

## Injuries caused by firearms treated at Brazilian urgent and emergency healthcare services

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**Abstract** *This paper analyzes the medical care given at Brazilian urgent and emergency health-care services to people injured by firearms in 2014. A cross-sectional study was carried out on care given to patients with firearms injuries in 24 capital cities of Brazilian states and in the Brazilian Federal District, included in the VIVA Survey. Simple and relative frequencies of the variables related to the patients and to the event were calculated, and a logistic model for complex samples was applied adopting care for firearms injuries patients as outcome. The results show the following percentages of care events as caused by firearms: 0.7% for the category 'other accidents (other than transport-related accidents)', 1.5% for self-inflicted injuries, 15.9% for injuries due to assault, and 65.1% of cases arising from legal intervention. The care given was predominantly to young male adults (age 20-39), of mixed race and with a low level of schooling. The most common injuries were: to arms and legs; and to multiple organs. The paper concludes by discussing the efforts to control firearms held by the public in Brazil, and how they can lead to severe and lethal outcomes in quarrels and interpersonal disputes.*

**Key words** *Firearms, Health survey, Urgent and emergency care*

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## Introduction

Injuries caused by firearms cause irreversible damage, incapacity to work, and demands on the health sector to provide care at various levels of complexity, from pre-hospital to physical and mental rehabilitation of victims. They thus increase the costs of Brazil's Unified Health System (SUS), and also costs of other sectors such as the economy itself, the national social security system, and the families involved<sup>1</sup>.

Possession and use of firearms have been considered to be important factors contributing to the high levels of violence, principally lethal violence, in Latin American countries<sup>2-4</sup>.

A firearm was the means used in 75% of all homicides taking place in 2012 in low and medium-income countries in the Americas as a region, and the instrument most used for all acts of violence<sup>4</sup>. In Brazil, firearms were used to inflict fatal injuries in 45,068 people in 2014. Of these, 94.9% were cases of assault, 2.2% resulted from self-inflicted violence, 2.1% were without known intention, and 0.8% were due to accidents. Of the total of deaths by homicide in 2014 (59,681), 71.6% were caused with a firearm<sup>5</sup>.

The presence of a firearm in acts of violence increases the probability of death or serious injuries. As well as the high degree of lethality, firearms were responsible for 29% of the 61,268 hospitalizations resulting from assault or suicide attempts in Brazil in 2014<sup>5</sup>.

A study in 2006 of urgent and emergency care units in 34 Brazilian municipalities and in the Federal District showed that, of 4,854 care events for victims of violence, 13.4% involved injuries produced by firearms<sup>6</sup>. However, there are few Brazilian studies on the injuries caused by firearms that have been treated in the emergency hospital services, since the data traditionally analyzed are those of the Hospitalization Information System (SIH) and Mortality Information System (SIM). Some studies have approached such injuries in the context of violence in general<sup>6-8</sup>, or suicide attempts<sup>9</sup>, or accidents<sup>10</sup>, but they do not analyze them based on the two groups of events: accidents and violence.

This paper provides an analysis of care given to firearms injury patients in urgent and emergency service units in Brazil in 2014. It completes a series of five research projects carried out by the Brazilian Health Ministry to ascertain demands in the health sector, specifically in the urgent and emergency service units, in relation to the adverse effects caused by accidents and violence.

## Methodology

This is a cross-sectional study of medical care given to patients with injuries caused by firearms in urgent and emergency services of 24 Brazilian State capitals and the Federal District, included in the 2014 VIVA (*Sistema de Vigilância de Violências e Acidentes – Violence and Accident Supervision System*) Survey.

The sampling of the survey included all care events taking place on 30 consecutive days in the period September to November, in 12-hour shifts previously chosen by lot, in 86 urgent and emergency service units of the public health network.

Data were collected from the individual accident and violence notification record form, created and standardized by the Health Ministry, which contains the data on the socio-demographic profile of the person served, the event, the injuries and the evolution of the case.

Simple and relative frequencies were calculated for the variables selected for description of the patients, their injuries and the care given: gender, age group, race/skin color, level of schooling, remunerated activity, use of alcohol by the victim in the preceding six hours, day on which the care was given, care given in another service, location of the occurrence, whether on the way to or from work, part of the body affected, degree of intention, and how the case evolved. All these variables were analyzed by the following subgroups of external causes in the ICD-10 (INCREASED, 10<sup>th</sup> revision): W00–X59 – Other external causes of accidental injury (except transport); X60–X84 – Intentional self-harm; X85–Y09 – Assault; and Y35–Y36 – Legal intervention and war operations, recorded on the notification file as Legal intervention. For the purpose of comparison with previous studies that analyzed VIVA data, a choice was made not to expand the sample in the descriptive analysis of these subgroups. However, to verify the precision of the estimates, expansion was carried out only in relation to the most frequent subgroups, and for adjustment of a statistical model.

To analyze the risk and protection factors in relation to injuries from firearms, a logistical regression model for complex samples was built, having as outcome 'care given to patients with firearm injuries'. Value 1 was assigned to the outcome 'firearms injury' (the sum of care events classified as: other accidents, self-harm, assault and legal intervention, caused by firearms); and value zero to 'other injuries' (the sum of care events for other accidents, self-harm, assault or

legal intervention caused by means other than firearms).

The risk exposure variables used in the model were: age (0–29 (young) and 30 or over (adult)); level of schooling (0–8 years, 9 years, or more); gender (male, female); race/skin color (white, black+black-mixed; and Asiatic+indigenous); perpetrator (father/mother+partner/former-partner+other family member, friend/acquaintance, and legal-agent+unknown+other), and place of occurrence (home, school+recreation-area+others, and public streets).

The process of adjustment of the model was carried out with initial inclusion of the variables relating to the patient (gender + age + schooling + race/skin color) and all were found to be statistically significant. After this stage the variables relating to the event were included (location of the event, and perpetrator of the aggression), in which the variable 'race/skin color' ceased to be significant (p-value 0.29), thus resulting in it being withdrawn from the final model (backward elimination)<sup>11</sup>.

Injury by firearms was related to the explanatory variables gender, age, level of schooling, perpetrator, and location of the event. For this regression analysis, the software SPSS version 20 was used, in the complex samples module. The associations and odds ratios between firearms injuries and the co-variables selected in the survey were evaluated.

The 2014 VIVA Survey was approved by the National Research Ethics Committee (CONEP), of the Health Ministry.

## Results

The 2014 VIVA Survey recorded 22,399 health-care treatments for the sum of the groups 'other accidents (excluding transport)', assault, self-harm and legal intervention. In only 3.9% of these cases were the injuries caused by firearms (Table 1).

As Table 1 shows, considering only victims of assault and events involving a public legal agent, the percentage of people injured by firearms is considerably greater. We also note that among patients with injuries caused by firearms, there is a predominance (79.7%) of victims of assault, characterized as attempted homicide.

In the analysis with the expanded sample for more frequent events, it is seen that the estimated prevalence for the subgroup of 'other accidents' was 11.8% – with CI of 9.4% to 14.7%; and for

the subgroup 'assaults' it was 81.2%, with CI of 77.4%–84.4%.

The profile of patients served for this type of injury shows a predominance of males, young adults aged 20 to 39, with racial type black-white mixed-race, and low level of schooling (0-8 years' study – corresponding to primary education). These characteristics were similar for all the types of occurrence, as is seen in Table 2.

For males, the estimates for the subgroup of other accidents in the expanded sample were 10.8% (CI 8.5%–13.7%), and for assaults 82% (CI 78.5%–85.1%); and for females these estimates were 19.4% (CI 9.8%–34.6%) and 73.9% (CI 57.9%–85.3%), respectively. As can be seen, the estimates for males were more precise than those observed in females. The estimates of the subgroups 'other accidents' and 'assaults' were more precise among young people than adults. For 'other accidents' the estimate was 10.9% (CI 8%–14.5%); for 'assaults' it was 81.9% (CI 77.6%–85.6%). In relation to skin color there was greater precision in the prevalences in the 'group black and mixed-race', compared to the others, both for 'other accidents' (12%, CI 9.2%–15.4%) and for 'assaults' (81.8%, CI 77.9%–85.2%).

A major proportion of the patients receiving care for firearms injuries in all the types of events said they had remunerated activity, except those that were involved in legal intervention. Among the latter, only one quarter had work at the time of the injury. On the other hand, it is important to point out that for a total of 44.1% of the care events this information was not recorded.

Among the patients receiving care for firearms injury, a significant proportion of those that were victims of self-harm (71.4%) and accidents (41%) had already been attended by other services due to that injury. This 'peregrination' was more frequent among those that suffered assault (28.2%) and among those that were victims of legal intervention (16.7%). The most common location of firearms injury events was the public streets, except for suicide attempts, which were more frequent in the victim's home. The weekend was the period in which the most accidents occurred (Sunday), and the most assaults (Saturday and Sunday); legal interventions were most frequent on Fridays. In all the types of event the great majority of the cases was not related to the route between home and work. A large proportion of those injured by accidents and by self-harm said that the event was not intentional, in contrast to those who suffered assault and legal intervention (Table 3).

**Table 1.** Distribution of provision of care for accidents and cases of violence (total, and by firearms) given in urgent and emergency service units in 24 Brazilian state capital cities and the Federal District, by subgroup of specific external causes. VIVA, 2014.

Subgroups of specific external causes	Number of care events		
	Total	Due to firearms	
	N	N	%
Other accidents (excluding transport)	17,450	128	0,7
Self-harm injuries	477	7	1.5
Assault	4,406	697	15.9
Legal intervention	66	43	65.1
TOTAL	22,399	875	3.9

**Table 2.** Percentage distribution of care given to patients with firearms injuries in urgent and emergency service units in 24 Brazilian state capital cities and the Federal District, by profile of patients and subgroup of specific external causes. VIVA, 2014.

		Subgroups of specific external causes (N = 875)			
		Other accidents (excl. transport)	Self-harm injuries	Assault	Legal intervention
Gender	Male	89.1	100.0	90.2	93.0
	Female	10.9	0	9.8	7.0
Age group	0-9	0.0	0.0	1.2	0.0
	10-19	23.8	28.6	26.1	31.7
	20-39	59.5	57.1	61.4	68.3
	40-59	14.3	0.0	9.5	0.0
	60 and over	2.4	14.3	1.8	0.0
Skin color/race	White	14.2	14.3	17.3	19.0
	Black	25.2	28.6	16.7	16.7
	'Yellow'	0.8	0.0	1.0	7.1
	Mixed-race	59.0	57.1	64.1	57.2
	Indigenous	0.8	0.0	0.9	0.0
Level of schooling	0-4 years	32.4	60.0	31.7	18.2
	5-8 years	33.4	20.0	35.5	54.6
	9-11 years	29.6	20.0	28.9	22.7
	12 +	4.6	0.0	3.9	4.5
Has remunerated activity	Yes	52.3	42.9	45.6	23.3
	No	41.4	42.9	42.3	32.6
	Not known	6.3	14.2	12.1	44.1

In the expanded sample, public streets were the location with the highest precision of estimates of other accidents and assault, compared to the other locations analyzed: 8.2% (CI 5.6%–11.6%) and 81.8% (CI 77.1%–85.7%), respectively.

Considerable percentages of the patients receiving care had not made use of alcohol, although the consumption of alcohol in the six

hours prior to the event was present in 30% of the legal interventions, 25% of the assaults, 16.7% of the self-harm injuries and 8.5% for accidents.

Legs and arms were the parts of the body most frequently affected by accidents; arms in the case of suicide attempts; and legs, and multiple organs, in cases of assault and intervention by public agent, showing that these last two groups of events had the most serious injuries (Table 4).

In occurrences of aggression and legal intervention the most frequent development of the case was hospitalization, once again indicating their severity; in the other groups of injuries, the development was toward hospitalization and also discharge. In spite of the lower frequency in relation to the other groups, it appears to be strange that three patients who received care for self-harm injury were discharged and only one was referred to outpatient monitoring.

In the expanded sample it was seen that location in the public streets had higher precision of estimates for injuries to arms in the subgroup of 'other accidents' (16.7%, CI 10.7%–25.1%), and in multiple organs in the 'assaults' subgroup (87.5%, CI 78.9%–92.9%), compared to the other parts of the body injured.

Table 5 shows the results of the logistic regression statistical model for complex samples and the Wald test. The analysis covered healthcare events for firearms injuries and the other healthcare treatment given and recorded in the 2014 VIVA Survey.

One item that stands out is the protective effect in relation to females: women receiving care in the urgent and emergency service units sur-

veyed had 66% less chance of suffering a firearms injury than men. Young men (under age 30) had a higher risk of being victim of injuries of this type than the 'adults' group (over 30), who had 52% less chance of suffering this type of injury. Similarly, the people with lower levels of schooling seem to be more susceptible to firearms injuries than those with a higher level, who had a 44% lower chance of suffering an event due to this type of instrument.

The chance of suffering assault by firearm from a family member or intimate partner is 97% less than that of suffering assault by an agent of the law or an unknown person. Friends and acquaintances have 81% less chance of being the perpetrators of these violent acts, than the group of 'agents of law' and 'persons unknown'. It is important to highlight that these results should be considered in context: they cannot be amplified to the cases of self-harm and accidents because, obviously, in accidents and suicide attempts this analysis does not apply.

The analysis of the location of the event showed that in the school environment and areas of recreation the chance of an event involving a firearm taking place is 54% lower than in the

**Table 3.** Percentage distribution of healthcare actions for people with injuries caused by firearms in 24 Brazilian state capital cities and the Federal District, by characteristics of the events and subgroup of specific external causes. VIVA, 2014.

		Subgroups of specific external causes (N = 875)			
		Other accidents (excl. transport)	Self-harm injuries	Assault	Legal intervention
Location of the event	Home	26.6	42.8	15.9	2.3
	School	0.8	0.0	0.3	0.0
	Recreation area	4.7	0.0	1.9	0.0
	Public street	40.5	28.6	65.7	93.0
	Other	21.1	28.6	13.2	4.7
	Not known	6.3	0.0	3.0	0.0
Day of the week of the event	Sunday	22.6	0.0	18.8	14.0
	Monday	14.1	14.3	10.0	16.3
	Tuesday	13.3	14.3	13.1	16.3
	Wednesday	15.6	0.0	14.1	16.3
	Thursday	13.3	28.6	10.8	7.0
	Friday	8.6	14.2	15.6	23.1
	Saturday	10.2	28.6	16.5	7.0
	Not known	2.3	0.0	1.1	0.0
Event took place on the way to or from work?	Yes	22.2	20.0	17.3	0.0
	No	77.8	80.0	82.7	100.0
Intentionality, in the patient's view	Intentional	36.6	28.6	83.5	85.0
	Not intentional	57.7	71.4	11.9	10.0
	Don't know	5.7	0.0	4.6	5.0

**Table 4.** Percentage distribution of healthcare actions for people with firearms injuries, by location of injury in 24 Brazilian state capital cities and the Federal District, by progress of the case and subgroup of specific external causes. VIVA, 2014.

		Subgroups of specific external causes (N = 875)			
		Other accidents (excl. transport)	Self-harm injuries	Assault	Legal intervention
Location of injury in the body	Legs	28.3	14.3	26.8	34.8
	Multiple organs	11.7	14.3	20.0	20.9
	Arms	25.0	42.8	15.4	4.7
	Chest/back	10.9	0.0	12.3	16.3
	Abdomen/thigh	7.8	14.3	10.8	9.3
	Other region of head/face	10.9	14.3	10.1	4.7
	Neck	2.3	0.0	2.3	0.0
	Genitals/anus	0.0	0.0	0.9	2.3
	Mouth/teeth	2.3	0.0	0.7	2.3
	Spine/medulla	0.8	0.0	0.7	4.7
Development of case	Hospitalization	42.6	42.9	49.0	64.3
	Discharge	44.3	42.9	31.4	16.7
	Referral to outpatient facility	5.7	14.2	7.3	0.0
	Referral to other service	6.6	0.0	6.4	7.1
	Death	0.0	0.0	4.7	9.5
	Avoidance / flight	0.8	0.0	1.2	2.4

**Table 5.** Result of the model adjusted for logistical regression for complex samples.

Variable	Category	OR	Lower limit (OR)	Upper limit (OR)	Wald F	p-value
(Intercept)					434.419	< 0.001
Gender	Male	1.00			30.455	< 0.001
	Female	0.34	0.23	0.50		
Age	Young (age 0-29)	1.00			31.241	< 0.001
	Adult (30+)	0.48	0.37	0.62		
Schooling	1-8 years' schooling	1.00			8.969	< 0.003
	9+ years' schooling	0.66	0.51	0.87		
Aggressor	Legal agent/unknown/other	1.00			55.389	< 0.001
	Father/mother/partner/former partner/other family member	0.03	0.01	0.07		
	Friend/acquaintance	0.19	0.13	0.29		
Location of event	Public street	1.00			10.599	< 0.001
	Home	1.14	0.76	1.72		
	School/recreation area/other	0.46	0.32	0.66		

public streets. Here it needs to be pointed out that, although the variable 'location of the event' was statistically significant in the model, one of its categories, 'home', was not.

In this model, the selected variables account for 26% of the variability of firearms injuries ( $R^2 = 0.264$ ).

## Discussion

At first sight the small percentage of care events for victims of firearms in the urgent and emergency services participating in the 2014 VIVA Survey could give the false impression that the prevalence/importance of these events was low, but it



needs to be pointed out that they are injuries of considerable severity, and in which possibly a large proportion of the people injured in this way do not even receive care from an urgent or emergency service unit, due to their high degree of lethality. This can be seen through the mortality figures for these causes in 2014 – in which 36.2% of the deaths were caused by a firearm<sup>5</sup>.

A point that calls attention is the high percentage of firearms injuries in the ‘legal intervention’ subgroup that are caused by bellicose action and confrontation between the police and the population. This issue is also expressed in the data for mortality, and has been a subject of criticisms and debates by academic authors who conclude that the Brazilian police is one of the most lethal in the world<sup>12,13</sup>. On this point, Lotin<sup>12</sup> counted 17,663 deaths arising from these interventions in Brazil over the period 2009–2015. The majority of them were cases of young people with the same characteristics observed in this present study.

The high level of young men with low level of schooling and of black or black-mixed race among the victims, seen in the analysis of the care reported in the 2014 VIVA Survey reproduces what has been seen in analyses of mortality, in hospitalization, and has been widely demonstrated in the literature on the subject<sup>1,13-18</sup>. In the subgroup of assaults, firearms injuries have historically had percentages similar to those in the VIVA Survey: In 2006 the percentage was 15.1%<sup>6</sup>, in 2011 it was 14.9%<sup>19</sup>, and in 2014 it was 15.9%.

The data indicate the ‘peregrination’ of some patients between various health services before arriving at the urgent and emergency service unit that gave the care and reported the case. People who attempted suicide appear to have found a greater difficulty for receiving care than the others, which may indicate a deficiency of the healthcare network in caring for these cases.

On the care for patients with self-harm injuries, Machin<sup>20</sup> discusses that there appears to be a resistance on the part of health professionals since the intentionality of the act committed by the person against him/herself negates the notion of care for a human body that is ill – these patients often being denied care or treated with indifference or aggression and with procedures that impose suffering and pain. They are, he says, seen as people who chose to have those injuries and are getting in the way of healthcare for patients who truly deserve it.

At the same time, it is interesting to note a lower degree of ‘peregrination’ among the vic-

tims of ‘legal intervention’ – this may be the result of the police having caused the injury and at the same time taken the victim to the health unit, ensuring that person getting faster service.

The high percentage of care events in which patients with self-harm injuries stated that they were not intentional could be covering a subjective phenomenon in which they regret and negate their act; this has been found in various studies on the subject<sup>21</sup>. Another point which attracts attention is that just under 37% of the accidents have been perceived as intentional. Such findings lead to certain suppositions: possibly, that there may have been an error in the classification of this variable; or that some stories of violence may have been covered up by being denominated as accidental. Some authors highlight the difficulties of establishing the intentionality of events<sup>22,23</sup>.

This study shows a differentiation between the parts of the body in which the injuries occurred, by type of event. Those with more severity, which affected multiple organs, were more common in the subgroups ‘assault’ and ‘legal intervention’. Another sign of the severity of these injuries is that a large proportion of them required hospitalization. The study by Maciel et al.<sup>24</sup> which analyzed victims of firearms injuries receiving care in an emergency hospital in Goiânia (State of Goiás) showed that the injuries recorded appear to have been more serious, since the regions of the body most affected were the chest and back (42.0%), followed by the abdomen (37.3%) and the arms (28.0%). It is important to point out that in that study the authors analyzed only intentionally caused injuries.

The participation of firearms in some accidental events, but above all in violent events and mortality, is very large. Curiously, there are only few studies that specifically deal with the question of firearms in Brazilian society and its impact on the health of the people injured, principally in relation to the temporary or permanent complications or disablement caused by the firearms.

In fights and conflicts in which the outcome could have been less serious, when a firearm is present the potential for a result involving injury and indeed even death is very high. Marques and Pollachi<sup>7</sup> highlight that there is a consensus that having a firearm does not guarantee the individual’s safety – on the contrary, it increases the risk of people’s exposure to possible reactions in events in which they are victims of crime in which the aggressor is also armed. These authors warn that, going against this finding, the demand

for firearms has been growing in Brazilian society in recent years, which appears to reflect people's sensation of insecurity much more than the real growth of the homicide rate in the country.

When analyzing care given to people with firearms injuries, it is also necessary to mention the present Brazilian context in relation to the control of use of this instrument that is so lethal. Brazilian Law 10826 of 2003, known as the Disarmament Law, aimed to reduce the high levels of death by homicide and accidents involving firearms, through measures restricting carriage or acquisition of firearms. In 2005 the Brazilian population was consulted in a referendum, and rejected the article of that Law which prohibited sales of firearms and ammunition throughout the country. Several authors discuss the factors that led to this result, which was considered surprising by the protagonists of the disarmament campaign in the country – who found themselves instigated to rethink the basis of the debate<sup>25</sup>. A recent law now before the Lower House of Congress aims to repeal the Disarmament Law, consequently enabling more firearms and more ammunition to reach the hands of more and younger people.

In view of the above, it is important to invite Brazilian society to reflect on the relationship between firearms and the injuries and deaths that they cause. The data analyzed in this study, on care given to victims of injuries caused by these arms, represent a small part of those who need to access the services of the Single Health System. Of the 45,068 people killed by events involving a firearm in 2014, 25.1% did receive care in a health establishment, but died as a result of their wounds<sup>5</sup>. Does an increase in the number of arms held by the civil population translate into more security and less victims? There is controversy on the control of firearms: On the one hand surveys indicate that this control reduces certain rates of violence such as homicide and suicide; and on the other, in developed countries, there is little evidence on the efficacy of that control<sup>26</sup>.

Felix<sup>27</sup>, analyzing the effect of apprehension of firearms on homicide rates in the State of São Paulo, found a negative correlation, indication that an increase in the number of firearms apprehended by the police did have as its counterpart

reduction of intentional homicides taking place in the period 2009–12. According to this study, for every 10 firearms taken out of circulation it was estimated that more than two lives (2.3 lives) were saved. At the same time, Scorzafave *et al.*<sup>28</sup> concluded their survey on the incidence of deaths from firearms in the State of Paraná, affirming that the campaign of disarmament in the State of Paraná had no effect on the rate of deaths from firearms in the first six months, indicating that in the short term this policy was not effective for reduction of crimes involving firearms.

Finally, it is important to point out that the data of the VIVA Survey, held in 2014, reflect only part of the reality of injuries caused by firearms in Brazil. Its records do not cover the totality of the urgent and emergency services of the country, but only those in state capital cities that were indicated as referrals for these cases and which agreed to take part in the survey. The result is restriction of the data, which cannot be generalized. Other limitations could be mentioned, such as the size of the sample, which might have adversely affected the stratified analyses of some variables relating to certain subgroups of external causes. As already mentioned, the option of not expanding the sample makes possible comparisons between the previous studies relating to the VIVA Survey, but working with the non-expanded data resulted in lower numbers in relation to the subgroups of the self-inflicted injuries and the legal interventions. Thus, to ensure greater confidence in the precision of the estimate, the work was done only with expanded samples for the subgroups of more frequent events.

We further highlight, as a limitation of the data, some precariousness in the filling in of certain variables such as the location of the event, in 6.3% of the accidental events, and whether the patients had some remunerated activity, which, for example, was recorded for 44.1% of those receiving care as a result of 'legal intervention'. In relation to the variable 'perpetrator' it is important to keep this interpretation in context, because in cases of self-harm the perpetrator of aggression is the person him/herself. However, this specific subgroup contributes only 1.5% of the variable indicating injury by firearms.



## **Collaborations**

AP Ribeiro and ER Souza worked on all aspects from conception to final write-up of the article; and CAM Sousa was responsible for the methodology and statistical analyses.

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