

Trends in the number of traffic accident victims on Brazil's federal highways before and after the start of the Decade of Action for Road Safety

Tendência do número de vítimas em acidentes de trânsito nas rodovias federais brasileiras antes e depois da Década de Ação pela Segurança no Trânsito

Tendencia del número de víctimas en accidentes de tráfico en carreteras federales brasileñas antes y después de la Década de Acción por la Seguridad en el Tráfico

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Abstract

This study aimed to analyze the trend in the number of fatalities, severe injuries, and minor injuries from traffic accidents on Brazil's federal highways according to the country's major geographic regions before and after the start of the Decade of Action for Road Safety (DARS). This was an interrupted time series study of data on accidents with fatal or injured victims provided by the Brazilian Federal Highway Police from 2007 to 2017. The Prais-Winsten method was used to calculate the monthly percentage change (MPC) in the number of fatalities, severe injuries, and minor injuries. Before the DARS, there was an upward monthly trend in the number of fatalities in these accidents in the country as a whole (MPC 0.71%) and in all five regions, especially in the South (MPC 1.01%) and Central-West (MPC 0.84%). There was an inverse trend after the start of the DARS, with a significant decrease in Brazil as a whole (MPC -1.24%) and in the major geographic regions. For each person that dies in an accident on a federal highway, at least 12 others suffer non-fatal injuries. There was an upward trend in the number of victims with severe injuries (MPC 0.53%) and minor injuries (MPC 0.8%) in Brazil and in the major geographic regions in the period prior to the DARS. After the start of the DARS, there was a significant downward trend in the absolute frequencies of these outcomes at the national and regional levels. In conclusion, before the DARS, there was an upward monthly trend in the number of fatal and injured victims of traffic accidents on Brazil's federal highways. After the start of the DARS, in 2011, there was an inverse trend, namely a decline in these outcomes in the country.

Wounds and Injuries; Traffic Accidents; Roads; Time Series Studies

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Introduction

In December 1999, the *Morbidity and Mortality Weekly Report* (MMWR), an official publication of the U. S. Centers for Disease Control and Prevention (CDC), published a list of the ten greatest public health achievements in United States in the 20th century. Not surprisingly, vaccination ranked first. Motor vehicle safety ranked second¹. The first “automobile” vehicle, the Fardier, was built in 1769 by French military engineer Nicholas Joseph Cugnot, and the inaugural test drive resulted curiously in the “first automobile accident in history”². But the automobile’s popularity was not to come until 1899, the same year that witnessed the first accident involving two motor vehicles in the United States². In the second half of the 20th century, items like safety belts and airbags were gradually incorporated into routine automobile manufacturing, and with the advent of the information age, the computerization of automobiles has been constant.

Despite the growing adoption of vehicle safety items, motor vehicle accidents (MVAs) are still acknowledged in the second decade of the 21st century as a “public health problem”, as phenomena that affect populations’ health levels. According to Costa & Victora³, the expression “public health problem” should not be used arbitrarily, but reserved for diseases and health problems whose repercussions occur not only at the individual level, but affective collectives. In fact, according to the World Health Organization (WHO), every year 1.35 million people die from MVAs in the world, as the eighth cause of death in all age brackets as a whole and the leading cause in individuals 5 to 29 years of age⁴.

In Brazil, data from the *Brazilian National Health Survey* (PNS 2013) showed that 3.1% of the 60,202 interviewees had been in traffic accidents with victims in the 12 previous months, and that the proportion was higher in men (4.5%) than in women (1.8%)⁵. Approximately one-fourth of treatments for accidents in sentinel emergency services in the country were due to traffic accidents⁶. Considering only external causes, MVAs were the second leading cause of disability-adjusted life years (DALYs), an indicator used in burden of disease studies, exceeded only by homicides and violence^{7,8}, with alcohol use identified as an important risk factor for deaths and disabilities from this cause, especially in the male population⁹.

In 2004, the WHO and World Bank jointly published the *World Report on Road Traffic Injury Prevention*, warning of the consequences of injuries from motor vehicle accidents and recommending strategies for accident prevention¹⁰. The joint report is emblematic, since the effects of traffic injuries and deaths transcend the health sector and are reflected in the economy, considering that accidents occur predominantly in the economically active population and result in significant public expenditures beyond patient care itself¹¹. In 2009, the WHO published the first Global Status Report on Road Safety with data from a survey in 178 countries that elucidated the magnitude of the problem on the global scale and established a baseline for MVA surveillance¹². That same year, Moscow (Russia) hosted the First Global Ministerial Conference on Road Safety, whose declaration includes measures to support the implementation of interventions proposed in the 2004 report¹³.

In 2010, the United Nations General Assembly issued a resolution designating the period from 2011 to 2020 as the “Decade of Action for Road Safety” (DARS), with the purpose of reducing deaths and injuries from MVAs through the adoption of coordinated actions at different levels, with an emphasis on the local and national levels¹⁴. The Global Plan for the Decade of Action for Road Safety¹⁵ was launched with this purpose, containing a detailed description of activities to be performed by the member states, grouped in five pillars: (1) road safety management; (2) safer roads and mobility; (3) vehicle safety; (4) road user behavior; and (5) post-crash response. Since then the situation has been monitored by the WHO^{4,16,17}.

In Brazil, the National Traffic Department, Ministry of Health, and Ministry of Cities launched the National Pact for the Reduction of Traffic Accidents in May 2011, as part of Brazil’s series of actions for the Decade of Action, including the Life in the Traffic Project, the Brazilian version of the international consortium *Road Safety in Ten Countries*¹⁸. In 2015, Brasília hosted the 2nd Global High-Level Conference on Road Safety, with participation by 120 countries, whose final document reaffirms the commitment to the implementation of the Global Plan for the DARS¹⁹. During this period the Brazilian morbidity and mortality indicators from MVAs have improved, but with differences between the various means of transportation and geographic regions^{8,20}.

The DARS does not involve just accidents on highways, but it is important to study them: “... since they involve higher energy (higher speed), they result in more severe case-fatality than urban accidents and account for more than 70% of the total costs of traffic accidents in Brasil”²¹ (p. 53). In other words, compared to other types of roads, highway accidents tend to be more fatal²², so that a reduction in the number of serious highway accidents is a prime target for the DARS¹⁴. The current study aimed to analyze the trend in the number of fatalities, severe injuries, and minor injuries from traffic accidents on Brazil’s federal highways, according to major geographic regions, before and after the start of the DARS.

Method

This was an interrupted time series (ITS) study, a method usually employed to assess the impact of actions and programs on population outcomes. In this case, we used data on accidents with fatalities or injuries provided by the Federal Highway Police (PRF in Portuguese) from 2007 to 2017. Since enactment of *Law n. 12,527* on November 18, 2011 (known to the public as the Access to Information Law), the Federal Highway Police began to publish data generated by the daily activity of federal highway patrols on its website.

The database on MVAs maintained by the Federal Highway Police stores data on traffic accidents on federal roads and highways in which a Traffic Accident Bulletin (BAT in Portuguese) has been filed. The BAT is an official document of the Federal Highway Police that contains data on the accident recorded by the attending patrol officer. It is generally used in so-called “accidents with social damage”, namely those involving fatalities or injuries. The current study only analyzed data on accidents that resulted in BAT, and the information on the victims’ physical condition is recorded by the federal highway patrol officer at the scene, without follow-up of their condition over time.

We analyzed accidents with victims on federal highways according to the major geographic region where the accident occurred (North, Northeast, Southeast, South, and Central). Duplicate records were excluded. The time series for the numbers of fatalities, severe injuries, and minor injuries were dichotomized in before versus after the start of the DARS in order to quantify changes, both immediate (level) and trend (slope). In this study, the post-intervention period started in May 2011, month of the launch of the DARS. The first and second segments had 52 and 80 observations, respectively, a sufficient amount for this type of analysis²³.

Interrupted time series studies are particularly resistant to gradually modified confounders such as the population’s age structure, but are sensitive to more abrupt changes such as seasonality²⁴, which was modeled here by the use of sine and cosine functions. Significant seasonal variation was seen in the models, where at least one of coefficient in seasonality assessment terms differed from zero ($p < 0.05$).

We thus used the regression equation $Y_i = b_0 + b_1 \cdot \text{time} + b_2 \cdot \text{level} + b_3 \cdot \text{trend}$, plus the terms b_4 (sine) and b_5 (cosine), as described by Antunes & Cardoso²⁵. In this model, b_1 represents the trend in the period prior to the DARS; b_2 is the level change, that is, the immediate impact of the DARS; and b_3 is the trend change and represents the period after the start of the DARS.

To calculate the monthly percentage change (MPC) in the number of fatalities, severe injuries, and minor injuries, we used the Prais-Winsten method, which allows correction of first-order autocorrelation of the error. The dependent variable was the logarithm of the absolute frequencies, and the independent variable was the months in the time series. The formulas recommended by Antunes & Waldman²⁶ were used to calculate the MPC (1) and confidence intervals (2):

$$\Delta = -1 + 10^b \quad (1)$$

$$95\%CI: -1 + 10^{(b \pm t \cdot SE)} \quad (2)$$

The values for “ b ” and the standard error (SE) were obtained from the regression analysis. The value for “ t ” is given by the Student t distribution table. Based on this procedure, the trend was classified as upward, downward, or stationary. The trend was considered stationary when the coefficient in the regression equation for this parameter was equal to zero in the test of hypothesis ($p > 0.05$).

The graphic presentation of the series used the LOWESS method (locally weighted regression scatterplot smoothing) with 5% bandwidth. The graphs were produced in R (<http://www.r-project.org>) (asts package), and trend analysis was performed in Stata, version 15.1 (<https://www.stata.com>).

The research project that produced this study was not submitted to an Ethics Research Committee, because, as mentioned above, it only uses public access data.

Results

In the period analyzed here, there were 1,122,904 victims of accidents on Brazil's federal highways, the majority of which (92.6%, $n = 1,039,777$) involving non-fatal injuries. During the DARS, 691,667 persons suffered traffic injuries. As shown in Table 1, the proportion of fatalities was highest in Northeast Brazil (10%) and lowest in the South (6%). In Brazil as a whole, the proportion was 7%. Of all the injuries, the Northeast had the highest proportion of severe injuries (32%) and the South had the lowest (23%).

The data showed upward and downward monthly trends in the number of fatalities, severe injuries, and minor injuries in traffic accidents on federal highways, respectively, before and after the launch of the DARS in Brazil as a whole and in all the major geographic regions.

From 2007 to 2017, there were 83,127 deaths from traffic accidents on Brazil's federal roads and highways, predominantly in the Northeast (31.52%), Southeast (29.02%), and South (20.83%). Before the DARS, there was an upward monthly trend in the number of fatalities in these accidents in Brazil as a whole (MPC 0.71%; 95%CI: 0.51; 0.90) and in all five regions, especially in the South (MPC -1.01%; 95%CI: 0.72; 1.29) and Central (MPC 0.84%; 95%CI: 0.58; 1.10), which showed the highest increases. There was an inverse trend after the start of the DARS, with a significant decrease in Brazil as a whole (MPC -1.24%; 95%CI: -1.46; -1.02) and in all five major geographic regions (Table 1). Figure 1 shows the monthly trend in the series involving fatalities on federal highways in Brazil before and after the DARS.

For each person that dies in an accident on a Brazilian federal highway, at least 12 others, on average, suffer non-fatal injuries. In the years analyzed here, there were 275,243 victims with severe injuries as shown in the historical series in Figure 2. There was an upward trend in Brazil as a whole (MPC 0.53%; 95%CI: 0.38; 0.69) and in all five major geographic regions in the period prior to the DARS, with the largest increases in the North (MPC 0.84%; 95%CI: 0.60; 1.09) and the South (MPC 0.84%; 95%CI: 0.63; 1.04) and the smallest in the Southeast (MPC 0.19%; 95%CI: 0.01; 0.38). With the DARS, there was a significant downward trend at the national level (MPC -1.15%; 95%CI: -1.32; -0.98) and in all the major geographic regions, with the largest decrease in the North (MPC -1.81%; 95%CI: -2.07; -1.54) (Table 1).

As for minor injuries, the South of Brazil showed the highest monthly increase before the DARS (MPC 1.10%; 95%CI: 0.92; 1.27), while the Southeast had the lowest increase (MPC 0.54%; 95%CI: 0.38; 0.70). After the start of the DARS, there was a downward trend in victims with minor injuries in Brazil (MPC -1.07%; 95%CI: -1.22; -0.92) and in all five major geographic regions (Table 1). A total of 764,534 persons suffered minor injuries from these traffic accidents, with the distribution shown in Figure 3.

As expected in such interventions, whose expected effect is gradual, there was no level change, i.e., no immediate reduction in the number of deaths ($p = 0.23$), minor injuries ($p = 0.69$), or severe injuries ($p = 0.09$) after the launch of the DARS in Brazil.

Table 1

Trends in the monthly number of fatalities, severe injuries, and minor injuries on Brazil's federal highways before and after the beginning of the Decade of Action for Road Safety (DARS). Brazil and major geographic regions, 2007-2017.

| Local | n | % | Before DARS MPC (95%CI) | Interpretation | After DARS MPC (95%CI) | Interpretation |
|------------------------|---------|-------|----------------------------|----------------|---------------------------|----------------|
| Fatalities | | | | | | |
| North | 5,377 | 6.47 | 0.62 (0.21; 1.04) | Increase | -0.89 (-1.35; -0.43) | Decrease |
| Northeast | 26,201 | 31.52 | 0.61 (0.36; 0.86) | | -1.10 (-1.37; -0.82) | |
| Southeast | 24,126 | 29.02 | 0.59 (0.30; 0.88) | | -1.30 (-1.61; -0.98) | |
| South | 17,318 | 20.83 | 1.01 (0.72; 1.29) | | -1.46 (-1.77; -1.15) | |
| Central | 10,105 | 12.16 | 0.84 (0.58; 1.10) | | -1.39 (-1.67; -1.10) | |
| Brazil | 83,127 | | 0.71 (0.51; 0.90) | | -1.24 (-1.46; -1.02) | |
| Severe injuries | | | | | | |
| North | 17,836 | 6.48 | 0.84 (0.60; 1.09) | Increase | -1.81 (-2.07; -1.54) | Decrease |
| Northeast | 73,226 | 26.60 | 0.59 (0.38; 0.79) | | -1.27 (-1.50; -1.05) | |
| Southeast | 83,371 | 30.29 | 0.19 (0.01; 0.38) | | -0.81 (-1.02; -0.60) | |
| South | 67,092 | 24.38 | 0.84 (0.63; 1.04) | | -1.19 (-1.42; -0.97) | |
| Central | 33,718 | 12.25 | 0.61 (0.29; 0.92) | | -1.40 (-1.75; -1.05) | |
| Brazil | 275,243 | | 0.53 (0.38; 0.69) | | -1.15 (-1.32; -0.98) | |
| Minor injuries | | | | | | |
| North | 46,490 | 6.08 | 0.81 (0.58; 1.04) | Increase | -1.26 (-1.51; -1.01) | Decrease |
| Northeast | 156,931 | 20.53 | 0.76 (0.56; 0.95) | | -1.19 (-1.40; -0.97) | |
| Southeast | 254,274 | 33.26 | 0.54 (0.38; 0.70) | | -0.77 (-0.94; -0.59) | |
| South | 223,585 | 29.24 | 1.10 (0.92; 1.27) | | -1.39 (-1.58; -1.20) | |
| Central | 83,254 | 10.89 | 0.89 (0.69; 1.08) | | -0.84 (-1.06; -0.63) | |
| Brazil | 764,534 | | 0.80 (0.66; 0.93) | | -1.07 (-1.22; -0.92) | |

95%CI: 95% confidence interval; MPC: monthly percentage change.

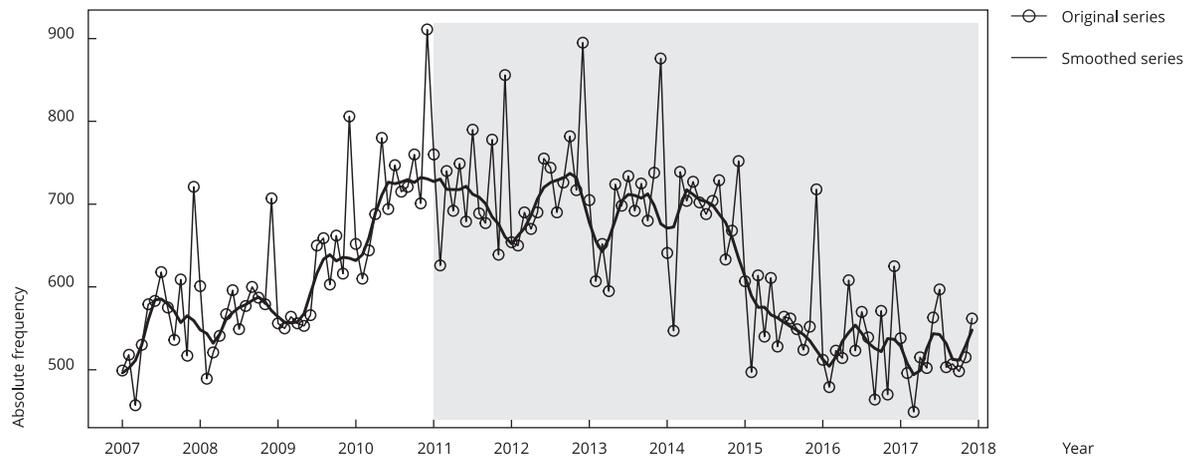
Discussion

Despite the increase in both motorization (Departamento Nacional de Trânsito. Frota de veículos. <https://www.denatran.gov.br/estatistica/237-frota-veiculos>, accessed on 06/Sep/2018) and the population size (Instituto Brasileiro de Geografia e Estatística. Séries históricas. <https://www.ibge.gov.br/estatisticas-novoportal/sociais/populacao/9662-censo-demografico-2010.html?edicao=10503&t=series-historicas>, accessed on 19/Nov/2018) this study found a downward trend in the number of fatalities and injuries in accidents on Brazil's federal highways since the start of the DARS. This finding is thus consistent with the overall objective of the DARS, namely to decrease the number of traffic fatalities. Between 1990 and 2015 there was a 32.8% decrease in the mortality rate from MVA in Brazil⁸. In the first three years of the DARS alone, the reduction was 4.1%²⁰.

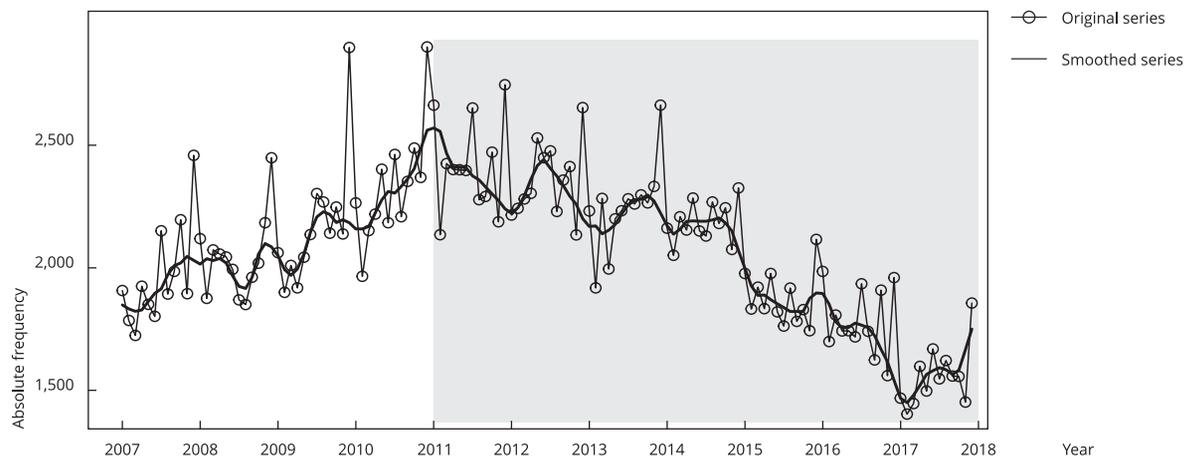
In general, epidemiological studies on morbidity and mortality from MVAs in Brazil do not analyze the outcome based on classification of the roadway where the accident occurred (urban versus rural). Compared to other types of roads, the proportion of fatal and non-fatal injuries is higher on expressways²⁷. Therefore, overall improvements in morbidity and mortality indicators do not necessarily include highways. In this sense, Zhou et al.²⁸ identified a decrease in both the number and the rate of fatalities and injuries from MVAs in China from 2003 to 2005, except for highway accidents. In Brazil, the reduction in the mortality rate from MVAs⁸ has been accompanied by a decline in the number of deaths from accidents on federal highways.

Figure 1

Time series of the monthly number of deaths from traffic accidents on Brazil's federal highways before and after the Decade of Action for Road Safety (DARS). Brazil, 2007-2017.

**Figure 2**

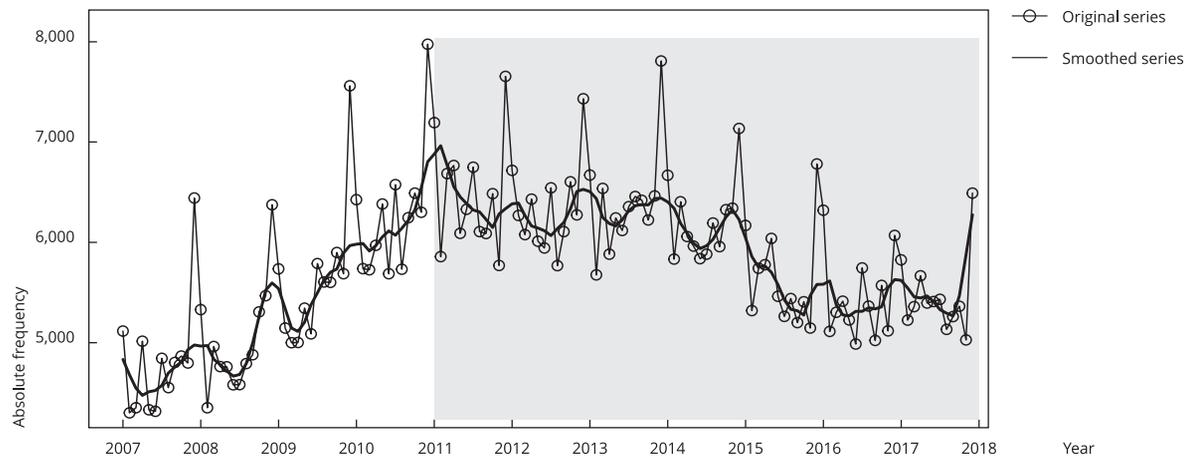
Time series of the monthly number of severe injuries from traffic accidents on Brazil's federal highways before and after the Decade of Action for Road Safety (DARS). Brazil, 2007-2017.



Accidents with victims on federal highways occur mainly in the Northeast, Southeast, and South of Brazil, where the largest motor vehicle fleets are located (Departamento Nacional de Trânsito. Frota de veículos. <https://www.denatran.gov.br/estatistica/237-frota-veiculos>, accessed on 06/Sep/2018). In the case of highway accidents with victims, the proportion of deaths was highest in the Northeast. Multiple factors influence highway safety, and these factors have implications for the outcomes analyzed here. However, when analyzing highway accidents in Brazil, it is relevant that there are longer

Figure 3

Time series of the monthly number of minor injuries from traffic accidents on Brazil's federal highways before and after the beginning of the Decade of Action for Road Safety (DARS). Brazil, 2007-2017.



stretches of unpaved highways in the Northeast (as in the North and Central) Departamento Nacional de Infraestrutura de Transportes. Sistema nacional de viação. <http://www.dnit.gov.br/sistema-nacional-de-viacao/sistema-nacional-de-viacao>, accessed on 01/Nov/2018). In addition, in some states of the Northeast there is a relevant proportion of federal highways with paving conditions classified as “terrible” by the National Department of Transportation Infrastructure (DNIT. ICM 2018. <http://www.dnit.gov.br/icm/icm-2018>, accessed on 01/Nov/2018). According to Ladeira et al. ⁸, the states of North and Northeast Brazil had the highest mortality rates from MVAs in 2015. Of the ten states of Brazil with the highest mortality rates, four are in the Northeast ⁸.

The downward trend in the number of fatalities and injuries, especially serious injuries, deserves to be emphasized, considering their implications, including economic costs. Brazil's Institute for Applied Economic Research (IPEA) ²⁹ analyzed the costs of accidents on federal highways in 2014 and concluded that each accident cost the country an average of BRL 72,705.31 (USD 18,940), including costs related not only to individuals but also to the vehicles and institutions. The amount is substantially higher in fatal accidents. In case of death or severe injury, the accident also affects the family, especially when the breadwinner is involved. The health care for a person with sequelae (sometimes irreversible) from an accident means a permanent cost for the family that is not limited to financial issues, but jeopardizes their quality of life in the broader sense ³⁰, also involving intangible dimensions.

Although favorable, the downward trend observed in this study should be viewed with caution, considering the background of high numbers of victims in highway accidents in Brazil. Taking just the period subsequent to the introduction of the DARS, there were 700,000 victims of accidents on federal highways. This calls attention to the reiterated plea by the WHO to improve road safety in the country ^{4,16,17}. Although traffic accidents are not totally avoidable, since they are sensitive to human error, they are amenable to prevention ¹⁵. Legislation is indispensable for this purpose ³¹, including highway legislation ³².

The Brazilian Traffic Code (CTB in Portuguese), enacted under *Law n. 9,503* of September 23, 1997, addresses aspects related to the five main behavioral risk factors for MVAs: speeding, driving under the influence of alcohol, and failure to use helmets, safety belts, and safety devices for children ¹⁷, the latter regulated by *Ruling n. 277* of May 28, 2008, of the National Traffic Council (CONTRAN) ³³. According to the WHO, it is urgent for national legislations to incorporate rules on

mobile phones and use of psychoactive substances¹⁷. Both are covered by the CTB, but their surveillance on highways is difficult.

Therefore, although Brazil has comprehensive road safety legislation that even predates the DARS, there are relevant gaps in the actual enforcement of such laws, a crucial strategy for maintaining road safety³⁴. Follow-up by the WHO in 2013, 2015, and 2018 identified improvements in the surveillance of some risk factors. However, during the same period the police enforcement of some other issues persisted or even became worse, especially in relation to motorists' blood alcohol levels^{4,16,17}. On this point, Moysés³⁵ contends that the problem with roadway accidents in Brazil is at least partly associated with a typical "Brazilian culture", which often views the public sphere as a place for achieving private interests. According to the author, Brazilians thus tend to "react [negatively] to the internalization of codes of civil behavior"³⁵ (p. 2242), such as the CTB.

Three years after the start of the DARS, no country of the Americas had implemented all seven vehicle safety items recommended by the United Nations³⁶. On the other hand, normative improvements in the manufacture of safer vehicles may help maintain the downward trend in the number of victims, although in the long term. In 2015, CONTRAN established mandatory electronic stability control, especially important for reducing accidents on highways, to be installed in all motor vehicles by 2022³⁷. In 2017, the same agency created a timetable of technical studies for the regulation of other items, such as "pedestrian protection", a device located on the front of the car, which helps reduce harm in case of a crash with a pedestrian³⁸. Both items are monitored by the WHO, given their importance for reducing traffic morbidity and mortality^{4,17}.

In the first assessment of the road safety situation in the Americas since the start of the DARS, most of the countries only furnished information from police databases, and not vital records. Brazil has a set of information systems that support the surveillance of indicators related to MVAs, like the Federal Highway Police database, considered "a model of records on highway accidents"²⁹ (p. 26). As in any information system, that of the Federal Highway Police has its limitations, such as the fact that it is time-limited, unlike the Brazilian Mortality Information System, in which, even if an individual dies from traffic injuries several days after the accident, the underlying cause of death on the death certificate is still recorded as a traffic accident¹⁷. On the other hand, information systems based on police records have data on non-fatal victims, which allows "analysis of trends other than just mortality"³⁹ (p. 1450).

Interrupted time series are useful for assessing an intervention's effect, which in this study was the DARS, not limited to a single measure, but to a set of them, ranging from the elimination of high-risk roads to the rehabilitation of victims and regulations to protect pedestrians. There are measures in the Global Plan for the DARS that have not been implemented in Brazil, such as the creation of a stepwise drivers' licensing system. Other measures existed in Brazil even before the DARS, such as the availability of a single telephone hotline for roadway emergencies. In addition, some measures were implemented in some cities but not in others, and to different degrees, such as the guarantee of safe mobility. Nevertheless, the current study identified a downward trend throughout Brazil in the number of highway accidents with victims since the start of DARS.

The study's limitations include the scope of the findings and data and the statistical methodology. State and municipal highways were not included in the analysis, although they represent an important share of Brazil's highway grid, with long unpaved stretches (Confederação Nacional do Transporte. Anuário CNT do transporte 2018. <http://anuariodotransporte.cnt.org.br/2018/Rodovario/1-3-1-1-1-1-/Malha-rodovi%C3%A1ria-total>, accessed on 18/Dec/2018). In addition, victimless accidents were not included in the analysis, since beginning in 2015 they have been recorded via internet by drivers themselves, who complete a Traffic Accident Report (DAT in Portuguese)⁴⁰. Since then, the Federal Highway Police only provides data on accidents that result in a BAT. As for the method, as mentioned, the Prais-Winsten model corrects the autocorrelation of first-order residuals, and not those of the highest order, which however tend to be less relevant²⁵.

Conclusion

Before the DARS, there was an upward monthly trend in the number of fatalities, severe injuries, and minor injuries from traffic accidents on federal highways in Brazil as a whole and in all five major geographic regions. After the start of the DARS in 2011, there was an inverse trend, namely a decline in these adverse outcomes on federal highways. Although the number of traffic accidents on highways remains high, the downward trend is consistent with the objectives of the DARS and indicates a favorable impact from the initiative. Time changes associated with initiatives like the DARS, which involve a set of measures that depend on multiple social actors and complex and conflicting decision-making processes, are not immediate, but have gradual effects.

Contributors

F. R. Andrade collaborated in the study's conception, data analysis and interpretation, writing of the article, and approval of the final version for publication and was responsible for all aspects of the work, guaranteeing the accuracy and integrity of all parts of the study. J. L. F. Antunes collaborated in the data analysis, critical revision of the content, and approval of the final version for publication and was responsible for all aspects of the work, guaranteeing the accuracy and integrity of all parts of the study.

Additional informations

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Resumo

O objetivo deste estudo foi analisar a tendência do número de mortos, feridos graves e feridos leves por acidentes de trânsito nas rodovias federais brasileiras, segundo macrorregião, antes e depois do início da Década de Ação pela Segurança no Trânsito (DAST). Trata-se de estudo de séries temporais interrompidas com dados sobre acidentes com vítimas, fatais ou feridas, disponibilizados pela Polícia Rodoviária Federal para o período de 2007 a 2017. Utilizou-se o método de Prais-Winsten para o cálculo da variação percentual mensal (VPM) do número de mortos, feridos graves e feridos leves. Antes da DAST, havia uma tendência de aumento mensal do número de mortos nesses acidentes no país (VPM de 0,71%) e em todas as regiões, com destaque para o Sul (VPM de 1,01%) e Centro-oeste (VPM de 0,84%). Verificou-se tendência inversa após o início da DAST, com diminuição significativa no Brasil (VPM de -1,24%) e macrorregiões. Para cada pessoa que morre em um acidente em rodovia federal, há, pelo menos, 12 outras, em média, que sofrem lesões não fatais. Houve tendência de aumento do número de vítimas com ferimentos graves (VPM de 0,53%) e leves (VPM de 0,8%) no Brasil e nas macrorregiões no período que antecedeu a DAST. Após a introdução da DAST, houve uma tendência de diminuição nas frequências absolutas significativas desses desfechos nos níveis nacional e regional. Conclui-se que, antes da DAST, houve tendência de aumento mensal do número de vítimas fatais e feridas por acidentes de trânsito nas rodovias federais. Após o início da DAST, em 2011, observou-se tendência inversa, ou seja, de declínio desses desfechos nos locais estudados.

Ferimentos e Lesões; Acidentes de Trânsito; Estradas; Estudos de Séries Temporais

Resumen

El objetivo de este estudio fue analizar la tendencia del número de muertos, heridos graves y heridos leves por accidentes de tráfico en las carreteras federales brasileñas, según macrorregión, antes y después del inicio de la Década de Acción por la Seguridad en el Tráfico (DAST). Se trata de un estudio de series temporales interrumpidas con datos sobre accidentes con víctimas, fatales o heridas, reveladas al público por la Policía de Carreteras Federal para el período de 2007 a 2017. Se utilizó el método de Prais-Winsten para el cálculo de la variación de porcentaje mensual (VPM) del número de muertos, heridos graves y heridos leves. Antes de la DAST, había una tendencia de aumento mensual del número de muertos en esos accidentes en el país (VPM de 0,71%) y en todas las regiones, resaltando la Sur (VPM de 1,01%) y Centro-oeste (VPM de 0,84%). Se verificó una tendencia inversa tras el comienzo de la DAST, con una disminución significativa en Brasil (VPM de -1,24%) y en sus macrorregiones. Por cada persona que muere en un accidente en una carretera federal, hay por lo menos otras 12, de media, que sufren lesiones no fatales. Hubo tendencia de aumento en el número de víctimas con heridas graves (VPM de 0,53%) y leves (VPM de 0,8%) en Brasil y en las macrorregiones durante el período que precedió la DAST. Tras la introducción de la DAST, hubo una tendencia de disminución en las frecuencias absolutas significativas de esos desenlaces en los niveles nacional y regional. Se concluye que antes de la DAST hubo una tendencia de aumento mensual en el número de víctimas fatales y heridas por accidentes de tráfico en las carreteras federales. Tras el inicio de la DAST, en 2011, se observó una tendencia inversa, o sea, de declive de esos desenlaces en los lugares estudiados.

Heridas y Traumatismos; Accidentes de Tránsito; Carreteras; Estudio de Series Temporales

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