

## Truck drivers' traffic accidents in the State of São Paulo: prevalence and predictors

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**Abstract** *The mortality rate of traffic accidents (TA) is high in Brazil. Trucks are the second category of motor vehicles most often involved in TA. However, few studies have addressed the issue of TA among these professionals. The study aimed to estimate the prevalence of TA and their predictors in a sample of 684 truck drivers recruited in the state of São Paulo during 2012 and 2013. We requested participants to answer a research instrument on their personal and occupational data and their involvement in TA and traffic violations. A logistic regression model was developed to identify TA predictors. Almost 11% of the respondents suffered at least one TA in that timeframe. We identified the following TA predictors: having few years of experience as professional drivers (OR = 1.86; CI 95% = 1.05-3.38; p = 0.036); receiving some traffic tickets (OR = 1.91; CI 95% = 1.04-3.66; p = 0.043) and working more than 12 hours daily (OR = 1.84; CI 95% = 1.04-3.24; p = 0.034). Given those results, we suggest the development of a joint action among all the involved social stakeholders in order to negotiate truck drivers' work organization aiming at reducing behaviors that may lead to traffic accidents.*

**Key words** *Traffic accidents, Automobile driving, Motor vehicles, Cross-sectional studies, Epidemiology*

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## Introduction

The World Health Organization (WHO) pointed out that traffic accidents (TA) caused the loss of 1.3 million lives in 2010 (2.2% of all deaths worldwide), placing TA among the ten major causes of death. Furthermore, in that same year, some 20 million to 50 million people were injured due to the TA<sup>1</sup>.

In particular, the high number of deaths and injuries is due to the increase of TA in low- and middle-income countries. Thus, these countries have concentrated 80% of deaths from TA in the world, despite having only 52% of the world motor vehicles' fleet<sup>1</sup>.

In fact, the lack of effective action shall lead TA to be the fifth leading cause of death worldwide by year 2030<sup>2</sup>. Thus, in order to save five million lives, the United Nations (UN) proclaimed the period 2011-2020 as the "Decade of Action for Road Safety"<sup>1</sup>.

In Brazil, the estimated TA mortality rate for the year 2010 was 22.5 deaths / 100,000 inhabitants, higher than the corresponding rate of middle-income countries and the Americas<sup>3</sup>. In this setting, from 1980 to 2011, 980,838 TA-related deaths were recorded in the country, and this figure has been increasing exponentially<sup>4</sup>. In addition, more recently, in 2012, the Unified Health System (SUS), through the Mortality Information System (SIM) and the Hospital Information System (SIH) recorded 44,812 deaths in the country from some TA, as well as 159,152 hospitalizations were recorded for the care of TA victims<sup>5</sup>. Overall, this has resulted in the loss of 1,230,944 years of useful life due to premature death or injury among Brazilians due to TA, especially among men<sup>6</sup>.

Also recently, in 2011, the report on "Accident Statistics" of the National Department of Transport Infrastructure (DNIT) pointed out that 331,652 TA occurred on federal highways, discriminated by type of vehicle, as follows: (a) 179,206 TA involved passenger vehicles; (b) 93,066 were freight vehicles; and (c) 34,635 motorcycles. Thus, according to this information, trucks made up the second largest category of vehicles involved in TA, which also means that three out of ten TA in the country involved freight vehicles<sup>7</sup>. Again, this data is alarming if we consider that just over 3% of the national fleet consists of trucks<sup>8</sup>. In addition, the number of deaths and truck occupants' mortality rate increased by 103.2% and 66% respectively in the

period 1996-2011 in the country<sup>4</sup>. Furthermore, truck drivers are the second category of workers with most sick leave due to temporary disability (32.5%), disability (27.9%) and death (33.2%)<sup>9</sup>.

The Ministry of Health (MOH) classifies TA as preventable or avoidable causes of death<sup>10</sup>. On the other hand, as well illustrated by Waiselfisz<sup>4</sup>, TA cannot be seen as accidental causes of death, such that identifying TA-related factors would lead to a better understanding of this phenomenon, thus enabling the development of specific health and safety policies. In this setting, apart from surveys on statistics of accidents in our country<sup>4,7,11</sup>, few publications have addressed TA in Brazil<sup>12</sup>, and rarely among truck drivers. Few studies available on this topic have suggested that the organization of occupational activity of these professionals is a factor that makes them vulnerable to accidents and diseases<sup>13-15</sup>. Thus, sleep deprivation, excessive daytime sleepiness, psychiatric disorders and substance abuse have already been mentioned as TA-associated factors in this social segment<sup>16-19</sup>, however, these health conditions were collected separately from other possible risk factors.

Engaging in traffic violations has also been mentioned as TA-influencing factor<sup>20</sup>, but both its prevalence and its association with TA in truck drivers samples remains unknown. Whereas this knowledge gap hinders a comprehensive understanding of TA in our country, this study assessed the prevalence of TA in a sample of truck drivers and their related factors by developing a logistic regression model, verifying impacts resulting from the interference of sociodemographic and occupational data, the use of psychoactive substances, emotional stress, sleep deprivation and poor sleep, psychiatric disorders and engaging in traffic violations. Thus, in this study, we proposed to evaluate these factors in an integrated manner, raising hypotheses about the conditions that could interfere with the ability of professional truck drivers to drive safely in the public roads of our country.

## Methodology

A non-probabilistic sample of 684 truck drivers traveling on three highways of São Paulo (President Dutra, Fernão Dias and Canon Domenico Rango-ni) was recruited in service stations of civil organizations Social Service of Transport (SEST) and the National Training Service of Transport (SENAT).

Since the research that originated this study aimed to evaluate the impact of psychoactive substance use on truck drivers' level of attention, individuals who presented at least one health condition that interfered in this assessment were excluded from the sample, namely: (a) has difficulty in viewing colors; (b) is under the therapeutic use of psychoactive drugs; (c) has reported a head injury event (TCE) in life; (d) has suffered an episode of loss of consciousness in life; (e) has a history of neurological diseases; as well as (f) has tested positive for HIV.

Truck drivers were approached by a staff recruiter at SEST-SENAT service stations, in the above highways and informed about the research. Following their consent to participate, drivers were sent to interviewers who explained study objectives, the time needed to answer research instruments, always emphasizing the principles of voluntariness and confidentiality of information. The informed consent form was read by interviewers and, when agreement, signed by the participants. All participants were evaluated individually in indoor, safe and quiet rooms whose use had been intended solely to carry out the activities of this study.

Truck drivers who actually participated in the study were then asked to answer a research tool already used with Brazilian truck drivers by Leyton et al.<sup>21</sup> for recording demographic and occupational information. As part of this instrument, we asked participants about their personal experience with the use of alcohol and other drugs, as well as engaging in transit and TA violations. The identification of these three variables was made according to three indicators: involvement *in life* ("at least once in a lifetime"), *over the year* ("at least once in the twelve months preceding the interview") and *during the month*.

Involvement in traffic violations include: (a) driving without wearing a seatbelt; (B) driving at higher speed than the maximum allowed on public roads; (c) bickering or fighting in traffic; (D) having received some traffic ticket for any reason; and (e) drunk-driving.

Involvement in TA was considered only during the truck driver performance of professional activity through the question "have you ever been involved in some TA?" The definition of TA explained to participants was used by the WHO<sup>22</sup>, that is, a TA is a fatal or non-fatal damage that would have occurred from a collision involving at least one moving vehicle on public roads.

Participants were also asked to answer research tools for evaluating other mental health variables, whose effect was controlled in the logistic regression model detailed later in this paper, which include: (a) Emotional stress ("Lipp's Stress Symptoms Inventory" – LSSI); (b) psychiatric disorders ("Mini International Neuropsychiatric Interview" – MINI): we used the sections related to major depression, mania, hypomania, generalized anxiety, panic disorder, agoraphobia, and posttraumatic stress disorder); sleep deprivation and quality ("Pittsburgh Sleep Quality Index" – PSQI); and (d) daytime excessive sleepiness ("Epworth Sleepiness Scale" – ESS).

Later, all the research instruments were corrected and submitted for double entry in Epi-Info v.6.0 software. Information consistency verifications and relevant corrections were made. Then data were transferred and analyzed in the R software, version 2.15.1. Categorical variables were expressed as percentages (%) and numerical variables (initially expressed as mean  $\pm$  standard deviation) were categorized according to the median value, except for the variable "working day", whose cutoff point (equal to 12 daily hours) followed proposal by Law No. 12.619/2012, which regulates the working day of truck drivers of our country. The outcome variable of this study was the involvement in TA in the year, enabling the clustering of participants into: TA Yes; TA No.

Bivariate analyzes were conducted using Pearson 2 test and Fisher's exact test. Variables that achieved  $p < 0.25$  were included in a logistic regression model and selected through the "backward elimination" method. Odds ratio (OR, CI = 95%) was calculated as a measure of association. The null hypothesis was rejected when  $p < 0.05$ . The model fit was assessed by analyzing the residual component of deviation and Cook's distance. The diagnosis of multicollinearity was evaluated by the impact on the estimates of parameters and through the Variance Inflation Factor (VIF).

This study is in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee (CEP), Faculty of Medicine, University of São Paulo, USP.

## Results

Of the 684 truck drivers who agreed to participate in the study, 149 (22.0%) were excluded for having met at least one of the exclusion criteria of the original research, so we just considered the

information for 535 truck drivers. The number of included and excluded subjects from the study who originated this study, distributed according to the highway in which they were recruited is shown in Figure 1.

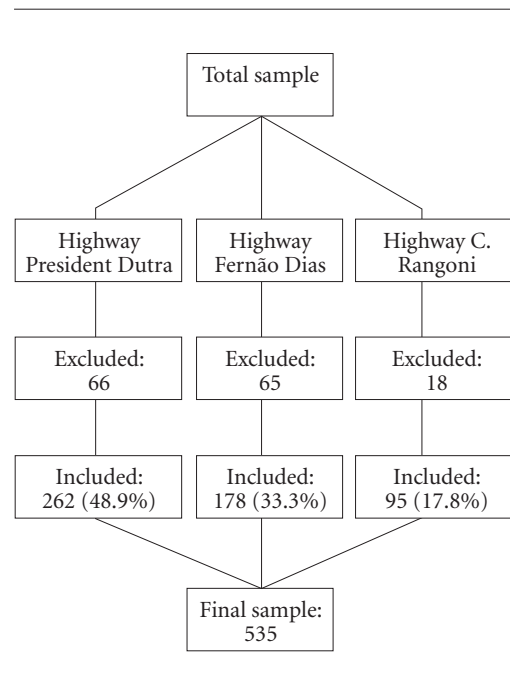
All participants were men, young adults (mean age  $36.5 \pm 7.8$  years) with low schooling (mean  $8.6 \pm 2.3$  years), and most of them (81.1%) declared being married or having a stable relationship with someone. In relation to occupational conditions, participants reported working as professional truck drivers with an average experience of  $12.5 \pm 8.1$  years; 61.2% of them were hired by some company at the time of interview, 78.9% worked during the day (morning/afternoon) and had an average of  $12.2 \pm 3.9$  daily working hours (Table 1).

Among them, 48.0% reported having suffered some TA at least once in their lifetime, 10.6% in the year and 2.6% in the period of thirty days prior to the interview. On the other hand, 98.1% of participants reported having engaged in at least one traffic violation in their lifetime, 89.0% in that year and 73.5% in that month.

Participants who had already suffered some TA *in the year* had a higher daily workload ( $p = 0.022$ ) than peers who reported not having suffered a TA. No other sociodemographic or occupational variable was associated with TA outcome in the year (Table 1).

Particularly regarding traffic violations, 60.2% of participants reported having been fined for any reason, 61.3% drove without wearing a seatbelt, 52.9% drove the vehicle at speed greater than the maximum allowed by the public road, 12.7% sparred or discussed in traffic and 6.9% drove under the influence of alcohol in the period relating to the twelve months prior to the interview. Almost 90% of participants reported having engaged in any of these behaviors (Table 2) and all participants who had undergone TA in the year had committed at least one traffic violation in the same period.

Regarding the use of drugs, 77.6% of participants reported having used alcohol and 31.0% of any illicit drug in the year. At the time of interview, 12.4% of participants would have a possible diagnosis of emotional stress and 7.5% a psychiatric disorder. Again, six to ten participants slept less than seven hours a day and had poor sleep quality (according to the criteria of the Pittsburgh Sleep Quality Index – PSQI) and, possibly because of that, 33.8% of respondents would already be suffering from excessive daytime sleepiness (Table 2).



**Figure 1.** Illustrative chart of the sample of the distribution of truck drivers driving along the highways of the State of São Paulo, from June 2012 to September 2013, according to the inclusion and exclusion criteria of the research that originated this study (adapted from Eckschmidt<sup>23</sup>).

Note: Highway C. Rangoni = Highway Canon Domênico Rangoni

In addition, drivers who were involved in some TA in the year had received traffic tickets more often than their peers who did not suffer TA ( $p = 0.028$ ). Otherwise, no mental health variable was associated with TA outcome in the year (Table 2).

Table 3 shows the results of the logistic regression model developed. The years of experience as a professional driver ( $p = 0.036$ ), the daily working hours ( $p = 0.034$ ) and having received traffic tickets in the year ( $p = 0.043$ ) were the variables that emerged as TA-associated factors through the adjusted logistic regression model. Following verification of the impact of sociodemographic, occupational and mental health variables (including the use of psychoactive substances), the following results were observed: (a) participants with fewer professional years were more likely to have suffered TA than more experienced professional peers (OR = 1.86); (b) participants who drove more than twelve hours per day were more

**Table 1.** Sociodemographic and occupational information of truck drivers approached on highways of the State of São Paulo, as per TA event reporting in the twelve months prior to the interview (N = 535). Highways of the State of São Paulo, from June 13, 2012 to September 25, 2013.

Variables	Traffic Accident						OR	CI95%	p-value
	Total		No		Yes				
	N	%	N	%	N	%			
Age (years)	36.5 ± 7.80		36.7 ± 7.27		34.9 ± 8.31				
≤ 35	260	48.7	226	47.4	34	59.6	1.64	0.91-3.01	0,107
> 35	274	51.3	251	52.6	23	40.4	1		
Schooling (years)	8.6 ± 2.29		8.6 ± 2.29		8.7 ± 2.33				
≤ 9	261	48.8	237	49.6	24	42.1	1		0,286
>9	274	51.2	241	50.4	33	57.9	1.35	0.78-2.36	
Marital Status									
Single	101	18.9	89	18.6	12	21.0	1.16		0,657
Not single	434	81.1	389	81.4	45	79.0	1	0.59-2.29	
Years of professional experience	12.5 ± 8.14		12.6 ± 8.10		11.5 ± 8.52				
≤ 11	283	52.9	246	51.5	37	64.9	1.74		0,055*
>11	252	47.1	232	48.5	20	35.1	1	0.98-3.09	
Service type									
Hired	327	61.2	287	60.2	40	70.2	1.56		0,143
Self-employed	207	38.8	190	39.8	17	29.8	1	0.86-2.83	
Work shift									
Day	422	78.9	376	78.7	46	80.7	1.13		0,721
Night and other	113	21.1	102	21.3	11	19.3	1	0.57-2.27	
Working day (hours)	12.2 ± 3.90		12.1 ± 3.94		13.0 ± 3.45				
≤ 12	354	66.2	324	67.8	30	52.6	1		0,022*
>12	181	33.8	154	32.2	27	47.4	1.89	1.09-3.30	
Total	535		478		57				

CI 95% = Confidence interval with a confidence coefficient of 95%; \* statistically significant =  $p < 0,05$ .

likely to engage in TA than those driving less daily hours (OR = 1.84); and finally, (c) drivers who had received some traffic ticket were more likely to engage in TA than those who had not been fined (OR = 1.91).

## Discussion

The sociodemographic description of the convenience sample of recruited truck drivers in this study is consistent with previous studies<sup>13,15,19,24</sup>.

In occupational terms, participants had extensive experience as truck professional drivers, taking excessive daily workload, which is also consistent with previous studies<sup>13,15,17,19,24</sup>. In this regard, Souza et al.<sup>25</sup> previously pointed out that almost half of the sample of interviewed truck drivers exceeded 16 daily working hours.

Regarding the outcome variable of this study, 10.6% of participants reported having suffered

some TA in the year. This prevalence is very close to that previously identified by Ulhoa et al.<sup>19</sup>, which is 10.9% in the year. However, it was not possible to compare our results with studies by Souza et al.<sup>25</sup> and Silva-Junior et al.<sup>24</sup> because of methodological differences, especially regarding the extent of TA, which then suggests the possibility of terms standardization for future studies.

As for the TA-related factors among approached truck drivers, we observed that little experience as a professional driver, having received some traffic ticket within one year and, finally, daily workload were associated with the outcome of TA after verifying sociodemographic, occupational and mental health variables.

Almeida et al.<sup>26</sup> pointed out that few years of experience as professional driver increase the likelihood of involvement in TA. In a study conducted with motorcycle professional drivers, Diniz et al.<sup>27</sup> pointed out that years of experience are crucial to the establishment of strategies and

**Table 2.** Traffic violations, drug use and mental health of truck drivers on highways of the State of São Paulo, as per the TA event reporting in the twelve months prior to the interview (N = 535). Highways of the State of São Paulo, from June 13, 2012 to September 25, 2013.

	Traffic Accident						OR	CI95%	p-value
	Total		No		Yes				
	N	%	N	%	N	%			
Risk behavior in traffic									
Received traffic ticket									
No	213	39.8	198	41.4	15	26.3	1		0.028*
Yes	322	60.2	280	58.6	42	73.7	1.98	1.07-3.67	
Drove without seat belt on									
No	207	38.7	186	38.9	21	36.8	1		0.762
Yes	328	61.3	292	61.1	36	63.2	1.09	0.62-1.92	
Drove above allowed speed limit									
No	252	47.1	223	46.7	29	50.9	1.18	0.68-2.05	0.546
Yes	283	52.9	255	53.3	28	49.1	1		
Quarreled and bickered in transit									
No	467	87.3	418	87.5	49	86.0	1		0.679
Yes	68	12.7	60	12.5	8	14.0	1.14	0.52-2.52	
Drunk drove									
No	498	93.1	445	93.1	53	93.0	1		> 0.999
Yes	37	6.9	33	6.9	4	7.0	1.02	0.35-2.98	
Any traffic violation									
No	59	11.0	59	12.3	0	0.0			0.005*
Yes	476	89.0	419	87.7	57	100.0			
Drug use and mental health									
Use of alcohol									
No	120	22.4	108	22.6	12	21.0	1		0.792
Yes	415	77.6	370	77.4	45	79.0	1.09	0.56-2.14	
Use of at least one illicit drug									
No	369	69.0	334	69.9	35	61.4	1		0.191
Yes	166	31.0	144	30.1	22	38.6	1.46	0.83-2.57	
Stress (LSSI)									
No	468	87.6	422	88.5	46	80.7	1		0.092
Yes	66	12.4	55	11.5	11	19.3	1.83	0.89-3.75	
With a psychiatric diagnosis (MINI)									
No	494	92.5	444	93.1	50	87.7	1		0.146
Yes	40	7.5	33	6.9	7	12.3	1.88	0.79-4.47	
Sleep quality (PSQI)									
Fair	231	43.2	208	43.5	23	40.4	1		0.649
Poor	304	56.8	270	56.5	34	59.6	1.14	0.65-1.99	
Excessive Sleepiness (ESS)									
Non existent	354	66.2	321	67.2	33	57.9	1		0.163
Moderate/Severe	181	33.8	157	32.8	24	42.1	1.49	0.85-2.60	
Hours of sleep									
≤ 7	325	60.8	294	61.5	31	54.4	1		0.298
>7	210	39.2	184	38.5	26	45.6	1.34	0.77-2.33	
Total	535		478		57				

LSSI = "Lipp's Stress Symptoms Inventory", for the assessment of emotional stress symptoms; MINI = "Mini International Neuropsychiatric Interview", for the assessment psychiatric disorders; PSQI = "Pittsburgh Sleep Quality Index", for the Assessment of sleep Quality and sleep disorders; ESS = "Epworth Sleepiness Scale", for the assessment of daytime excessive sleepiness; CI95% = Confidence interval with a confidence coefficient of 95%; \*statistically significant =  $p < 0.05$ .

**Table 3.** Estimates before and after logistic regression model adjustment on factors associated with the occurrence of TA among truck drivers approached on highways of the State of São Paulo (N = 535). Highways of the State of São Paulo, from June 13, 2012 to September 25, 2013.

Variables	Before adjustment			After adjustment		
	OR	CI 95%	p-value	OR	CI 95%	p-value
Age (years)						
≤ 35	1.64	0.91-3.01	0.107	--	--	--
> 35	1					
Years of professional experience (years)						
≤ 11	1.74	0.98-3.09	0.055	1.86	1.05-3.38	0.036*
> 11	1			1		
Service type						
Hired	1.56	0.86-2.83	0.143	--	--	--
Self-employed	1					
Working day (hours)						
≤ 12	1		0.022	1		0.034*
> 12	1.89	1.09-3.30		1.84	1.04-3.24	
Received traffic ticket						
No	1		0.028	1		0.043*
Yes	1.98	1.07-3.67		1.91	1.04-3.66	
Use of at least one illicit drug						
No	1		0.191			
Yes	1.46	0.83-2.57		--	--	--
Stress (LSSI)						
No	1		0.092			
Yes	1.53	0.89-2.59		--	--	--
Psychiatric diagnosis (MINI)						
No	1		0.146			
Yes	1.36	0.70-2.65		--	--	--
Excessive Sleepiness (ESS)						
Non existent	1		0.163			
Moderate/Severe	1.49	0.85-2.60		--	--	--
Total						535

LSSI = "Lipp's Stress Symptoms Inventory", for the assessment of emotional stress symptoms; MINI = "Mini International Neuropsychiatric Interview", for the assessment psychiatric disorders; PSQI = "Pittsburgh Sleep Quality Index", for the assessment of sleep Quality and sleep disorders; ESS = "Epworth Sleepiness Scale", for the assessment of daytime excessive sleepiness; OR = Odds Ratio; CI95% = Confidence interval with a confidence coefficient of 95%; \*statistically significant =  $p < 0,05$ .

operating methods that prevent driver's involvement in TA. In any case, although our results are consistent with this information (despite association between professional years and TA has arisen only after adjusting the logistic regression model), it is also important to consider the direct relationship between the time of experience in the profession and the driver's age. In this regard, a review of literature on the association between age and the TA involvement rate among truck drivers found that younger people were more often involved in TA<sup>28</sup>. In fact, in our country, these data are confirmed by the fact that young truck

drivers have the highest frequency of Work Accident Report (CAT)<sup>9</sup> records, reflecting the global trend, as previously pointed out by the WHO, that TA predominantly affect the youngest<sup>4</sup>.

In this study, all (100%) truck drivers who reported having suffered TA in the year had engaged in at least one traffic violation in the same period, a higher prevalence than the 75% reported by Zhang et al.<sup>20</sup>. Among the surveyed traffic violations, 60.2% of study participants reported having received some traffic tickets in the year, which emerged as a TA-associated factor in adjusted logistic regression model.

In this setting, Gates et al.<sup>29</sup> argued that committing any traffic violation increased the likelihood of truck drivers' risky behavior while driving. Consistent with this information, Brodie et al.<sup>30</sup> identified in a study conducted with fatally injured truck drivers that 85% of those fatalities have resulted from the victim's reckless behavior in traffic.

Certainly, the issue of traffic violations is associated with drivers' individual characteristics. In this case, Marin & Queiroz<sup>31</sup> had suggested a direct relationship between the drivers' personality, the issue of traffic violations and the occurrence of TA. In this regard, the literature systematic review developed by Araújo et al.<sup>32</sup> pointed out that impulsivity is a personality trait that interferes with traffic violations that can then culminate in accidents.

However, we believe that drivers' personality is not *per se* a prominent factor for the occurrence of TA, so that one could not blame only the truck driver for its occurrence. In this regard, although we have observed that committing traffic violations has been a TA-associated factor, this may have been a professional strategy to dodge aversive occupational contingencies. Thus, it is necessary to proceed with a systematic evaluation of these conditions pervading occupational activities of these workers, so that environmental interventions are developed and implemented in order to reduce the risk of accidents. In a broader sense, one must avoid a reductionist interpretation of accidents, which is driver error-centered, disregarding the social and organizational context in which they occur<sup>27</sup>.

In this setting, it should be noted that excessive workload emerged as a TA-associated factor among truck drivers. In fact, according to Soccolich et al.<sup>33</sup>, the likelihood of some critical TA-culminating security event increases with increased working hours. Thus, among truck drivers, it may be that the impact of increased working hours on the outcome of TA is mediated by physical and mental symptoms stemming from the intense workload. Therefore, it is common for truck drivers who drive for long time periods to have worse perception of the quality of life, as well as many body aches<sup>18,34</sup>.

This worsened perception of life extends to mental health complaints, such that the extended workday is seen as one of the major stressors of the profession, determining the appearance of minor psychiatric disorders such as depression,

anxiety, fatigue, irritability, insomnia, memory loss and impaired concentration<sup>19</sup>. In addition, it is also very possible that the effect of the excessive workload on the TA among truck drivers is mediated by the use of psychoactive substances used in order to prolong wakefulness and driving hours<sup>35</sup>, as well as the sleep debt hours and its consequences<sup>16,25</sup>. Anyway, all these variables (emotional stress, psychiatric disorders, substance abuse, sleep quality and excessive daytime sleepiness) were verified in the adjusted logistic regression model, suggesting that future studies can further investigate the relationship between them and truck drivers' working hours.

Van der Beek<sup>36</sup> proposed that reducing the number of daily hours worked is one of the protection strategies to ensure truck drivers' health and safety, increasing the likelihood of their proper recovery after a typical day of work, thus reducing the likelihood of their involvement in TA. In our country, it has long been suggested to adjust hours worked by truck drivers. In this regard, Law No. 12.619/2012, known as the Rest Law<sup>37</sup>, recently regulated professional drivers' driving time, ensuring a minimum one-hour meal interval and daily rest of at least eleven hours, suggesting a daily work period of up to twelve hours.

Thus, we believe that social stakeholders' compliance with the law in this setting is relevant, however, it will not be enough to change behavior in accordance with the previously pointed out by Diniz et al.<sup>27</sup>. Thus, it is necessary to develop a joint action among truck drivers, contractors, representatives of civil organizations and public authorities with a view to negotiating the organization of the work of this category to reduce risk behaviors that may ultimately evolve toward TA. In addition, it is necessary that the development of laws and regulations governing the profession, as well as prevention strategies and other interventions rely on the knowledge and skills accumulated by truck drivers, which, of course, shall facilitate the acceptance and adherence to developed measures and consequently promote increased safety in our roads. Above all, it is important to consider that the few currently available measures flout the central importance of these professionals to the Brazilian economy and undermine recommendations of the International Labour Organisation (ILO), which states that every individual has the right to dignified, safe and healthy work<sup>38</sup>.



### Study strengths and limitations

This study is unique in the sense that it assessed truck drivers' TA-associated factors, following verification of the confounding effect of sociodemographic and occupational characteristics, mental health and the issue of traffic violations. In addition, survey of traffic violations is an underexplored subject among freight vehicle drivers. Thus, the inclusion of this topic in this study walks *pari passu* to the WHO recommendations which have encouraged member countries to develop and monitor compliance with laws that promote best practices regarding driving risk behaviors so that there may be a further overall decrease in number of TA and deaths by 2020<sup>1</sup>. In any case, the results of our study will

enable a deeper understanding of TA in our country and, of course, assist in the formulation of public policies geared to this professional category. However, some limitations of this study are also worth mentioning. Given the cross-sectional feature, this research is only a picture of the situation, so that the association between the outcome variable (TA) and explanatory variables cannot be understood as cause-effect. The use of non-probability sample is another limiting factor, because data cannot be generalized to all the Brazilian truck drivers' population. In addition, TA event was evaluated according to participants' account, which can limit results by a possible memory bias. Following assessment of all the results, authors encourage further studies so that these hindrances are overcome.

## Collaborations

LG Oliveira, CVD Almeida, LP Barroso, MJC Gouvea, DR Muñoz and V Leyton participated in the project design, analysis and interpretation of data, wording and critical evaluation of the paper, the approval of the final version of this paper and were jointly responsible for all work aspects.

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