



Distracted driving of a motor vehicle on Brazilian federal highways as a cause of traffic accidents

Falta de atenção ao conduzir veículo automotor como causa de acidentes de trânsito nas rodovias federais brasileiras

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ABSTRACT: *Introduction:* Distracted driving (DD) of a motor vehicle is considered an increasing risk factor for land transport accidents. *Objective:* To identify the tendency in the number of victims in DD accidents and in the number of offences due to cell phone use on Brazilian federal highways, as well as analyze the DD category in depth as it is being used in the country. *Method:* A time series study with data on accidents with victims, made available by the Federal Highway Police, whose cause was distracted driving, from 2007 to 2016 and data on offences for driving using a cell phone. *Results:* There was a tendency towards a monthly increase in the number of distracted driving accident victims in the country up to mid-2011 (percentage monthly variation — PMV = 0.57%), followed by a significant decrease (PMV = -0.45%). Macro-regions showed similar behavior, except in the Southeast. There was a monthly increase in the number of offences caused by drivers using cell phones from 2007 to 2013. *Conclusion:* There was a tendency towards monthly increases in the number of victims of distracted driving in Brazil and in most macro-regions up to 2011, followed by a subsequent downward tendency. The inaccurate nature of the expression “distraction” compromises the quality of the data and, consequently, the adequate estimation of victims attributable to this risk factor. The cell phone-driving dyad could be the root cause of accidents with victims caused by distracted driving in the country.

Keywords: Accidents, traffic. Roads. Distracted driving. Cell phone.

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RESUMO: *Introdução:* Falta de atenção ao conduzir (FAC) veículo é tida como fator de risco em ascensão para Acidentes de Transporte Terrestre (ATT). *Objetivo:* Os objetivos deste estudo foram identificar a tendência do número de vítimas em acidentes por FAC e do número de infrações por uso de aparelho telefônico celular nas rodovias federais brasileiras e problematizar a categoria FAC tal como vem sendo empregada no país. *Método:* Estudo de séries temporais, com dados de acidentes com vítimas disponibilizados pela Polícia Rodoviária Federal, cuja causa tenha sido FAC, no período de 2007 a 2016, e dados de infrações por dirigir utilizando celular. *Resultados:* Identificou-se tendência de aumento mensal do número de vítimas de acidentes por FAC no país até meados de 2011 (variação percentual mensal — VPM = 0,57%), seguida de diminuição significativa (VPM = -0,45%). As macrorregiões apresentaram comportamento similar, com exceção do Sudeste. Houve tendência de aumento mensal do número de infrações pelo uso de celular pelo condutor de 2007 a 2013. *Conclusão:* A tendência é de aumento mensal do número de vítimas decorrentes de FAC no Brasil e na maioria das macrorregiões até 2011, com posterior tendência de declínio. A inexistência da expressão “falta de atenção” compromete a qualidade dos dados e, por consequência, o adequado dimensionamento das vítimas atribuível a esse fator de risco. A diade celular-condução pode estar na origem de acidentes com vítimas por FAC no país.

Palavras-chave: Acidentes de trânsito. Estradas. Direção distraída. Telefone celular.

INTRODUCTION

“The creature is limited. Time, space, standards and customs. Wrongs and rights. Creation is unlimited. It exceeds time and mean”¹. The reflection from the poet Anna Lins dos Guimarães Peixoto Bretas, known as Cora Coralina, applies to the motor vehicle, as an example of how the creation overcomes the creature, often turning it into a victim of its own creation. By analyzing the behavior of young adults in traffic, Dellatorre² goes further and mentions the “fusion” between creature and creation, represented by the Greek myth Centaur. As the mythical being, with human head, arms and back, and horse legs, contemporary young adults form, for the author, a single body, person-car, and, in this mixed being, turn into executioners and victims, because they kill and they die.

In 2016, the world got to know Graham, the “super-human” designed to survive contemporary traffic accidents, whose objective was to show that the human being did not evolve as fast as cars³. Every year, 1.35 million people die because of Road Traffic Injuries (RTI) in the world. This is the main cause of death among people aged between 5 and 29 years⁴. These are preventable deaths, therefore, totally or partially preventable through actions that contemplate, as shown in the Graham project, both the vulnerability and the fallibility of the human being⁵. The elaboration of such preventive strategies should preferably be based on a systemic approach, since RTI are a result of a set of elements that are not only interdependent, but interacting, involving the road, the vehicle, the environment and the user⁵.

The development of strategies that have a positive impact on the behavior of the “creature”, that is, the user of the public space, is essential to reduce morbidity and mortality rates in traffic. According to the World Health Organization (WHO), the main behavioral risk factors related to RTI are speed, blood alcohol content, nonuse of helmets, seat belt and safe transport devices for children; more recently, the use of psychoactive substances by drivers and distracted driving were added to the list⁶.

Distracted driving is considered as an increasing risk factor, constituting a serious obstacle for road safety^{6,8}. “Distracted driving” is a comprehensive expression, including several situations. What they have in common is the driver’s momentary attention deflection caused, for example, by objects or actions, such as smoking or eating while driving. The intensification of the use of another “creation” by the driver, that is, the cell phone, after the first decade of the XXI century, has been pointed out as a determining factor for the increasing rates of RTI due to this cause^{6,8,9}. In Brazil, some national surveys, such as the National Health Survey (PNS) and the National Survey of School Health (PeNSE), approach risk behaviors for RTI, but none of them contemplates distracted driving.

The Information System (IS) maintained by the Federal Highway Police (PRF) is currently the only one that allows a national dimension of the impact of distracted driving on the occurrence of deaths and injuries caused by RTI. The objectives of this study were to identify the tendency in the number of victims of accidents caused by distracted driving and the number of infractions due to using a cell phone on Brazilian federal highways, besides analyzing the distracted driving category as it is being used in the country.

METHOD

This is a time series study with data on accidents with victims, both fatal or injured, which occurred in federal roads and highways, whose cause was specified as distracted driving, from 2007 to 2016.

The IS from the Federal Highway Police contains data from traffic accidents that originate a Traffic Accident Report. This document is filled out by the federal highway officer, and contains information about the fact. The Traffic Accident Report is used in accidents involving social damage; when, for example, there is bodily injury or spillage of dangerous goods. Therefore, only the accidents that had a Traffic Accident Report were analyzed in this study. We used the officer’s classification of the physical condition of the parties involved: mild, severe or deceased. The document was signed by the officer, and there was no follow-up on the victims.

In the Traffic Accident Report, the officer must indicate the presumed causes of the accident, classifying them as primary and secondary, based on traces and evidence collected at the place of the fact, as well as on the statement of people involved or witnesses. Distracted driving is one of those causes that, according to the Federal Highway Police:

Results from the careless behavior of the driver, due to distracting factors or not, which led the driver to a delayed perception of danger, such as: speaking on the cell phone, handling equipment, talking to passengers, not observing the rearview mirror, taking the wrong route, making inappropriate maneuvers, wrongly handling the vehicle etc.¹⁰.

The IS adopted by the Federal Highway Police has been active in the entire national territory since 2017. In 2017, there was a change in the variable referring to the cause of the accident in the public interface of the database. The studied period was then defined based on these arguments.

Accidents with victims caused by distracted driving in the federal highways, according to macro-region of occurrence, were analyzed (North, Northeast, Southeast, South and Center-West), as well as infractions for driving a vehicle while using a cell phone. Therefore, two databases were analyzed, both from the Federal Highway Police: one regarding accidents, and another one about infractions. Duplicate records were removed and, in the case of accidents, we disregarded those whose physical condition of the parties involved was classified as ignored. The Joinpoint Regression Program, version 4.6.0.0, made available for free by the National Cancer Institute, from the United States of America, was used in order to identify the inflection points of each one of the time series; that is, the periods of time when there were changes in the direction or intensity of the tendency.

The calculation of the monthly percentage variable (MPV), both of the number of victims of accidents caused by distracted driving and the number of infractions caused by using a cell phone while driving, was performed by the Prais-Winsten method, used in trend analysis by carrying out a correction of the first order residual correlation¹¹. The dependent and independent variables were, respectively, the logarithm of absolute frequencies and the months in the time series. The formulas in Equation 1 and Equation 2, proposed by Antunes and Waldman¹², were used to calculate the MPV and the confidence intervals:

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

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

The b and standard error (SE) values were identified in the regression analysis. The t value is obtained in the Student's t distribution table. Based on the MPV, the trend was considered as increasing, decreasing or stationary. The trend was considered stationary in cases in which the coefficient of the regression equation regarding this component was not significantly different than zero ($p > 0.05$).

To graphically present the behavior of the series, the smoothing splines method was used. The graphics and the trend analysis were carried out, respectively, using the software R and Stata, version 15.1 (College Station, Texas, 2018).

The project of this study was not submitted to a Research Ethics Committee, because only secondary data, with public access and without nominal identification of the people involved in the accidents, were analyzed.

RESULTS

Between 2007 and 2016, there were 643,231 accidents with victims in the Brazilian federal highways, of which 194,203 (30.2%) had distracted driving as the cause. Figure 1 shows that this proportion stayed relatively stable throughout the analyzed period. The total of 199,162 (31%) accidents with victims did not have a presumed cause specified in the public interface of the database; therefore, they were grouped by the Federal Highway Police in the “others” category. This category includes accidents with less frequent causes, and not necessarily records in which the field referring to the cause was not filled out. Of the 444,069 facts with determined cause, distracted driving (43.7%, $n = 194,203$) was the most frequent one, followed by incompatible speed (14.2%, $n = 62,933$) and alcohol consumption (8.1%, $n = 35,811$).

For every person who dies in the country in an accident caused by distracted driving in a federal highway, there are at least 18 others who suffer from non-fatal injuries. Regarding the macro-regions, the number of victims in these accidents was higher in the South, Southeast and Northeast. On the other hand, the South region has the lowest percentage of deaths, and the Northeast, the highest (Table 1). Considering only the injured ones, the observation is the same, that is, the South region presented the lowest proportion of severe injuries, and the Northeast, the highest.

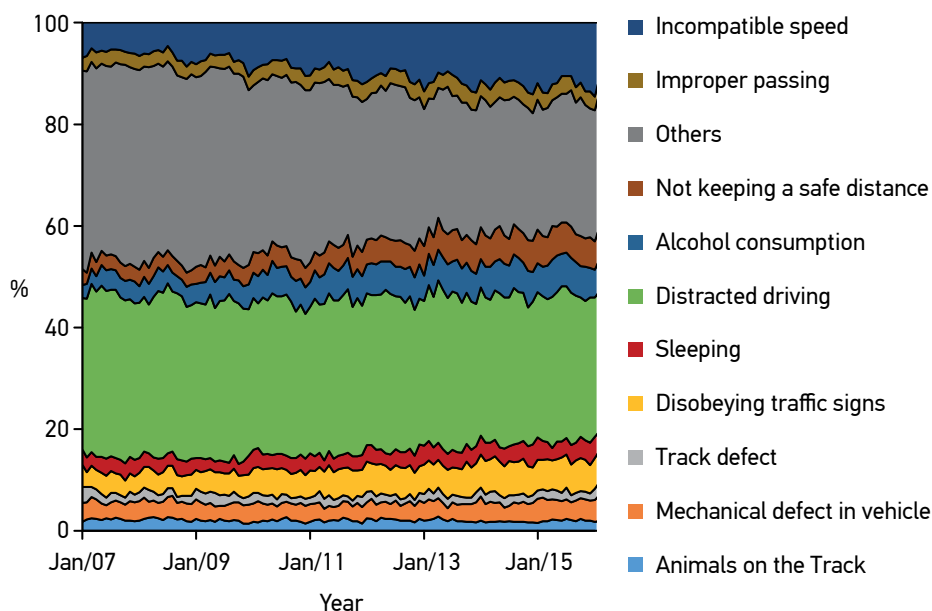


Figure 1. Distribution of accidents with victims in Brazilian federal highways according to cause. Brazil, 2007 to 2016.

Table 1. Tendency of the number of victims in traffic accidents in the Brazilian federal highways caused by distracted driving. Brazil and macro-regions, 2007–2016.

Place	Victim	n	%	Tendency 1 ^a	Int.	Tendency 2 ^b	Int.	Tendência 3 ^c	Int.
				(MPV, 95%CI)		(MPV, 95%CI)		(VPM, IC95%)	
North (N)	Deceased	1,199	5.3						
	Severely injured	5,765	25.6						
	Mildly injured	15,590	69.1						
	Total	22,554		0.6 (0.3 – 0.9)	I	-0.3 (-0.6 – -0.1)	D	-	-
Northeast (NE)	Deceased	5,102	7.8						
	Severely injured	19,954	30.4						
	Mildly injured	40,663	61.9						
	Total	65,719		0.5 (0.3 – 0.8)	I	-0.7 (-0.8 – -0.5)	D	-	-
Southeast (SE)	Deceased	3,472	4.5						
	Severely injured	17,754	23.2						
	Mildly injured	55,289	72.3						
	Total	76,515		0.3 (0.2 – 0.35)	I	-1.3 (-1.9 – -0.7)	D	0.5 (-1.4– 2.5)	E
South (S)	Deceased	3,450	3.7						
	Severely injured	19,637	21.0						
	Mildly injured	70,624	75.4						
	Total	93,711		0.7 (0.5 – 0.8)	I	-0.5 (-0.6 – -0.4)	D	-	-
Center-West (CO)	Deceased	1,850	5.7						
	Severely injured	8,903	27.2						
	Mildly injured	21,974	67.1						
	Total	32,727		0.9 (0.6 – 1.2)	I	-0.5 (-0.7 – -0.2)	D	-	-
Brazil	Deceased	15,073	5.9						
	Severely injured	72,013	24.7						
	Mildly injured	204,140	70.1						
	Total	291,226		0.6 (0.4 – 0.7)	I	-0.5 (-0.6 – -0.4)	D	-	-

^aN: Jan. 2007 to Feb. 2011, NE: Jan. 2007 to Dec. 2011, SE: Jan. 2007 to Jun. 2014, S: Jan. 2007 to May 2011, CO: Jan. 2007 to Jun. 2011, Brazil: Jan. 2007 to Jul. 2011; ^bN: Mar. 2011 to Dec. 2016, NE: Jan. 2012 to Dec. 2016, SE: Jul. 2014 to Feb. 2016, S: Jun. 2011 to Dec. 2016, CO: Jul. 2011 to Dec. 2016, Brazil: Aug. 2011 to Dec. 2016; ^cSE: Mar. 2016 to Dec. 2016; MPV: monthly percentage variation; 95%CI: 95% confidence interval of the MPV; Int.: Interpretation; I: increasing; D: decreasing; S: stationary.

Figure 2 shows the monthly distribution in the number of victims of accidents caused by distracted driving in federal highways in Brazil. There was a tendency of monthly increase in the number of victims in these accidents (MPV of 0.6%; 95% confidence interval — 95%CI 0.4 – 0.7%) until 2011, with significant reduction after this period (MPV = -0.5%; 95%CI -0.6% – -0.4%) (Table 1). Except for the Southeast Region, all others presented with a similar behavior, that is, increasing tendency until 2011, especially the Center-West region (MPV = 0.9%; 95%CI 0.6 – 1.2%), which had the highest increment, followed by the inverse tendency in the second segment of the series. The Northeast Region presented the highest average monthly reduction after 2011 (MPV = -0.7%; 95%CI -0.8 – -0.5%), and the North region, the lowest (MPV = -0.3%; 95%CI 0.6 – -0.1%).

On the other hand, in the Southeast there was an increasing tendency in the number of people with fatal and non-fatal injuries until the half of 2014 (MPV = 0.3%; 95%CI 0.2 – 0.4%), that is, for a longer period than in the other regions. After that, there was a decreasing tendency in the absolute frequencies (MPV = -1.3%; 95%CI -1.9 – -0.7%), which became stationary in the past year (MPV = 0.5%; 95%CI -1.4 – 2.5%) (Table 1).

In the analyzed years, 185,898 infractions were registered because the driver was using a cell phone, whose historical series is presented in Figure 3. There were three inflection points. There was a more evident increasing tendency in the two first years (MPV = 4.1%; 95%CI 3.1 – 5%), which continued to grow, although less intensively, until the half of 2013 (MPV = 1.4%; 95%CI and 1.1 – 1.7%). After this period, the tendency became stationary (MPV = -1.3%; 95%CI -3.1 – 0.5%). However, there is a clear reduction in the number of infractions in the end of 2015 and beginning of 2016, with subsequent growth, indicating problems in the system records.

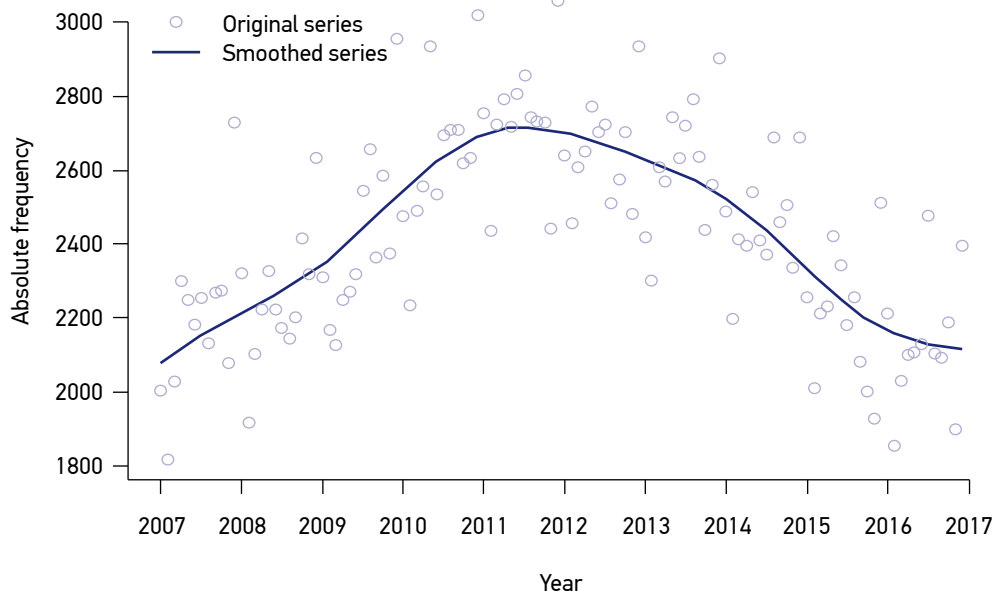


Figure 2. Monthly tendency in the number of victims of accidents in Brazilian federal highways due to distracted driving. Brazil, 2007 to 2016.

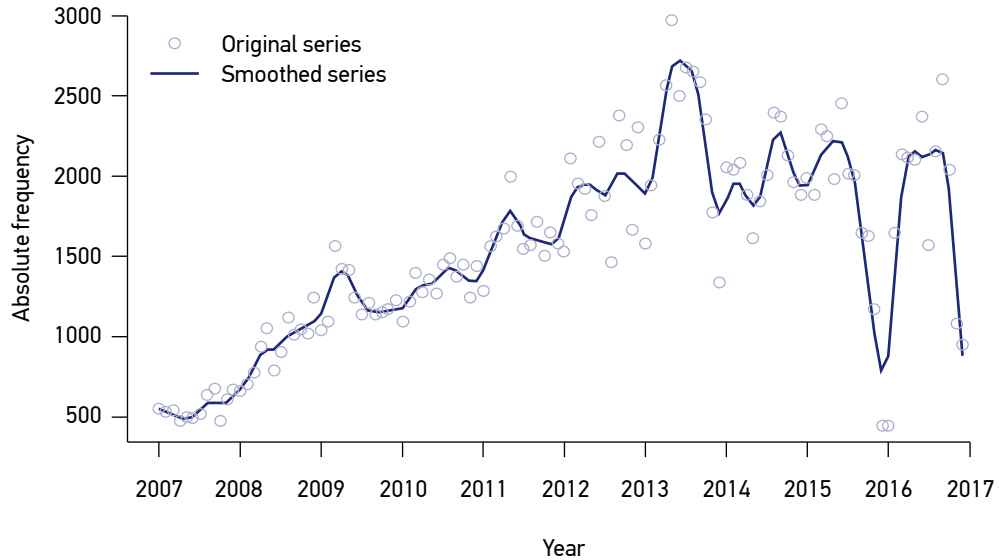


Figure 3. Monthly tendency of the number of infractions due to distracted driving, when the driver was using a cell phone. Brazil, 2007 to 2016.

DISCUSSION

In this study, distracted driving corresponds to the cause of one third of the accidents with victims in the Brazilian federal highways, with increasing tendency in the number of victims in these accidents until 2011 and posterior reduction; this pattern was also observed in the macro-regions, except for the Southeast. These time series analyses were carried out considering Comstock's warning regarding the challenge faced by epidemiologists, who often have to deal with what he calls "imperfect data"¹³.

The imperfection of the data used in this study started with the inaccuracy of the "distracted driving" expression. The definition used by the Federal Highway Police, described before, contemplates several and diverse situations, which include the use of a cell phone and taking the wrong path, but also not looking in the rear-view mirrors.

Besides, the expression "distracted driving", as it is being used in Brazil, has a different meaning in the Portuguese language ("*falta de atenção à condução*"), which would be translated as "lack of attention"⁶. For the WHO, driver inattention and distraction are not equivalent words, so it is necessary to make a semantic distinction. Distracted driving is triggered by an external event, which captures the attention of the driver and makes him/her deviate from the task of driving, such as to answer the cell phone. On the other hand, driver inattention concerns a situation or an event that makes the driver pay less attention to the task of driving, for example, introversion ("shutdown") and inwardness⁷. Therefore, the lack of attention used by the Federal Highway Police is considered by the WHO as distraction. It is worth to mention that, in 2017, the Federal Highway Police changed the variable referring to the cause of accident in the base available in their website, extinguishing the "others" category. Besides,

the cause “lack of attention” became “distracted driving”. There was the incorporation of the category “pedestrian’s lack of attention”. It is not possible to know, however, if before that period the few records (2.67% of the total, in 2017) related to this cause belonged to the category “lack of attention” or “others”.

These considerations about the inaccuracy of the term expose the fragility of the analyzed data, which, as mentioned, are the only ones regarding distracted driving in the national territory.

The WHO has warned for the role played by the cell phone in the production of distracted driving as cause of traffic accidents^{6,7}. The data analyzed in this study do not allow, however, to know the impact of the use of a cell phone on the number of people with injuries caused by traffic in federal highways.

In an attempt of approximation, it is plausible to observe the field of infractions, since the drivers are at higher risk of being involved in the accident. Due to the number of infractions identified in this study, it is observed that the use of a cell phone by drivers in federal highways is a reality in Brazil. It implies that the improper use of this device can be the cause of some accidents with victims, because of the driver’s lack of attention while driving. But this is just a hypothesis, in the incompleteness of the word. It is important to mention that the increasing tendency in the number of infractions observed until 2013 coincides with the period when resources, such as instant messaging applications and social media, became popular in Brazil.

Based on the last Supplement of Access to the Internet and Television and Possession of a Mobile Phone for Personal Use in the 2015 National Household Survey (PNAD), 78.3% of the Brazilians aged 10 years or more have a cell phone, which is a 147.2% growth in relation to 2005¹⁴. In this context of the unprecedented popularization of cell phones, which are in the classrooms and everywhere, these devices are also inside the vehicles. In a study carried out by the Centers for Disease Control and Prevention (CDC), it was observed that, in 2011, the self-reported prevalence of the use of cell phone in the United States, by drivers aged between 18 and 64 years, at least once in the 30 days before data collection, was 69%, and reading or sending text messages, 31%¹⁵.

The driver who uses the cell phone while driving has higher chances of committing other types of infractions, and, as a consequence, having a history of RTI in comparison to the driver who does not use the device¹⁶. However, in several countries, such as Brazil, it is not yet possible to identify the effective contribution of the cell phone in the occurrence of RTI because of the lack, or even the absence, of data, both because of the assistance routine and record of accidents and the development of observational studies that are properly designed with the objective of reducing information bias⁸.

In the two first decades of the XXI century, some national health surveys, such as PNS, PeNSE, The Health Supplement in PNAD and the Violence and Accidents Surveillance Systems (VIVA), in the Viva Survey, have allowed the characterization of risk behaviors for RTI in Brazil.

All of these collected data about the use of the seat belt¹⁷⁻¹⁹ and, except for PNAD²⁰, the use of the helmet. PeNSE¹⁸ also includes the vehicles driven by people aged less than 18 years, and the transportation of passengers by an inebriated driver; VIVA analyzes the use of the safety device for transporting children¹⁹. On the other hand, none of the surveys mentions the use

of a cell phone while driving a vehicle, despite its major importance, since it is able to call the attention of diverse parties, such as the media, public policy makers and the vehicle industry⁸.

Therefore, Brazil still has a considerable gap concerning the role cell phones play in the production of health problems resulting from RTI. However, it is known that it is not something superfluous, considering the most recent strategies of traffic education focusing on the cell phone. Such initiatives are elaborated by institutions such as the National Traffic Department (Denatran)²¹, and very much motivated by the number of traffic tickets applied due to the use of a cell phone inside the vehicles; since 2016, this infraction has been considered “extremely serious”.

Some of the study limitations are related to the specificities of police data and the object of the study, as aforementioned, as well as the statistical methodology used. That is because the Prais-Winsten model does not correct the residual correlation of higher orders, only of the first, which tends to be more relevant anyhow¹¹. The IF of the Federal Highway Police has a time-related limitation, once it identifies the physical status of the person involved in the accident, without a follow-up period. In case of death during the route to the emergency room, for example, the victim is classified as “severely injured”. Besides, there are no data regarding traffic score for the analyzed period.

Despite the insufficiencies in the IS analyzed in this study, the conclusion that distracted driving was the cause of about one third of the accidents with victims in the Brazilian federal highways between 2007 and 2016 is consistent. A monthly increasing tendency in the number of victims due to this cause in Brazil and in most macro-regions was identified until 2011, with posterior reduction. In the Southeast region, the only exception, the growth tendency was observed until mid-2014. The inaccuracy of the “distracted driving” expression compromises the quality of the data, and, as a consequence, so does the sizing of the number of victims of road accidents that can be attributed to this behavioral risk factor. Even though highways are high-speed motorways, the use of a cell phone while driving on them is a fact in Brazil. There was a monthly increase tendency in the number of infractions caused by the use of a cell phone by the driver between 2007 and 2013, which became stationary in the following years. It seems reasonable to assume that the dyad cell phone-driving may be the origin of some accidents with victims due to distracted driving in the country. Considering the importance of this behavioral risk factor in contemporaneity, particularly due to the use of cell phone by the drivers, it is suggested that national health surveys approaching RTI start to contemplate it as soon as possible.

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