Original article

# Transport accident mortality time trend and spatial distribution in Piauí, Brazil, 2000-2017

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## Abstract

**Objective:** To analyze the time trend and spatial distribution of transport accident (TA) mortality in Piauí, from 2000 to 2017. **Methods:** An ecological time series study was conducted using Mortality Information System (SIM) data on TA mortality among people resident in the state of Piauí, according to sex, age group and municipality. Prais-Winsten regression was used. **Results:** 14,396 deaths were recorded. The mortality rate per 100,000 inhabitants was 13.9 in 2000 and 30.6 in 2017. There was a significant increase in the TA mortality rate (annual percent change [APC] of 6.4% – 95%CI 4.3;8.7), being higher among motorcyclists (APC = 14.7% – 95%CI 9.7;20.0) and among vehicle occupants (APC = 15.2 – 95%CI 10.5;20.2). **Conclusion:** There was significant increase in TA mortality in Piauí, especially among motorcyclists and vehicle occupants. Actions are needed to promote road safety and to prevent road traffic deaths.

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

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## Introduction

Road traffic violence is a serious and complex Public Health problem. Despite the mortality rate having decreased globally, the annual number of deaths remains extremely high at around 1.35 million/year, with a considerable increase in road transport accident injuries.[1,2]

Transport accident mortality and incidence rates vary depending on regional and sociodemographic aspects. In 2016, low or middle-income countries accounted for approximately 93% of all road traffic deaths worldwide. Risk of injury and death due to transport accidents is greater among adolescents and young adults, as well as among people of the male sex.[1,2]

> *Between 1990 and 2015, a reduction in the transport accident mortality rate was identified in 26 of Brazil's 27 federative units, with Piauí being the only state showing an increase (9.7%).*

In Brazil between 2000 and 2010, the number of deaths caused by transport accidents rose from 28,995 to 42.884, representing an increase of 32.3%.[3] In 2017, these accidents were the second leading cause of death among all deaths from external causes (N=35,400), being more frequent among males (82.0%) and people between 20 and 39 years old (42.9%).[4]

Between 1990 and 2015, a reduction in the transport accident mortality rate was identified in 26 of Brazil's 27 federative units, with Piauí being the only state showing an increase (9.7%). Moreover, in 2015, the states of Piauí and Maranhão had the second highest mortality rate (36.3/100,000 inhabitants) after the state of Tocantins (41.7/100,000 inhab.).[5] Despite its high transport accident mortality rate, Piauí has a ratio of 1 vehicle per 2.7 inhabitants, coming in 19th place among the country's 27 Federative Units in terms of registered vehicles in 2018.[6] Even with one of the lowest volumes of registered vehicles, Piauí faces problems arising from having the highest incidence of road traffic deaths in Brazil and this requires epidemiological analyses to contribute to a better understanding of these events.

The objective of this article was to analyze the time trend and spatial analysis of transport accident mortality in Piauí from 2000 to 2017.

## Methods

This was an ecological time series study of transport accident deaths between 2000 and 2017 involving people living in the state of Piauí.

The data for the study were retrieved from the Mortality Information System (SIM) via the Brazilian National Health System Information Technology Department (DATASUS).[4] We selected deaths of people living in Piauí whose cause of death corresponded to codes V01 to V89 of chapter XX of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10). Population information was retrieved from the Brazilian Institute of Geography and Statistics (IBGE), using its projections for the years analyzed by the study.

The following variables were analyzed:

a) Sex (male; female);
b) Age group (in years: up to 9; 10-19; 20-39; 40-59; 60 or over);
c) Race/skin color (Black [Black + brown]; White; yellow; indigenous);
d) Schooling (in years of study: none; 1-7; 8 or more);
e) Municipality of residence;
f) Type of victim
   - Pedestrian, V01-V09
   - Cyclist, V10-V19
   - Motorcyclist, V20-V39 (motorcycle and three-wheeled motor vehicle)
   - Vehicle occupant, V40-V79 (car, pick-up truck, heavy transport vehicle and bus)
   - Occupant of other types of transport, V80-V89 (animal-drawn vehicle, railway train, streetcar, special vehicles and non-specified vehicles).

The data were imported from the DATASUS website and organized using the Microsoft Excel Office 2016 computer program. The mortality rates were calculated by dividing the number of deaths (numerator) by the number of people resident in the state (denominator) in the initial and final year of the period (2000 and 2017), and then multiplying each result by 100,000 inhabitants. The rates were aggregated for each municipality. In order to visualize evolution of mortality in each municipality, we calculated three-year average transport accident mortality rates shown on maps prepared by the QGIS 2.18 computer program.

In order to analyze the time trend of the annual transport accident mortality rates, we used the Prais-Winsten linear regression model, which takes into account serial auto-correlation, i.e. the dependence of a serial measurement on its own values in previous periods. Annual percent change (APC) and its respective 95% confidence intervals (95%CI) were calculated. The mortality rate trend was interpreted as rising ($p<0.05$ and positive beta), falling ($p<0.05$ and negative beta) and stable ($p\geq0.05$), in accordance with the conception of Antunes & Cardoso.[7] Exploration of the explanatory variables and analysis of the time series were performed by the Stata computer program, version 14 (StataCorp LP, College Station, USA).

## Results

Between 2000 and 2017, 14,396 deaths resulting from transport accidents were recorded in Piauí. The majority of deaths occurred among males (85.0%), in the 20-39 age group (47.3%), among those of Black race/skin color (80.9%) and among those who had 1-7 years of schooling (58.6%). Almost half (48.9%) the deaths resulted from motorcycle accidents (Table 1). There was an increase in the mortality rate, from 13.9 deaths/100,000 inhab. in 2000, to 30.6 deaths/100,000 inhab. in 2017 (Table 2).

Motorcyclists were at greatest risk of transport accident-related death. In 2000, the mortality rate for motorcyclists was 2.1/100,000 inhab., rising to 19.6/100,000 inhab. in 2017 (rata ratio=9.3). Between the beginning and the end of the period analyzed, the vehicle occupant mortality rate rose (from 0.3 to 5.1/100,000 inhab.), while there was a fall in the mortality rate for other victim types – except motorcyclist deaths as mentioned above and a slight increase in the cyclist mortality rate (Figure 1).

Transport accident mortality increased significantly in the period analyzed (APC=6.4% –95%CI 4.3;8.7), both among males (APC=6.5% – 95%CI 4.3;8.7) and females (APC=3.9% – 95%CI 1.9;6.0). With regard to types of victim, there was an increase in vehicle occupants (APC=15.2% – 95%CI 10.5;20.2) and motorcyclists (APC=14.7% – 95%CI 9.7;20.0). Among males, the highest increase was among motorcyclists (APC=14.7% – 95%CI 9.0;20.7). Mortality remained stable for pedestrians and showed a falling trend (APC=-6.6% – 95%CI -9.2;-4.1) for occupants of other types of transport (Table 2).

**Table 1 – Transport accident deaths according to demographic characteristics and type of victim, by sex, Piauí, 2000-2017**

| Características) | Total[a] | | Male | | Female | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| **Age (in years)** | | | | | | |
| ≤9 | 383 | 2.7 | 219 | 1.8 | 163 | 7.6 |
| 10-19 | 1,544 | 10.7 | 1,236 | 10.1 | 308 | 14.3 |
| 20-39 | 6,796 | 47.3 | 6,009 | 49.2 | 785 | 36.4 |
| 40-59 | 3,754 | 26.1 | 3,226 | 26.4 | 528 | 24.5 |
| ≥60 | 1,898 | 13.2 | 1,526 | 12.5 | 371 | 17.2 |
| **Race/skin color** | | | | | | |
| Black (black + brown) | 10,897 | 80.9 | 9,366 | 81.8 | 1,531 | 75.9 |
| White | 2,539 | 18.8 | 2,059 | 18.0 | 480 | 23.8 |
| Yellow | 32 | 0.2 | 28 | 0.2 | 4 | 0.2 |
| Indigenous | 8 | 0.1 | 5 | 0.0 | 3 | 0.1 |
| **Schooling (in years)** | | | | | | |
| None | 1,923 | 15.2 | 1,631 | 15.1 | 292 | 15.7 |
| 1-7 | 7,426 | 58.6 | 6,495 | 60.1 | 931 | 50.1 |
| ≥8 | 3,314 | 26.2 | 2,680 | 24.8 | 634 | 34.1 |
| **Type of victim** | | | | | | |
| Pedestrian | 2,137 | 14.8 | 1,595 | 13.0 | 540 | 25.0 |
| Cyclist | 684 | 4.8 | 620 | 5.1 | 64 | 3.0 |
| Motorcyclist | 7,041 | 48.9 | 6,310 | 51.6 | 729 | 33.8 |
| Vehicle occupant | 1,702 | 11.8 | 1,287 | 10.5 | 412 | 19.1 |
| Occupant of other types of transport[b] | 2,832 | 20.0 | 2,416 | 19.8 | 413 | 19.1 |

a) Includes 10 cases with no information on sex.

b) Includes animal-drawn vehicles, railway trains, streetcars, special vehicles and non-specified vehicles.

Note: Missing values were excluded for the following variables: age group (n=21), race/skin color (n=920) and schooling (n=1,733).

**Table 2 – Mortality rate trend (per 100,000 inhab.) for transport accidents, by type of victim and sex, Piauí, 2000-2017**

| Type of victim and sex | Mortality rate | | Annual percent change (%) | 95%CI[a] | p-value[b] | Trend |
|---|---|---|---|---|---|---|
| | 2000 | 2017 | | | | |
| **Total** | **13.9** | **30.6** | **6.4** | **4.3;8.7** | **<0.001** | **Rising** |
| Male (M) | 22.4 | 53.1 | 6.5 | 4.3;8.7 | <0.001 | Rising |
| Female (F) | 5.6 | 9.0 | 3.9 | 1.9;6.0 | 0.001 | Rising |
| M/F ratio | 4.0 | 5.9 | | | | |
| **Pedestrian** | **3.3** | **2.7** | **-0.9** | **-4.9;3.4** | **0.667** | **Stable** |
| Male (M) | 5.3 | 4.8 | 0.3 | -2.8;3.5 | 0.838 | Stable |
| Female (F) | 1.4 | 0.8 | -1.8 | -6.9;3.5 | 0.471 | Stable |
| M/F ratio | 3.7 | 6.1 | | | | |
| **Cyclist** | **0.6** | **1.4** | **4.7** | **1.8;7.6** | **0.003** | **Rising** |
| Male (M) | 1.1 | 2.5 | 5.4 | 1.2;9.7 | 0.014 | Rising |
| Female (F) | 0.1 | 0.3 | 2.3 | -2.8;7.6 | 0.367 | Stable |
| M/F ratio | 7.7 | 8.2 | | | | |
| **Motorcyclist** | **2.1** | **19.6** | **14.7** | **9.7;20.0** | **<0.001** | **Rising** |
| Male (M) | 3.8 | 35.7 | 14.7 | 9.0;20.7 | <0.001 | Rising |
| Female (F) | 0.5 | 4.2 | 13.3 | 10.3;16.4 | <0.001 | Rising |
| M/F ratio | 7.9 | 8.4 | | | | |
| **Vehicle occupant** | **0.3** | **5.1** | **15.2** | **10.5;20.2** | **<0.001** | **Rising** |
| Male (M) | 0.6 | 7.1 | 14.4 | 10.7;18.2 | <0.001 | Rising |
| Female (F) | – | 3.0 | 13.6 | 8.1;19.4 | <0.001 | Rising |
| M/F ratio | – | 2.4 | | | | |
| **Occupant of other types of transport[c]** | **7.5** | **1.8** | **-6.6** | **-9.2;-4.1** | **<0.001** | **Falling** |
| Male (M) | 11.6 | 3.1 | -6.0 | -8.5;-3.5 | <0.001 | Falling |
| Female (F) | 3.6 | 0.6 | -9.2 | -11.3;-7.0 | <0.001 | Falling |
| M/F ratio | 3.2 | 4.9 | | | | |

a) 95%CI: 95% confidence interval.

b) Wald's test.

c) Includes animal-drawn vehicles, railway trains, streetcars, special vehicles and non-specified vehicles.

The evolution of transport accident mortality rates over time, by age group, showed an increasing trend with effect from 10 years of age, in particular among those aged 60 or over (APC = 5.8% – 95%CI 3.7;8.0). Motorcyclist mortality showed an average annual increase greater than 10.0% in all age ranges (Table 3).

Figure 2 illustrates the geographic distribution and evolution of the average three-yearly transport accident mortality rates according to the 224 municipalities in which those who died resided. There was steep and heterogeneous growth in transport accident deaths in the state. In the 2000-2002 three-year period, only 2.3% of the municipalities had mortality rates above 36.7/100,000 inhab. (Figure 2A), increasing to 54.9% in the 2012-2014 three-year period (Figure 2E). In the last three-year period, 43.3% of municipalities had transport accident mortality rates above 36.7/100,000 inhab. (Figure 2F).

## Discussion

In Piauí, transport accident mortality rates increased significantly over the time series analyzed. Male, young adult, motorcyclist and vehicle occupant victims predominated. Risk of death from transport accidents was higher among vehicle occupants and motorcyclists, compared to the other types of victim, especially among the elderly in relation to those who were younger.

The groups socially vulnerable to transport accident mortality identified in this study are similar to those found by other studies.[8-11] The World Health Organization[12] has highlighted that approximately 73.0% of deaths due to transport accidents occur among males and younger age groups.

Greater occurrence of death being found more frequently among males is explained by their social, cultural and risk-exposure behavior, such as driving

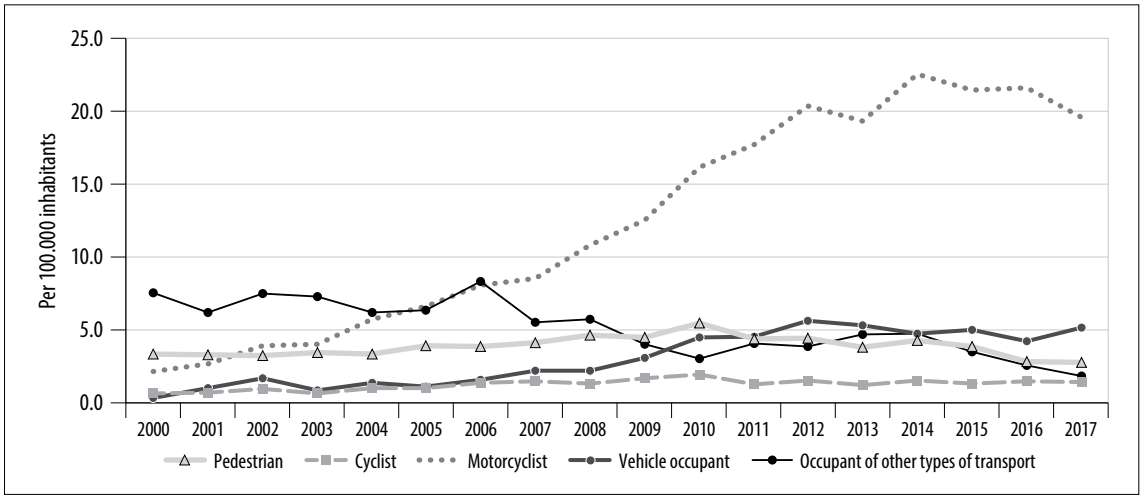


**Figure 1 – Mortality rate (per 100,000 inhab.) for transport accidents, by type of victim and year of death, Piauí, 2000-2017**

at high speed, getting involved in traffic disagreements and abusive alcohol consumption.[13]

In younger age groups, road transport risk behaviors can be associated with peer group pressure, emotional immaturity, little experience and lack of driving skill. Moreover, impulsiveness found in younger age groups is an important risk factor for getting involved in dangerous situations. Although it is a controversial issue, some studies report that traits of impulsiveness are linked to traffic-related risk behaviors, such as excess speed as an adventure, making wrong decisions, a variety of breaches of the highway code and a variety of transport accidents.[14-17]

Although deaths from transport accidents were more frequent among the 20-39 age group, this study found a greater increase in annual percent change among the elderly (≥65 years), especially in accidents involving motorcyclists and vehicle occupants. Increased life expectancy in Brazil, together with independence and autonomy of their social and political role, enables more elderly people to spend more time on public thoroughfares. As a result of physiological and organic changes, appearance of chronic diseases and limitations intrinsic to age, elderly people need more time to carry out cognitive and motor tasks which, when associated with stress, worry, irritation and haste, increases risk of involvement in transport accidents, especially as pedestrians and drivers.[18] In view of the results found for this population group, there is a need for urgent interventions to reduce transport accident deaths among the elderly.

The State and society should guarantee less violent, more collaborative and supportive traffic for all groups of road users. Longer crossing times for pedestrians at traffic lights, especially in regions with heavy traffic, with accessible pedestrian signals, improvements to the quality and safety of public transport, creation and application of enforcement and educational strategies are effective alternatives for protecting the elderly in relation to road traffic.[18]

The study also found greater frequency of transport accident deaths among individuals with up to seven years of schooling and of Black race/skin color, similar to the findings of Andrade & Mello-Jorge.[19] This reveals social vulnerabilities and inequities. Black and less educated people form the greater part of vulnerable users in the road traffic environment.[20]

Motorcyclists stand out among the types of victim because of the large number of deaths and their increasing trend. Motorcycles are considered to be a vulnerable means of transport, with direct exposure to impact during accidents: their small size and structure and few protection devices, when compared to cars, for example, or when compared to more resistant forms of urban transport, mean that their occupants are more vulnerable to multiple and serious injuries.[21,22]

Associated with this, certain political, economic and social aspects need to be mentioned: the political

**Table 3 – Mortality rate trend (per 100,000 inhab.) for transport accidents, by type of victim and age, Piauí, 2000-2017**

| Type of victim and age | Mortality rate | | Annual percent change (%) | 95%CI[a] | p-valor[b] | Trend |
|---|---|---|---|---|---|---|
| | 2000 | 2017 | | | | |
| **Age (in years)** | **13.9** | **30.6** | **6.4** | **4.3;8.7** | **<0.001** | **Rising** |
| ≤9 | 4.7 | 3.3 | -1.5 | -3.6;0.6 | 0.140 | Stable |
| 10-19 | 7.7 | 13.2 | 4.0 | 0.5;7.5 | 0.026 | Rising |
| 20-39 | 20.1 | 41.9 | 5.6 | 3.2;7.9 | <0.001 | Rising |
| 40-59 | 21.1 | 39.8 | 5.2 | 3.0;7.4 | <0.001 | Rising |
| ≥60 | 19.9 | 45.5 | 5.8 | 3.7;8.0 | <0.001 | Rising |
| **Pedestrian** | **3.3** | **2.7** | **-0.9** | **-4.9;3.4** | **0.667** | **Stable** |
| ≤9 | 2.2 | 0.8 | -2.4 | -4.9;0.2 | 0.066 | Stable |
| 10-19 | 1.9 | 0.5 | -6.6 | -11.5;-1.3 | 0.018 | Falling |
| 20-39 | 3.1 | 1.7 | -3.4 | -7.8;1.1 | 0.130 | Stable |
| 40-59 | 5.6 | 3.7 | -1.0 | -3.8;2.0 | 0.498 | Stable |
| ≥60 | 6.9 | 10.6 | 3.1 | -0.4;6.7 | 0.080 | Stable |
| **Cyclist** | **0.6** | **1.4** | **4.7** | **1.8;7.6** | **0.003** | **Rising** |
| ≤9 | 0.3 | 0.2 | -5.7 | -10.0;-1.1 | 0.020 | Falling |
| 10-19 | 0.1 | 0.7 | 3.1 | -1.7;8.2 | 0.189 | Stable |
| 20-39 | 0.8 | 0.9 | 1.2 | -4.4;7.2 | 0.659 | Stable |
| 40-59 | 1.1 | 1.9 | 3.9 | -0.7;8.7 | 0.090 | Stable |
| ≥60 | 0.9 | 4.6 | 13.6 | 10.0;17.5 | <0.001 | Rising |
| **Motorcyclist** | **2.1** | **19.6** | **14.7** | **9.7;20.0** | **<0.001** | **Rising** |
| ≤9 | 0.0 | 0.6 | 10.1 | 4.5;15.9 | 0.001 | Rising |
| 10-19 | 1.7 | 9.1 | 12.5 | 7.0;18.3 | <0.001 | Rising |
| 20-39 | 4.5 | 32.0 | 12.5 | 8.4;16.8 | <0.001 | Rising |
| 40-59 | 1.9 | 23.1 | 16.1 | 10.7;21.8 | <0.001 | Rising |
| ≥60 | 0.4 | 19.7 | 21.0 | 13.7;28.7 | <0.001 | Rising |
| **Vehicle occupant** | **0.3** | **5.1** | **15.2** | **10.5;20.2** | **<0.001** | **Rising** |
| ≤9 | 0.0 | 1.4 | 6.0 | -1.6;14.0 | 0.112 | Stable |
| 10-19 | 0.0 | 2.0 | 9.4 | 2.0;17.3 | 0.015 | Rising |
| 20-39 | 0.6 | 5.3 | 12.5 | 7.2;18.0 | <0.001 | Rising |
| 40-59 | 0.6 | 8.4 | 13.2 | 8.3;18.4 | <0.001 | Rising |
| ≥60 | 0.4 | 7.7 | 18.3 | 13.9;22.9 | <0.001 | Rising |
| **Occupant of other types of transport[c]** | **7.5** | **1.8** | **-6.6** | **-9.2;-4.1** | **<0.001** | **Falling** |
| ≤9 | 2.1 | 0.4 | -12.3 | -16.3;-8.2 | <0.001 | Falling |
| 10-19 | 4.0 | 0.8 | -8.8 | -14.4;-2.7 | 0.008 | Falling |
| 20-39 | 11.1 | 2.0 | -7.4 | -10.6;-4.1 | <0.001 | Falling |
| 40-59 | 11.8 | 2.7 | -7.4 | -10.0;-4.7 | <0.001 | Falling |
| ≥60 | 11.2 | 2.9 | -5.6 | -8.5;-2.6 | 0.001 | Falling |

a) 95%CI: 95% confidence interval.

b) Wald's test.

c) Includes animal-drawn vehicles, railway trains, streetcars, special vehicles and non-specified vehicles.

option for individual transport and tax incentives for motorcycle assembly plants; the unemployment situation faced by a large part of the population who have seen the motorcycle as an opportunity to earn income; the increase in the number of jobs that use this means of transport because of its quickness, cheapness and productivity-based payment; as well ease of purchasing motorcycles and their lower maintenance cost.[20] The result of the increase in the motorcycle fleet has been the considerable increase in fatal victims of transport accidents.

Other factors need to be considered when studying transport accidents, such as structural shortcomings of public thoroughfares, lack of inspection of driving licenses and safety equipment, as well as speeding, especially in poorer outskirts and rural areas of cities.[21] Moreover, law-breaking behavior of motorcyclists, consumption of alcoholic drinks and vulnerability of motorcycles themselves are possible reasons for the intensification of transport accidents involving motorcycles.[23]

The study made clear the increase and heterogeneity of transport accident mortality rates in no Piauí from

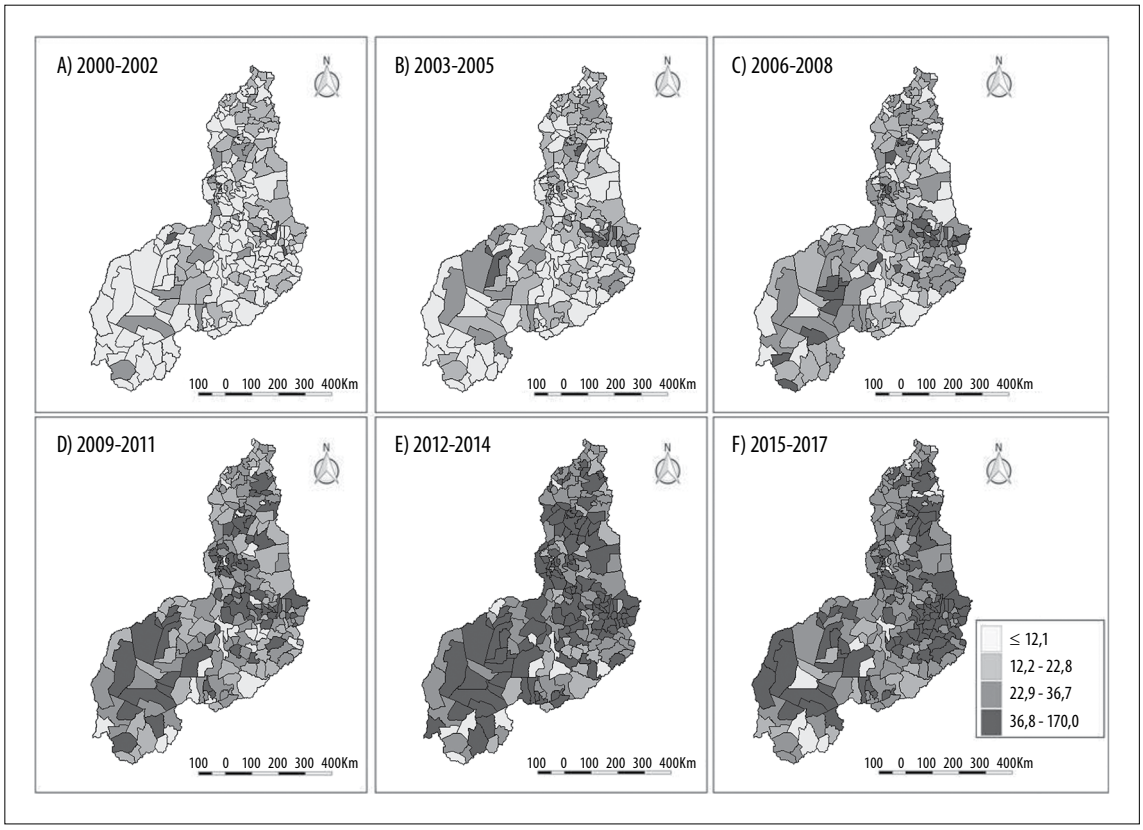


**Figure 2 – Evolution of three-year average mortality rate (per 100,000 inhab.) for transport accidents, by municipality of residence, Piauí, 2000-2017**

2000 to 2017, similar to findings on the national scenario.[3,24] Nevertheless, we found a reduction in risk of transport accident deaths in the last three-year period (2015-2017). A study of the possible effect of the economic crisis and austerity policies in Brazil on outcomes related to external causes,[25] suggests that as unemployment and poverty have increased and use of personal vehicles has decreased due to the economic recession, this may have had a substantial impact on the reduction in transport accidents in the 2014-2017 three-year period. This reduction may also have resulted from important strategies and public policies adopted over the course of time. Standing out are laws to restrict drink-driving, especially with the implementation of the so-called Dry Law in 2008 and its enhancement in 2012 including more severe measures, other forms of witness evidence and increased penalties that have enabled progress in reducing alcohol consumption.[26-28]

Another action that has contributed to the reduction in road transport accidents is the Life in the Traffic Project (*Projeto Vida no Trânsito*). Implemented by the Ministry of Health in 2011 in several Brazilian state capitals, including Teresina, the capital of Piauí, this project consists of a set of strategies for analyzing and preventing road transport injuries and deaths in partnership with Health and Transport authorities. Some of the project's positive results include the high percentage of achievement of its performance targets, increased speeding control, road blocks to perform breath tests, with a larger number of tests performed and corresponding reduction in the number of positive tests and, as a probable consequence, reduction in mortality per 100,000 inhabitants in some cities.[29]

Transport accidents are complex events, although the majority of their causes are potentially avoidable through prevention actions and health promotion actions. For this reason, formulating and enforcing legislation in relation to risk factors are important for reducing the occurrence and severity of these events. Reduction of the maximum speed limit and reduced drink-driving,

obligatory use of crash helmets, safety belts and safety seats for children, installation and maintenance of adequate road infrastructure, the existence of obligatory safety devices in cars and the rapid and adequate response of health services following accidents are fundamental actions for addressing transport accidents.[30]

It must be noted that this study has limitations and, therefore, caution must be taken when interpreting its results. Although the coverage and quality of Mortality Information System death records has improved over the years, which certainly explains the reduction of mortality in the 'occupant of other types of transport' category, the system still has problems with regard to underreporting and filling in and coding of data.[14]

Notwithstanding these limitations, this is the first study to analyze the time trend of transport accident mortality in Piauí, presenting the most affected groups and those most exposed to this kind of fatality – Black people, those with little schooling and the elderly –, as well as using spatial analysis to enable visualization of the evolution of road transport mortality in each of the state's municipalities. As such, the information produced by this study enables identification of priority groups and areas for developing strategies to prevent these events, strengthening actions to protect the most vulnerable and to promote safe transport in the state, as well as serving to inform the enhancement of existing policies and assist with the process of preparing, building and applying new means and instruments aimed at promoting safe environments and better quality of life for its population.

## Authors' contributions

Sousa RA, Sousa CMS and Mascarenhas MDM contributed to the study concept and design, as well as data analysis and interpretation. Sousa RA and Silva FRS contributed to relevant critical drafting of the intellectual contents of the manuscript. Mascarenhas MDM, Rodrigues MTP and Cardoso OO contributed to relevant critical reviewing of the intellectual content and approving the final version of the manuscript. All the authors are responsible for all aspects of the study, including the guarantee of its accuracy and integrity.

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