

## Accidental falls in urgent and emergency care: results of the 2014 VIVA Survey

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**Abstract** *This cross-sectional study aimed to analyze the cases of falls in urgent and emergency care services of 24 Brazilian capitals and the Federal District participating in the 2014 VIVA Survey. We sought to describe the epidemiological profile of victims, characterizing the event and the severity of injuries it caused and to perform an association study. We calculated the simple and relative frequencies of variables and performed multivariate logistic regression analysis for complex sample data in order to verify associations between falls and selected variables. Fall victims profile results show a predominance of males, age groups 0-9years and 20-39 years and brown skin. Outcomes show that 56% fell from own height, public road was the most frequent place of falls and 92.7% of people receiving care for falls suffered some kind of injury, of which most common were bruises, sprain and strains, followed by cut/laceration. In the final model, we were able to associate fall with gender, age, education, disability and place of the event. The likelihood of falls at school is 14% higher than at home, but falls in recreation areas, public roads and other places are less likely than at home.*

**Key words** *Fall, Health survey, Urgent and emergency care, Logistic regression*

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## Introduction

Fall is an accidental event that results in the change of the individual's position to a lower level in relation to his/her initial position<sup>1</sup>, with inability to correct it timely<sup>2</sup> and lean over the ground. When an individual falls on his back on a seat, for example, this is not considered a fall. A fall requires balance disruption and a postural control system failure to compensate for this disruption<sup>3</sup>.

Body stability depends on the proper receipt of information through integrated sensory, cognitive, central nervous system and musculoskeletal components<sup>4</sup>.

Falls are classified as accidental events and, along with traffic accidents, other accidental causes, interpersonal and self-inflicted violence make up a group of mortality and morbidity causes named "external causes" under the International Classification of Diseases / ICD, tenth revision. This large group of causes are responsible for more than five million deaths per year worldwide, which corresponds to 9% of all deaths<sup>5</sup>.

In Brazil, 13,327 deaths by falls were reported in 2014, corresponding to 8.5% of deaths from external causes. Among the 1,118,048 hospitalizations for this group of causes, under the Unified Health System (SUS), 390,204 (34.9%) were due to falls; among them, 53.1% were of adults, 26.1% elderly, 11.6% adolescents and 9.1% children in 2015.

In its most recent version (2008), the study on the *Global Burden of Disease in Brazil* found that 10% of the total burden of disease estimated in the country was due to external causes. The DALY or disability-adjusted life years indicator pointed out that assaults and homicides accounted for 38.8% of the burden, traffic accidents 29.1% and falls 8.3%. This last accidental cause was more important in the YLD (Years Lived with Disability) component, due to its high potential to generate disability. Fall-related DALY is more important in the Southeast and South, which may be due to the highest proportion of elderly people in those regions<sup>5</sup>.

Although adult population is also affected by falls, literature strongly emphasizes the importance of falls in children, adolescents and the elderly, given their greater frequency in these groups and the high incapacitating percentage, especially in the elderly.

Falls were the most common accidents among patients treated in urgent and emergency

care services participating in the 2009 VIVA Survey, representing 37% of all accidental events that led people to seek these services<sup>6</sup>. Some 30% of attendances for falls in emergency wards are for children aged 0-9 years, and 11.5% for the elderly. Males are the ones who suffer more falls in the population under 49 years, and females are the main victims in the age group above 50 years<sup>7</sup>.

Falls stand out in children due to the characteristics of their development, such as curiosity and lack of motor coordination. Studies reveal that falls among children are more common in boys. This is due to differences in behavior between boys and girls, as well as cultural issues that influence choices for different types of recreation<sup>8</sup>.

Regarding the elderly, these events are an important health issue and lead to increased morbidity, reduced functional capacity and early institutionalization. Around 30% of the elderly suffer at least one fall per year; among the elderly above 80 years, this proportion increases to 40% and can reach 50% among the institutionalized elderly<sup>9</sup>. Falls occur due to the combination of intrinsic factors, such as some physiological changes arising from aging: decreased visual and auditory acuity, muscle weakness, gait change, disability, use of multiple medications (polypharmacy), previous falls, osteoporosis, Parkinson's disease, cognitive decline and other; as well as extrinsic factors involving aspects of the environment, such as adequate structure of housing and public roads<sup>10-12</sup> and violence<sup>13</sup>.

A single event of this nature can bring many consequences, such as fear of falling, fractures and varying degrees of injuries, disabilities, impaired walking ability, removal from work and ultimately death<sup>8,11</sup>. Falls also affect health services increased cost<sup>14</sup>.

Due to the size and impact on health conditions described above, this study aims to analyze the cases of falls seen in urgent and emergency care services of 24 Brazilian state capitals and the Federal District participating in the 2014 VIVA Survey. It specifically seeks to describe the epidemiological profile of victims, characterize the event and severity of injuries thereof and conduct an association analysis.

## Methodology

This is a cross-sectional study that analyzes data from falls treated in urgent and emergency care services located in 24 Brazilian state capitals and

the Federal District, participating in the 2014 Violence and Accident Surveillance System (VIVA) Survey.

The VIVA Survey is part of a series of studies conducted at the Ministry of Health to analyze the trend and describe the profile of violence (interpersonal or self-inflicted) and accidents (traffic, falls, burns, among others) treated at Brazilian urgent and emergency care facilities. The VIVA Survey was previously conducted in 2006, 2007, 2009 and 2011.

The 2014 survey data collection was performed in 30 consecutive days from September to November in 12-hour shifts selected by probabilistic draw; data collected were used as primary sampling units (PSU) in services providing urgent and emergency care under the Unified Health System, which were used as strata of the sampling plan. The survey as a whole included care provided in urgent and emergency care services located in 24 capitals and the Federal District, and 11 selected municipalities, covering 86 services and totaling 55,950 attendances.

The completion of the accidents and violence notification form standardized by the Ministry of Health enable data collection; this procedure was applied to patients attended in selected services and shifts. This form contained: (1) general data; (2) patient data; (3) patient's full address; (4) event data; (5) accident data; (6) violence data; (7) injuries sustained and case development data. Simple and relative frequencies of the selected variables were calculated: gender, age group, race/skin color, education, paid work, medical insurance or health plan, disability, victim's alcohol intake in the last six hours, city where care was provided, day and time of care, fall type, place of event, event occurred at the workplace, affected body part, type of injury, intention and evolution.

The following variables were used in the multivariate logistic regression analysis for complex sample data: Fall (yes or no) as the dependent variable and age (years), gender (male and female), education (0-4 years, 5-8 years, 9-11 years, 12 years and over), disability (yes or no), alcohol intake in the last six hours (yes or no), paid work (yes or no) and place of event (home, school, recreation area, public roads and others) as exhibits, as indicated by the Freitas et al. study<sup>15</sup>.

The regression analysis was adjusted using SPSS software, version 20<sup>16</sup>, in the complex sample module, applying logistic regression to evaluate associations and odds ratios between falls and other covariates selected in the survey.

Covariates were included one by one in the regression model and a statistical significance ( $p$ -value  $< 0.05$ ) was found, withdrawing from the model those whose  $p$ -value was greater than 0.05 according to Wald's test. One of the education variable categories (category 9-11 schooling years) was not significant. Thus, we decided to make a new categorization of the education variable (Education2), with two new categories: 0-8 schooling years and 9 schooling years and over<sup>17,18</sup>. The procedure of automatic variable selection was described by Hosmer and Lemeshow<sup>17</sup> as part of the adjustment methodology of generalized linear models, called Backward, and is the automatic withdrawal of the model's non-significant variables. This study carried out the manual removal to consider the epidemiological criteria described by Freitas et al.<sup>15</sup> and the statistical significance criterion.

Odds ratios (OR) were calculated to evaluate the associations between fall and gender, education, disability, place of event and age, which were statistically significant in the final model obtained in the regression.

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

## Results

The 2014 VIVA Survey recorded 51,001 attendances for accident injuries in urgent and emergency care services. Among them, 17,080 (33.5%) were from people who had suffered falls. The Northeast was the one that had most treatments for injuries caused by this accidental cause (37.2%), followed by the North (22.4%), Southeast (19.3%), Midwest (14.3%) and South (6.9%). State capitals that most stood out in these attendances were Rio de Janeiro (8.7%), Brasília (6.6%), João Pessoa (6.4%), Maceió (5.7%) and Manaus (5.4%). The remaining capitals appear with percentage below 5%.

Table 1 shows the predominance of: males in the victims of falls' profile; age group 0-9 years, followed by group of 20-39 years; brown skin color; up to 4 years schooling; lack of paid work; no health covenant or plan and no disabilities.

Table 2 shows the characteristics of falls, by treated patient gender. Much fell from own height or same level, home was the most frequent place of falls and most victims suffered the accident on the way to work.

Children in the group 0-9 years suffered falls from same level (47.9%) at home (72.5%). However, falls from other levels (12.4%), from bed (14.9%) or other furniture (10.2%) were also important. Same level falls (66.1%) at home (35.0%) were significant in the group of adolescents aged 10-19 years, as were those among adults aged 20-59 years (53.1%) at home (49.1%). A very significant percentage of these events occurred in ladder/step (22.1%) and other places (23.6%). The main type of fall affecting the elderly over 60 years is from own height (67.3%), which usually occurs at home (74.1%).

Most people receiving care for falls (92.7%) suffered some type of physical injuries. The most common were bruises, sprains and strains, followed by cut/laceration, as shown in Table 3. Around 22.3% of falls caused serious injuries such as fractures, amputations and traumas. Noteworthy is the category poisoning / burns resulting from fall-related injuries, which deserves further investigation.

Women receiving care mostly sustained more common minor injuries, such as bruises, sprains and strains, and among men, besides these, also noteworthy were fractures, amputations and traumas, which are more serious injuries. The upper and lower limbs were the most affected body parts, followed by head and neck. Almost 80% of cases evolved toward discharge.

The analysis by age group showed that, among children, the most common injuries were bruises, sprains and strains (38.6%), followed by cuts and lacerations (27.5%); minor injuries (bruises, sprains and strains) stand out in other age groups. Among adults (40-59 years) and elderly, the percentage of fractures, amputations and traumas were significant (21.7% and 29.8%, respectively), as well as cuts and lacerations among the elderly (16.9%).

Among children, the most affected body parts were head and neck (54.7%), followed by upper and lower limbs (38.6%); for the remaining age groups, upper and lower limbs come first, followed by head and neck, with lower percentages. The most common evolution of care in all age groups was discharge, but it is important to note that 19.7% of the elderly required hospitalization.

Most victims of falls received care on Mondays (18.7%) and Tuesdays (17.4%) in the afternoon (37.4%) and evening (31.1%). Lower percentages of people sought health services in the morning (26.7%) and the first hours of the morning (4.8%).

Table 4 shows the statistical results of the logistic regression model for complex samples and the Wald's test. The final model may be represented by the equation  $Fall \sim 0$  (Interception) + 1\*Gender + 2\*schooling + 3\*disability + 4\*Place of event + 5\*Age + (error).

It is worth noting that women are more likely to suffer falls compared to men who, in the model, showed a 41% lower risk of being victims of this accidental event; the group with less education (up to 8 years schooling) is 19% more likely to suffer falls compared to the group with 9 or more years schooling; having a disability was associated with the occurrence of fall, with 61% higher likelihood of being a victim of this event. The probability of falls at school is 14% higher than at home, but there seems to be a protective effect in recreation areas, on public roads and in other places, and the likelihood of occurrence of these events in these locations is lower and stand at 4%, 75% and 49%, respectively, when compared to home.

The analysis for the victim's age variable indicated that the probability of falls among the elderly (60 years and over) is 205% higher than the 20-39 years group. Compared to young adults, children had an 87% higher risk of falling and those with 40 to 59 years had a 52% higher risk.

## Discussion

The analysis of attendances for falls in urgent and emergency care services shows that they were declining proportionately, compared to previous surveys: in 2006 they represented 40.2% of all accident cases; in 2007, this percentage fell to 36%<sup>19</sup>; and in 2011, it further dropped to 30.9%<sup>20</sup>. However, in 2014, it started to increase again, reaching 33.5% of attendances for accidents. Nevertheless, caution is required regarding these results since they do not cover all of the attendances in the country, although they include services indicated as reference for such cases in cities that joined the VIVA Survey. Thus, data cannot be generalized for the entire country or the municipalities included in the survey, which is one of the limitations of this study.

There was a predominance of males and patients with less schooling as is usually the case in other events related to external causes. Young adults between the ages of 20 and 39 years were the most affected and the main type was the same level fall in both sexes and all age groups.

**Table 1.** Profile of patients who suffered a fall treated at urgent and emergency care facilities participating in the VIVA Survey in 24 Brazilian state capitals and the Federal District, 2014, by gender.

	Gender				Total	%
	Male	%	Female	%		
<b>Age group</b>						
0 to 9	2,566	28.0	1,716	21.8	4,282	25.1
10 to 19	1,697	18.5	1,040	13.2	2,737	16.1
20 to 39	2,389	26.1	1,848	23.5	4,237	24.9
40 to 59	1,577	17.2	1,689	21.4	3,266	19.2
60 and over	928	10.1	1,586	20.1	2,514	14.8
<b>Race/Skin Color</b>						
Brown	5,235	57.6	4,073	52.0	9,308	55.0
White	2,381	26.2	2,631	33.6	5,012	29.6
Black	1,263	13.9	914	11.7	2,177	12.9
Yellow	161	1.8	168	2.1	329	1.9
Indigenous	51	0.6	51	0.7	102	0.6
<b>Schooling</b>						
0 to 4	3,060	42.5	2,698	42.1	5,758	42.3
5 to 8	1,818	25.3	1,327	20.7	3,145	23.1
9 to 11	1,920	26.7	1,913	29.8	3,833	28.2
12 and over	399	5.5	474	7.4	873	6.4
<b>Paid work</b>						
Yes	3,415	38.8	2,362	31.0	5,777	35.2
No	5,388	61.2	5,263	69.0	10,651	64.8
<b>Health covenant or plan</b>						
Yes	554	6.2	536	7.0	1,090	6.6
No	8,328	93.8	7,125	93.0	15,453	93.4
<b>Disability</b>						
Yes	392	4.4	393	5.1	785	4.7
No	8,610	95.6	7,360	94.9	15,970	95.3

**Table 2.** Characterization of falls suffered by patients treated at urgent and emergency care facilities participating in the VIVA Survey in 24 Brazilian state capitals and the Federal District, 2014, by gender.

	Gender				Total	%
	Male	%	Female	%		
<b>Type of fall</b>						
Same level	4,817	52.8	4,684	59.7	9,501	56.0
Ladder/Step	1,292	14.2	1,388	17.7	2,680	15.8
Other levels	961	10.5	473	6.0	1,434	8.5
Bed	492	5.4	513	6.5	1,005	5.9
Other furniture	418	4.6	419	5.3	837	4.9
Hole	267	2.9	240	3.1	507	3.0
Roof/Slab	375	4.1	58	0.7	433	2.6
Scaffolding	299	3.3	11	0.1	310	1.8
Tree	198	2.2	64	0.8	262	1.5
<b>Place</b>						
Home	4,441	49.0	5,068	64.9	9,509	56.4
Public road	1,394	15.4	1,257	16.1	2,651	15.7
Other	1,481	16.4	779	10.0	2,260	13.4
Recreation area	938	10.4	203	2.6	1,141	6.8
School	802	8.9	502	6.4	1,304	7.7
<b>Event of fall on the way to work</b>						
No	1,422	26.8	881	20.0	2,303	23.7
Yes	3,886	73.2	3,514	80.0	7,400	76.3

**Table 3.** Characterization of injuries caused by falls suffered by patients treated at urgent and emergency care facilities participating in the VIVA Survey in 24 Brazilian state capitals and the Federal District, 2014, by gender.

	Gender				Total	%
	Male	%	Female	%		
Type of injury						
Bruise / Sprain and Strain	4,262	47.3	4,455	57.5	8,717	52.0
Fracture / Amputation / Trauma	2,191	24.3	1,554	20.1	3,745	22.3
Cut / laceration	1,886	20.9	1,049	13.5	2,935	17.5
No injury	547	6.1	578	7.5	1,125	6.7
Poisoning / burn	128	1.4	111	1.4	239	1.4
Body part affected						
Upper and Lower Limbs	4,785	54.87	4,484	60.68	9,269	57.5
Head / Neck	2,561	29.37	1,725	23.34	4,286	26.6
Spine / Chest / Abdomen	799	9.16	726	9.82	1,525	9.5
Multiple Organs / Regions	555	6.36	438	5.93	993	6.2
Genitals / Anus	21	0.24	17	0.23	38	0.2
Evolution						
Discharge	6,974	78.1	6,301	81.7	13,275	79.8
Hospitalization	1,232	13.8	867	11.2	2,099	12.6
Outpatient referral	636	7.1	488	6.3	1,124	6.8
Other	92	1.0	52	0.7	144	0.9

**Table 4.** Result of logistic regression-adjusted model for complex sample.

Variables/Reference	OR	Wald F	p-value
Interception			
Gender		2,117	0.46
Female (Reference)	1.00	287.17	<0.001
Male x Female	0.59		
Schooling		29.52	<0.001
9 years and over (Reference)	1.00		
0 to 8 years vs. 9 years and over	1.19		
Disability		34.12	<0.001
No (Reference)	1.00		
Yes vs. No	1.61		
Place of event		311.56	<0.001
Home (Reference)	1.00		
School vs. Home	1.14		
Recreation area vs. Home	0.96		
Public road vs. Home	0.25		
Other vs. Home	0.51		
Age		110.84	<0.001
20 to 39 years (Reference)	1.00		
0 to 9 years vs. 20 to 39 years	1.87		
10 to 19 years vs. 20 to 39 years	1.15		
40 to 59 years vs. 20 to 39 years	1.52		
60 years and over vs. 20 to 39 years	3.05		

The significant percentage of people who fell at work or on their way to work points to a portion of the population that is mainly made up of young adults, who are exposed to work-associated accidents that generate absenteeism, social and economic losses and also require extended health care treatment for their injuries. This is evident in some studies such as the one of Junior et al.<sup>21</sup>, which included 110 work-related accident victims receiving care at the Regional Emergency Care Facility of Sorocaba, São Paulo. Authors found that most of them were male (77.27%), aged between 20 and 39 years (38.18%) and that the two main causes of accidents were motorcycle (46.4%) and fall (21.8%). A significant percentage of these events occurred on the way to work (57.3%), slightly more than one third of cases (38.3%) evolved to cure and more than half (58.8%) had temporary disability<sup>21</sup>. In the 2011 VIVA Survey, a third of attendances for accident victims was for a work-related event (33.1%); among these, 23.1% suffered falls<sup>22</sup>.

Contrary to findings of the 2014 VIVA Survey, in which children fell more from own height and at home, that profile was different in other studies. Among children in the age group 0-12 years, receiving care for fall in the emergency department of a children's hospital in the US, the most common fall was object-derived. Falls from bed or chair were more frequent among those under

2 years, mainly causing head injury. The group 5-12 years was more susceptible to falls from playground equipment, with mostly fractures of the upper limbs<sup>23</sup>.

Worth noting in the results is the fact that, while men have fallen more often, women are at greater risk. Home has proven to be a dangerous place for falls of people of all ages, but school has emerged as particularly significant in the occurrence of falls among adolescents (10-19 years). Home appeared as a place of greater risk than the recreation area, public road or other places. However, we must emphasize that school was the most likely location for falls than home, which shows the need for protection in these environments, seeking to identify and prevent factors that predispose to such accidents.

Several studies have pointed out that home has been the most common place of accidents due to falls in childhood. This accidental event was the predominant type of home injuries in the age group 0-19 years in the US, causing 38% of treatments for injuries in emergency care services<sup>24</sup>. In the under 1 year age group, falls from home furniture, equipment such as walkers, strollers and baby changing table are common. Among children under 6 years, predominant falls are from windows, bed, cot and bunk<sup>25</sup>. Home inadequacies for the elderly have been also indicated in gerontological literature that highlights the presence of carpets, stairs, low light, unstable furniture, wet floors, among others<sup>26,27</sup>.

Regarding the highest probability of falls in schools, little was found in the literature on injuries and risk factors that predispose to this event in the school environment. A study in pediatric emergency services in Portugal found that, among 1,746 children treated for accidents in nine months of observation, 29.1% occurred in the surrounding areas of schools and 18.1% within their premises, where fall was the predominant accident, requiring significant consumption of health resources<sup>28</sup>.

Less severe injuries were most frequent, but it is worth noting that 22.3% of injuries were serious because they involved fracture, amputation and traumas and affected especially the group of children aged 0-9 years (26.0%). As in the 2014 VIVA Survey, the study of Parreira et al.<sup>29</sup> who analyzed the cases of 305 patients treated at the Emergency Care, São Paulo Clinics Hospital, identified that most were adults and sustained minor injuries, frequently limbs; however, a lower percentage of serious injuries in the skull (8.9%) and in the extremities (4.9%) was reported.

Most falls were reported as unintended, as would be expected. However, the finding deserving consideration is the fact that almost 2% of records have informed that falls were intentional, that is arising from an assault. A study by Ribeiro<sup>30</sup> on elderly women admitted to Rio de Janeiro municipal hospitals wards noted that several cases identified as falls during hospitalization were the result of assaults by family members and caregivers.

It is important to mention that this logistic regression analysis compared the care of victims of falls and the group treated for other types of accidents, which does not invalidate the analysis made, but may have underestimated the strength of the observed associations, considering that the "control group" was also exposed to some accidental event. This effect may even have removed the significance of some variables.

It is worth highlighting the good quality of information provided regarding the variables included in this analysis, except in terms of schooling (not reported in 11.6% of records) and whether the fall occurred at work or on the way to work (not reported in 43.2% of cases). However, the percentage of lack of information about schooling in this study still seems quite low in relation to Datasus mortality data presented, in which 27% of those who died from external causes and 22.7% of those who died by falling in 2014 lacked information about their schooling.

Finally, some recommendations are required from the analyses in this study. Evidence indicates that children and the elderly are most at risk of falls and their consequences, especially at home. This is a prime location for preventive measures by health professionals, but also from professionals of other areas who should have a closer look at households and families. In turn, school premises and surrounding areas should be subject to actions and adjustments for the safety of teenagers, who are more exposed to falls in those places. Some studies recommend the use of safety indicators that need to be taken as reference by managers from different areas (including health and education) in order to ensure the effectiveness of actions to prevent injury and trauma produced by accidental events such as falls. Accident prevention based on a public health intervention can be effective when associated with environment adaptation strategies, responses geared to the most vulnerable groups and their specificities and when it directs the evaluation and research results toward community intervention.

### **Collaborations**

The authors AP Ribeiro and ER Souza worked in all steps of the construction of the article; CA Sousa worked in statistical analysis and M Freitas worked writing the article.



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