02	-1.98	5.19	stationary
Southwest	5.11	5.50	5.47	0.05	-0.01	0.12	0.117	0.13	-5.17	34.42	stationary
West	7.90	8.78	8.66	-0.01	-0.07	0.05	0.796	-0.02	-15.55	14.43	stationary
North	8.03	7.67	7.88	-0.01	-0.08	0.06	0.779	-0.02	-17.65	16.40	stationary
Northwest	9.45	9.43	9.57	-0.01	-0.10	0.08	0.820	-0.02	-23.58	24.67	stationary
East	1.33	1.34	1.34	-0.02	-0.03	-0.01	0.002	-0.04	-6.59	-1.30	decreasing
Campinas- Center	6.76	6.99	6.94	-0.09	-0.13	-0.05	0.000	-0.18	-26.51	-9.23	decreasing

Pedestrian mortality decreased in Goiânia as a whole (b=-0.02; p=0.02) and also in the Southern District (b=-0.05; p=0.04) and Western District (b=-0.03; p=0.03). Motorcycle and tricycle occupant mortality decreased in the Southern District (b=-0.06; p=0.001). Automobile occupant mortality increased in Goiânia as a whole (b=0.01; p=0.04) and also in the Southern District (b=0.05; p=0.02), while decreasing in the Campinas-Center District (b=-0.03; p=0.04). All other mortality rates remained stationary (Table 4).

Discussion

Great intra-urban inequality was found between Goiânia's health subdistricts with respect to RTA mortality rates. The highest pedestrian mortality rates occurred in the Northwestern District in 2006/2007/2008, the Western District in 2009/2010/2011 and once again in the Northwestern District in 2012/2013/2014. With respect to motorcycle and motor tricycle occupant mortality, the highest rates were found in the Eastern District in 2006/2007/2008 and in 2009/2010/2011; and in the Western District in 2012/2013/2014. Automobile occupant mortality rates were higher in the Northwestern District throughout the entire study period. The fact of this District having the worst situation can be associated with it being crossed by various federal and state highways.[8]

The RTA mortality rate for Goiânia as a whole showed a falling trend for pedestrians and an increasing trend for automobiles between the years 2006 and 2014. In the same period, there was a falling mortality trend for motorcycles/tricycles in the Southern District; a reduction in pedestrians in the Southern and Western

Table 3 – Magnitude of road traffic accident mortality rates (per 100,000 inhabitants), according to health district and mode of transport, Goiânia, 2006-2014

Health District	Mode of transport	2006/2007/2008	2009/2010/2011	2012/2013/2014
Goiânia	pedestrian	8.34	8.11	6.45
	motorcycles and tricycles	9.10	10.17	8.93
	automobiles	6.27	7.40	7.53
South	pedestrian	7.27	7.72	3.81
	motorcycles and tricycles	7.93	3.96	3.82
	automobiles	3.93	6.59	7.78
Southwest	pedestrian	6.04	7.39	6.63
	motorcycles and tricycles	8.68	12.00	10.95
	automobiles	4.40	5.57	4.57
West	pedestrian	11.55	9.40	6.85
	motorcycles and tricycles	12.27	14.00	15.17
	automobiles	5.94	8.23	7.32
North	pedestrian	11.42	7.17	8.35
	motorcycles and tricycles	10.35	11.25	12.25
	automobiles	5.40	6.24	6.71
Northwest	pedestrian	11.59	8.24	10.51
	motorcycles and tricycles	6.42	7.11	6.90
	automobiles	11.68	16.31	18.16
East	pedestrian	7.61	9.37	7.30
	motorcycles and tricycles	12.33	14.78	12.17
	automobiles	5.78	4.65	5.35
Campinas- Center	pedestrian	7.68	9.04	5.51
	motorcycles and tricycles	8.08	10.94	5.52
	automobiles	7.72	6.04	4.61

Table 4 – Trends of road traffic accident mortality rates, by health district and mode of transport, Goiânia, 2006-2014

Health district	Mode of transport	Prais-Winsten				Taxa de incremento anual (TIA%)			Trend
		b	95% Confidence Interval		p -value	AIR%	95% Confidence Interval		
			Lower limit	Upper limit			Lower limit	Upper limit	
Goiânia	pedestrian	-0.02	-0.04	-	0.020	-4.70	-8.18	-1.08	reduction
	motorcycle and tricycle	-0.01	-0.02	0.01	0.328	-1.53	-4.81	1.86	stationary
	automobiles	0.01	-	0.02	0.040	2.62	0.21	5.09	increase
South	pedestrian	-0.05	-0.10	-0.02	0.043	-11.30	-20.73	-0.75	reduction
	motorcycle and tricycle	-0.06	-0.09	-0.03	0.001	-13.52	-19.01	-7.65	reduction
	automobiles	0.05	0.01	0.09	0.022	12.88	2.58	24.21	increase
Southwest	pedestrian	0.01	-0.02	0.03	0.474	1.80	-3.60	7.51	stationary
	motorcycle and tricycle	0.01	-0.03	0.05	0.630	2.17	-7.41	12.73	stationary
	automobiles	-0.02	-0.06	0.02	0.342	-3.96	-12.40	5.25	stationary
West	pedestrian	-0.03	-0.07	-0.04	0.031	-7.83	-14.05	-1.15	reduction
	motorcycle and tricycle	0.01	-0.01	0.03	0.329	2.21	-2.59	7.26	stationary
	automobiles	0.01	-0.02	0.05	0.345	3.37	-4.15	11.47	stationary
North	pedestrian	-0.02	-0.06	0.01	0.188	-4.93	-12.24	2.99	stationary
	motorcycle and tricycle	0.01	-0.01	0.02	0.107	1.73	-0.43	3.94	stationary
	automobiles	0.01	-0.02	0.05	0.395	3.18	-4.74	11.76	stationary
Northwest	pedestrian	-0.01	-0.05	0.02	0.345	-3.44	-10.83	4.57	stationary
	motorcycle and tricycle	-0.01	-0.04	0.02	0.550	-2.09	-9.41	5.83	stationary
	automobiles	0.02	-0.01	0.05	0.151	5.04	-2.10	12.69	stationary
East	pedestrian	-	-0.04	0.04	0.842	0.80	-7.82	10.23	stationary
	motorcycle and motor tricycle	-	-0.02	0.02	0.792	-0.54	-4.10	4.12	stationary
	automobiles	-	-0.05	0.05	0.949	-0.34	-11.71	12.49	stationary
Campinas- Center	pedestrian	-0.02	-0.05	0.01	0.093	-5.10	-10.83	0.99	stationary
	motorcycle and motor tricycle	-0.04	-0.10	0.02	0.132	-8.95	-19.80	3.37	stationary
	automobiles	-0.03	-0.06	-0.01	0.044	-7.40	-13.87	-0.45	reduction

Statistical significance: $p<0.05$.

Districts; a reduction in automobiles in the Campinas-Center District and an increase in the Southern District. The trend was stationary for all other districts and modes of transport.

The reduction in pedestrian mortality rates in Goiânia follows a worldwide trend.[18] This decrease can be explained by the reduction in the average speed on urban roads, due to the increase in the fleet of automobiles and motorcycles during the study period. This large increase in the fleet in the period from 2006 to 2014 was mainly due to automobile and motorcycle purchases, resulting from tax exemption incentives and increased supply of financing for buying these means of transport.[3] One of the determinants of this increase in the fleet is also low quality public transport in the capital. In addition, there was an increase in the purchasing power of middle- and low-income populations, who prioritized buying individual private vehicles for traveling, encouraged by the exemption from Tax on Industrialized Products (IPI) for new vehicles.[3,19]

In relation to Goiânia's health districts, the reduction in pedestrian mortality in the Southern Health District can be explained by the higher percentage of middle

and high income people, this being the segment that most purchased motor vehicles, principally automobiles, in the period from 2006 to 2014. As such, a change occurred in the mode of transport of the population of this district, focusing on the use of automobiles to the detriment of walking or going by motorcycle.[10,20] This would explain the reduction in mortality rates due to accidents in the case of pedestrians and motorcycle occupants.

In Western District, where population density has increased more intensely in recent years, there is a lower percentage of elderly people,[10] which would explain the reduction in the pedestrian mortality rate. The Campinas-Center District is an older district and has low levels of building verticalization, low population density and a greater percentage of elderly people.[10] In this district, the reduction in automobile occupant mortality could be related to low verticalization, low population density, a higher percentage of elderly people, narrow streets, low average speed and few night-time and leisure activities.

On the other hand, it is possible to assume that the preponderance of stationary or falling RTA mortality rate trends in various health districts in the city of Goiânia between 2006 and 2014, has been caused by the decrease in the growth of the fleet of vehicles, accompanied by improvements in road infrastructure, reduction in average speed (both by the increasing flow of vehicles and also owing to the implementation of speed control and monitoring measures), increased use of safety equipment (crash helmets, seatbelts, child control equipment etc.), reduction of risk factors - such as 'drinking and driving' - and also improved pre-hospital care and hospital care for the victims.[21,22]

According to the DPVAT Vehicle Insurance Statistical Yearbook,[23] there was an increase of 11.1% in the fleet of vehicles in Midwest region between 2008 and 2014. However, according to the National Road Traffic Department (DENATRAN),[24] the fleet in Goiânia grew more rapidly until 2010, and has grown at a slower rate since then.

With effect from 2012, Goiânia joined the Life in the Traffic Program, the main objective of which is to promote, by means of data integration and intersectoral actions, effective traffic safety interventions. Although there are no studies that assess the impact of the Life in the Traffic Program on RTA mortality specifically in Goiânia, taking the example of what occurred in locations where the program has been in place for longer – such as Palmas/TO, Teresina/PI, Belo Horizonte/MG, Curitiba/PR and Campo Grande/MS where deployment occurred with effect from 2010,[25] it is assumed that the result of the Program has been the reduction or initial stabilization of serious and fatal traffic accident rates.

Actions to prevent road traffic accidents - such as the modification of the Dry Law in December 2012 (Law No. 12.760/2012),[26] awareness campaigns and more rigorous monitoring of traffic violations in the capital - may also have influenced the stationarity of a large part of the series analyzed.

With respect to the health care network, the increase in the number of beds for urgent and emergency care and in the number of Mobile Urgent Care Service (SAMU) units in the capital[11] may have contributed to the improvement of care for victims, avoiding the death as the outcome.

Examination of available information system data allows us to infer that RTA mortality rate stabilization or reduction in various of Goiânia's health districts follows a national trend. According to the DPVAT Vehicle Insurance Statistical Yearbook,[23] from 2012 onwards there has been a reduction in the number of indemnities paid for RTA deaths in Brazil.

Souza et al.[27] reported an increase in standardized rates of mortality due to motorcycle and pedestrian accidents in the period from 1980 to 2003 in Brazil as a whole. These authors also found a reduction in mortality owing to road traffic accidents involving other means of transport in the same period. Bachieri and Barros[28] pointed to a reduction in the RTA mortality rate and also in the number of deaths per vehicle in Brazil as a whole between 2006 and 2008. Morais Neto et al.[1] reported that the Brazilian RTA mortality rate increased from 18.2 per 100,000 inhab. in 2000 to 22.5 per 100,000 inhab. in 2010, representing an increase of 23.8%.

The magnitude of RTA mortality rates differs in Brazil's different cities. In the municipality of Marília SP, for example, Biffe et al.[29] found records of 78 deaths from road traffic accidents in 2012, representing 34.4 deaths/100,000 inhabitants. In Campinas/SP, the RTA mortality rate among men in 2008 was 24.6 deaths/100,000 inhabitants.[30] It is worth noting that the global RTA mortality rate is 20/100,000 inhab., whereby in developed countries this figure drops to 8/100,000 inhab.[2]

According to Morais Neto et al.,[1] the RTA mortality rate in the state of Goiás increased from 29 deaths/100,000 inhab. in 2000 to 33.3 deaths/100,000 inhab. in 2010. However, in this period, the state went from third to fifth place in the ranking of RTA mortality rates for all 27 Brazilian Federative Units. The same study found increased risk for motorcycle and automobile occupants in the state when comparing the data for the years 2000 and 2010. Ladeira et al.,[20] using data from the Global Burden of Disease Study 2015, estimated a reduction in RTA mortality in Goiás from 50.70 deaths/100,000 inhab. in 1990 to 32.70 in 2015.

Although the studies mentioned above delineate satisfactorily the scenario related to RTA mortality in Brazil, in the Midwest region and in the state of Goiás, there are no reports in the literature about the trends in the municipality of Goiânia in respect to this outcome. At the time our study was conducted, no research had been carried out estimating the mortality indicators for Goiânia's intra-urbana areas. Our study took into consideration the mortality rate in each district, providing a reliable picture of the health situation related to road traffic in the capital, performing a specific diagnosis for each health district. The categorization of these indicators according to the mode of transport provided a more detailed analysis of the issue.

An important limitation of this study relates to the use of secondary data. This makes it difficult to control for possible confounding factors and the reliability of information, which is directly dependent on the coverage and quality of notification of deaths. Redistribution of unspecified RTA deaths (ICD-10 V89, V99 and Y32 to Y34) was used to correct the so-called garbage codes and thus guarantee the quality of the records. With respect to the coverage of death records, although there are still flaws in data capture, these have decreased in Brazil, so that the data have become increasingly reliable.

Differences were found in magnitude and trends in the health districts that may serve to inform traffic safety actions focused on groups and regions at higher risk and with a tendency to increase. It is also important to emphasize that, despite all the measures and conditions adopted in order to reduce RTA mortality at municipal, state and national levels, there was no reduction in the majority of the trends analyzed. Thus, RTAs continue to be a public health problem in Goiânia, in virtue of the high burden of morbidity and mortality, economic costs and social impact, due to their affecting mainly working age individuals.[7]

The discrepancies between the results for the different health districts show that there is a need to closely examine the characteristics of each one of them, so that health policies geared to RTA prevention can be based on the reality of each region. In this sense, it is important to note that mortality related to the 'automobile' mode of transport showed a tendency to increase in the Southern Health District. This increase was so high that it countered the decline (also significant) in the Campinas-Center District, and resulted in the mean values of the municipality tending to increase. High automobile occupant mortality in the Northwest District and high motorcycle occupant mortality in the Eastern and Western Districts also drew attention. There is a clear need to reorganize public transport, so that it is used rather than individual private means of transport. In addition, there is a need to strengthen traffic safety actions targeting, mainly, the districts where there was a high magnitude or increasing trend of RTA mortality rates.

Authors' contributions

Morais Neto OL and Neves CM participated in the conception and design of the study, analysis and interpretation of the results, writing and critical review of the manuscript. Aquino EC contributed to data analysis and interpretation, writing and critical review of the manuscript. The authors have approved the final version and declared themselves to be responsible for all aspects of the study, ensuring its accuracy and integrity.

References

1. Morais Neto OL, Montenegro MMS, Monteiro RA, Siqueira Júnior JB, Silva MMA, Lima CM, et al. Mortalidade por acidentes de transporte terrestre no Brasil na última década: tendência e aglomerados de risco. Ciênc Saúde Coletiva. 2012 set;17(9):2223-36. doi: 10.1590/S1413-81232012000900002.

2. World Health Organization. Global status report on road safety 2015 [Internet]. Geneva: World Health Organization; 2015 [cited 2018 Oct 26]. 323 p. Available in: https://www.who.int/violence_injury_prevention/road_safety_status/2015/en/

3. Morais Neto OL, Beniz LAF, Rodrigues FR, Botacin CF, Mandacarú PMP, Oliveira IV, et al. Tendências de mortalidade por acidentes de trânsito pós redução de IPI. Rev Goiana Med. 2016 abr;49(1):6-10.

4. Malta DC, Silva MMA, Lima CM, Soares Filho AM, Montenegro MMS, Mascarenhas MDM. Impacto da legislação restritiva do álcool na morbimortalidade por acidentes de transporte terrestre-Brasil, 2008. Epidemiol Serv Saúde. 2010 jan-mar;19(1):78. doi: 10.5123/S1679-49742010000100009.

5. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância de Doenças e Agravos Não Transmissíveis e Promoção da Saúde. Saúde Brasil 2014: uma análise da situação de saúde e das causas externas [Internet]. Brasília: Ministério da Saúde; 2015 [citado 2018 out 26]. 462 p. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/saude_brasil_2014_analise_situacao.pdf

6. Morais Neto OL, Andrade AL, Guimarães RA, Mandacarú PMP, Tobias GC. Regional disparities in road traffic injuries and their determinants in Brazil, 2013. Int J Equity Health. 2016 Nov;15(1)142. doi: 10.1186/s12939-016-0433-6.

7. Mandacarú PMP, Rabelo IVM, Silva MAA, Tobias GC, Morais Neto OLD. Óbitos e feridos graves por acidentes de trânsito em Goiânia, Brasil-2013: magnitude e fatores associados. Epidemiol Serv Saúde. 2018; 27(2):e2017295. doi: 10.5123/S1679-49742018000200001.

8. Agência Nacional de Transportes Públicos (BR). Sistema de informações da mobilidade. Dados informados de transporte e trânsito - Maiores Cidades Brasileiras [Internet]. 2014 [citado 2018 jul 10]. Disponível em: http://www.antp.org.br/sistema-de-informacoes-da-mobilidade/maiores-cidades.html

9. Instituto Brasileiro de Geografia e Estatística. Cidades @. Brasil em síntese [Internet]. 2017 [citado 2017 jul 10]. Disponível em:http://cidades.ibge.gov.br/xtras/home.php

10. Prefeitura de Goiânia (GO). Secretaria Municipal de Planejamento e Urbanismo de Goiânia (SEPLAM). Anuário estatístico 2013 [Internet]. 2013 [citado 2017 jul 10]. Disponível em: http://www.goiania.go.gov.br/shtml/seplam/principal.shtml

11. Prefeitura de Goiânia (GO). Portal da transparência 2017 [Internet]. 2017 [citado 2017 jul 10]. Disponível em: https://www.goiania.go.gov.br

12. França EB, Passos VMA, Malta DC, Duncan BB, Ribeiro ALP, Guimarães MDC, et al. Cause-specific mortality for 249 causes in Brazil and states during 1990–2015: a systematic analysis for the global burden of disease study 2015. Popul Health Metr. 2017 Nov;15(1):39. doi: 10.1186/s12963-017-0156-y.

13. Malta DC, Felisbino-Mendes MS, Machado ÍE, Passos VMDA, Abreu DMX, Ishitani LH, et al. Fatores de risco relacionados à carga global de doença do Brasil e Unidades Federadas, 2015. Rev Bras Epidemiol. 2017;20 Suppl 1:217-232. doi: 10.1590/1980-5497201700050018.

14. Kruskal WH, Wallis WA. Use of ranks in one-criterion variance analysis. J Am Stat Assoc. 1952 Dec;47(260):583-621. doi: 10.2307/2280779.

15. Antunes JLF, Cardoso MRA. Uso da análise de séries temporais em estudos epidemiológicos. Epidemiol Serv Saúde. 2015 jul-set;24(3):565-76. doi: 10.5123/S1679-49742015000300024.

16. Chechi L, Bayer FM. Modelos univariados de séries temporais para previsão das temperaturas médias mensais de Erechim, RS. Rev Bras Eng Agríc Ambiental. 2012;16(12):1321-29. doi: 10.1590/S1415-43662012001200009.

17. Brasil. Ministério da Saúde. Conselho Nacional de Saúde. Resolução nº 466, de 12 de dezembro de 2012. Aprova as diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Diário Oficial da República Federativa do Brasil, Brasília (DF), 2012 dez 12; Seção 1:59.

18. Eid HO, Abu-Zidan FM. Pedestrian injuries-related deaths: a global evaluation. World J Surg. 2015 Mar;39(3):776-781. doi: 10.1007/s00268-014-2853-z.

19. Instituto de Pesquisa Econômica Aplicada (BR). Nota técnica: impactos da redução do imposto sobre produtos industrializados (IPI) de automóveis [Internet]. Brasília: Instituto de Pesquisa Econômica Aplicada; 2009 [citado 2018 jul 10]. 9 p. Disponível em: http://ipea.gov.br/agencia/images/stories/PDFs/2009_nt015_agosto_dimac.pdf

20. Ladeira RM, Malta DC, Morais Neto OL, Montenegro MMS, Soares Filho AM, Vasconcelos CH, et al. Road traffic accidents: global burden of disease study, Brazil and federated units, 1990 and 2015. Rev Bras Epidemiol. 2017 May;20 Suppl 1:157-170. doi: 10.1590/1980-5497201700050013.

21. Andrade SSCA, Mello-Jorge MHP. Mortalidade e anos potenciais de vida perdidos por acidentes de transporte no Brasil, 2013. Rev Saúde Publ. 2016;50:59-62. doi: 10.1590/S1518-8787.2016050006465.

22. Souto CC, Reis FKW, Bertolini RPT, Lins RSMA, Souza SLB. Perfil das vítimas de acidentes de transporte terrestre relacionados ao trabalho em unidades de saúde sentinelas de Pernambuco, 2012-2014. Epidemiol Serv Saúde. 2016 abr-jun;25(2):351-61. doi: 10.5123/S1679-49742016000200014.

23. Seguradora Líder. DPVAT. Anuário estatístico 2014 DPVAT [Internet]. 2014 [citado 2017 jun 10]. 148 p. Disponível em: http://www.seguradoralider.com.br/Documents/boletim-estatistico/Anuario-Estatistico-2014-DPVAT.pdf

24. Departamento Nacional de Trânsito. Frota de veículos - 2018 [Internet]. Relatórios Estatísticos. 2018 [cited 2018 Sep 8]. Disponível em: http://www.denatran.gov.br/estatistica/635-frota-2018

25. Silva MM, Morais Neto OL, Lima CM, Malta DC, Silva Júnior JB. Projeto vida no trânsito-2010 a 2012: uma contribuição para a década de ações para a segurança no trânsito 2011-2020 no Brasil. Epidemiol Serv Saúde. 2013 jul-set;22(3):531-6. doi: 10.5123/S1679-49742013000300019.

26. Brasil. Presidência da República. Casa Civil. Lei nº12.760, de 20 de dezembro de 2012. Altera a Lei nº9.503, de 23 de setembro de 1997, que institui o Código de Trânsito Brasileiro. Diário Oficial da República Federativa do Brasil, Brasília (DF), 2012 dez 21; Seção 1.

27. Souza MFM, Malta DC, Conceição GMS, Silva MMA, Gazal-Carvalho C, Morais Neto OL. Análise descritiva e de tendência de acidentes de transporte terrestre para políticas sociais no Brasil. Epidemiol Serv Saúde. 2007 mar-maio;16(1):33-44. doi: 10.5123/S1679-49742007000100004.

28. Bacchieri G, Barros AJ. Acidentes de trânsito no Brasil de 1998 a 2010: muitas mudanças e poucos resultados. Rev Saúde Pública. 2011 out;45(5):949-63. doi: 10.1590/S0034-89102011005000069.

29. Biffe CRF, Harada A, Bacco AB, Coelho CS, Baccarelli JLF, Silva KL et al. Perfil epidemiológico dos acidentes de trânsito em Marília, São Paulo, 2012. Epidemiol Serv Saúde. 2017 abr-jun;26(2):389-98. doi: 10.5123/S1679-49742017000200016.

30. Marín-León L, Belon AP, Barros MBDA, Almeida SDDM, Restitutti MC. Tendência dos acidentes de trânsito em Campinas, São Paulo, Brasil: importância crescente dos motociclistas. Cad Saúde Pública. 2012 jan;18(1):39-51. doi: 10.1590/S0102-311X2012000100005.

Received on 01/08/2018
Approved on 08/10/2018