The characteristics and factors of emergency service visits for falls

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ABSTRACT

OBJECTIVE: To analyze the characteristics of visits to the emergency services that result from falls and to identify the factors associated with these visits.

METHOD: A cross-sectional study of 12,617 visits that resulted from falls, recorded in the National Injury Surveillance System, was carried out. The data were collected in 23 Brazilian capitals and the Federal District between September and November 2009 using cluster sampling. Correspondence analysis was used, which allowed for the joint observation of a large number of qualitative variables.

RESULTS: Most of the victims were male (56.5%), aged 0 to 19 years (45.7%), and identified as non-white skin color (62.2%). The majority of the falls occurred at home (54.6%) and in the street (17.4%); 14.3% were work-related. The predominant types were "falls on the same level" (57.0%) and "falls from a ladder/step" (15.6%). Most of the injuries were classified as sprains, dislocations, bruises, cuts, or lacerations (68.3%). Falls among children occurred mostly at home; among adolescents at school; and among young people at sports facilities. Falls among adults were associated with the work place, including falls from scaffolding, roofs, stairs/steps, and holes and were linked to alcohol use. Falls on the same level resulted in less serious injuries, mostly on the upper and lower limbs, and falls from scaffolding and roofs were associated with more severe injuries and hospitalization.

CONCLUSIONS: The results show that strategies to prevent falls should target residences, schools, and work environments.

DESCRIPTORS: External Causes. Accidental Falls. Emergency Medical Services. Risk Factors. Cross-Sectional Studies.

INTRODUCTION

Many people experience unintentional falls. Falls affect people of all ages, genders, and socioeconomic conditions. Some groups have a greater likelihood of suffering from a fall, such as children, the elderly,[3,13] workers,[15] and athletes.[6] Falls occur in various locations, including the home, public areas, school, the work place, and leisure areas.

The impact of falls on individual health varies greatly. One fall may result in no injury, but another may lead to injuries of various degrees of severity, disability, time off from work, and even death. For example, studies show that these events can seriously affect quality of life for the elderly and that the fear of falling may restrict people's activities and mobility, decrease physical activity, and cause social isolation and depression.[3,13]

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Due to the high frequency of falls, this issue deserves attention in public health as one of the leading causes of mortality worldwide. Estimates from the U.S. show that falls are the principal cause of non-fatal injuries for children and adolescents under 19, and that approximately 2.8 million children[a] and 1.7 million people over 65[1] are treated annually in U.S. emergency services due to falls.

In Brazil, falls affect the national mortality rate and have an even greater impact on morbidity, according to official sources of health information. Data from the Mortality Information System (*Sistema de Informações sobre Mortalidade*, or SIM) show that 9,171 deaths resulted from falls in 2009, which represents 6.6% of total deaths due to external causes.[b] Regarding non-fatal falls, the data from the Hospital Information System of the Unified Health System (*Sistema de Informações Hospitalares do Sistema Único de Saúde*, SIH/SUS) report 320,000 hospitalizations in the Brazilian public health system in 2009 for injuries resulting from falls. This figure represents almost 40% of total hospitalizations due to external causes.[5] In 2006, the Ministry of Health implemented the National Injury Surveillance System (*Sistema Nacional de Serviços Sentinelas de Vigilância de Violências e Acidentes*, or VIVA, survey component) to compile information about accidents and violence that result in emergency care. Studies using information from emergency services and public hospital emergency departments participating in VIVA have shown that external causes account for the largest proportion of emergency visits.[5,10]

Unintentional falls result from a variety of risk factors, and it is difficult to identify a single causal factor in the event of a fall. However, preventative programs and measures may reduce a considerable number of falls. Therefore, it is essential to increase awareness about the dangers of falls and their characteristics, consequences, and risk factors. Studies using data from emergency services are particularly appropriate for this purpose because they provide detailed information about the victims, circumstances, and locations of falls, which are not provided in official mortality and morbidity data. This study aims to describe the characteristics of emergency service visits that result from falls and identify the associated factors.

METHOD

The analyzed data include 12,617 visits resulting from falls in 2009 and are available in VIVA's database of external causes. The methodology for these data has been presented in other publications.[9,c] We define a fall as an incident in which a person unintentionally falls onto the ground or another lower level.

VIVA's 2009 survey component is a cross-sectional study. The data were collected every 12 hours over 30 consecutive days from September to November 2009. We chose different emergency services in the Brazilian Unified Health System (SUS) using probability. The study population consisted of the victims of violence and accidents (external causes) who sought emergency treatment in the selected municipalities.

Academics in nursing and medicine and healthcare professionals conducted the interviews under the supervision of technicians from Health Departments. The collected data were recorded in proper form. We ensured that our collection procedures were standardized by training technicians from the state and municipal health departments, which are overseen by the Health Surveillance Secretary (*Secretaria de Vigilância em Saúde*, SVS) and the Surveillance Coordination for Non-communicable Diseases and Injuries (*Coordenação de Vigilância de Doenças e Agravos Não Transmissíveis da Secretaria*). The data were entered into the software EpiInfo 3.5.1 for each participating municipality's Department of Epidemiological Surveillance. The technical staff from the Ministry of Health examined the consistency of the data using Link Plus software, version 2.0.

The research project included 74 emergency service centers in the Federal District and 23 Brazilian state capitals. The centers were selected based on the criteria of the availability of services for injuries due to external causes, accreditation and registration in the National Register of Health Facilities (*Cadastro Nacional de Estabelecimentos de Saúde*, CNES), number of visits, range of services provided, and treatment success. Additionally, the project considered how each health department's technical staff viewed their emergency care services. We estimated our sample size using the number of visits for injuries due to external causes, recorded in the Hospital Information System (SIH/SUS), and the proportion of visits from VIVA's 2006-2007 research project. Furthermore, we used accuracy criteria for our study's estimates. Based on these criteria (coefficient of variation below 30% and standard error below three), the sample size included at least 750 visits for injuries due to external causes in the Federal District and 1,500 in the state capitals.

Based on previous studies and the large volume of cases treated in these centers, we decided to conduct a

[a] Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Protect the ones you love: falls. Atlanta; [cited 2010 Jun 27]. Available from: http://www.cdc.gov/safechild/Falls/index.html

[b] Ministério da Saúde/ DATASUS - Departamento de Informática do SUS. Tabulador na Web. [cited 2011 Nov 15]. Available from: www.datasus.gov.br

[c] Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Análise de Situação de Saúde. Viva: Vigilância de Violências e Acidentes, 2009. Brasília (DF): Editora do Ministério da Saúde; 2010.

sample of all the cases. To do so, we used single-state cluster sampling.[7,16] The primary sampling unit (UPA) consisted of 12-hour shifts in centers that were selected in each municipality. To randomly select shifts, we assigned two shifts per day to the 30-day collection period for a total of 60 shifts. To define the number of shifts sampled in each facility, we used a ratio of the minimum sample size of primary care visits (2009) for injuries due to external causes and the average number of such visits to the same institution in previous years. To ensure a minimum sample size in the capitals, we randomly sampled two extra shifts.

The following variables were examined: 1) demographics (gender, age, race, and education); 2) event characteristics (type of violence, victim/aggressor relationship, location of occurrence, repeat offense); and 3) referrals to the service network (i.e., referrals to other institutions outside the healthcare sector). To improve our interpretation of the results, we used correspondence analysis, which is an appropriate technique for qualitative variables. Correspondence analysis is equivalent to factor analysis, and the results are presented graphically. The smallest distances between the rows and columns represent the strongest association between the categories, and a greater distance represents disassociation.[14] The correspondence analysis[11] applies mainly to contingency tables, where the rows and columns in the table are dependent on each other. It is also useful for a large number of variables because it allows for a joint, exploratory analysis and summarizes the variability of the data in few dimensions. This analysis was performed using the SPSS software version 13.0.

The algorithm for correspondence analysis that is available in statistical software assumes that the data come from single random sampling. However, Souza et al[17] warned that using this technique on data from complex sampling planes, without considering this source, affects the quality of the results. We considered the sample weights to calculate the proportions of each cell in the table so that the resulting graph will reflect the population proportions. In this context, we first produced the expanded contingency tables (total visits) and, from them, developed the correspondence graph.

The estimator[18] for total visits to emergency services due to accidents and violence in the 30-day period is given by the equation:

$$\hat{Y} = \sum_{h=1}^{L} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} y_{hij}$$

where:

w_{hij} is the sample weight in the h-th stratum (CNES); i-th is the UPA (shift); and j-th is the number of elements in the h-th stratum of i-th UPA.

y_{hij} is the value observed for the variable (1 if it was observed and 0 if not) in the h-th stratum, the i-th UPA, and the j-th number of elements in the h-th stratum of i-th UPA.

The National Commission of Ethics in Research approved the research project (Opinion nº 439/2009, 07/21/2011). Because this study examines national epidemiologic surveillance, we replaced verbal consent from the patient or guardian with a consent form, which was recorded in a proper form. We guaranteed total anonymity and privacy to the patients, professionals, and service managers and the freedom to cease participation in the interview at any time without repercussions for the participant or family, in accordance with Resolution 196/1996.

RESULTS

The data presented below refer to the 12,617 visits due to falls that were registered by VIVA during the 2009 survey. These visits represented between 30.7% and 32.3% of the cases treated during the studied 30-day period in the 74 emergency service centers we sampled in 23 capitals and the Federal District.

Table 1 shows the predominance of male patients, who represented 56.5% of visits. Regarding age, the highest rates were observed among children and adolescents, followed by young adults and the elderly. The 0-9 age group represented 29.3% of the total visits; 10-19-years, 18.1%; 20-29 years, 13.2%; and 60 years and above, 11.5%. These age groups were the most frequent for both females and males. Regarding race, non-white individuals represented 64.2% of the victims (8,100/12,617). We observed that approximately 65.2% of the falls among males were suffered by non-white males (4,767/7,125) and that 58.3% (3,333/5,492) of the falls among females were suffered by non-white women. The largest proportion of the cases aged six or above and with no serious mental disability on record had up to four years of education (36.3%). They were followed by patients who had at least nine years of formal education (23.7%) and those with four to eight years of formal education (23.0%). The distribution of the variable by gender showed no significant differences. A total of 4.3% of the sample, with 4.9% of women and 3.9% of men, reported some type of disability (physical, mental, visual, auditory, and/or other disabilities).

Table 2 shows the characteristics of the events: 13.5% of all visits were work-related falls (16.2% for males and 10.0% for females). Alcohol consumption in the six hours prior to the fall, as reported by the victim, had occurred in 6.3% of the cases, with men reporting a rate 4.1 times higher than that of females (8.9% and 2.8%, respectively). Notably, if we include the service visits for which the interviewer suspected unreported alcohol use, this proportion reaches 11.4% (data not shown).

Table 1. Emergency service visits resulting from falls, according to demographic characteristics. Brazil, September-November 2009.

Variable	Male (n = 7.125)		Female (n = 5.492)		Total (n = 12.617)	
	n	%	N	%	n	%
Age group (years)						
0 to 9	2,188	30.7	1,504	27.4	3,692	29.3
10 to 19	1,498	21.0	788	14.4	2,286	18.1
10 to 14	967	13.6	451	8.2	1,418	11.2
15 to 19	531	7.5	337	6.1	868	6.9
20 to 29	1,009	14.2	658	12,0	1,667	13.2
30 to 39	812	11.4	593	108	1,405	11.1
40 to 49	641	9.0	531	9.7	1,172	9.3
50 to 59	426	6.0	482	8.8	908	7.2
60 and older	527	7.4	920	16.8	1,447	11.5
No information	24	0.3	16	0.3	40	0.3
Skin color						
White	2,279	32.0	2,111	38.4	4,390	34.8
Non white	4,767	66.9	3,333	60.7	8,100	64.2
No information	79	1.1	48	0.9	127	1.0
Schooling (years)						
0 to 4	2,572	36.1	2,009	36.6	4,581	36.3
5 to 8	1,741	24.4	1,160	21.1	2,901	23.0
9 and above	1,574	22.1	1,414	25.8	2,988	23.7
Not applicable	951	13.3	729	13.3	1,680	13.3
No information	287	4.0	180	3.3	467	3.7
Suffers some kind of disability[b]						
Yes	278	3.9	269	4.9	547	4.3

[a] The category "Not applicable" includes children aged 6 or younger.
[b] Physical, mental, visual, hearing, and/or other disabilities. Total number of cases without information for this variable was 208 (1.7% of total).

More than half of the falls (55.9%) occurred at home, followed by the street (16.4%). The proportion of women who suffered falls at home was greater than that of men (64.8% and 49.1%, respectively). The most frequent type of fall occurred on the same level (55.2%), followed by a fall from a step (14.6%). Mild lesions were the most common form of injury: sprains and strains (26.2%), bruises (23.7%), and cuts/lacerations (19.0%). However, 16.8% of the falls resulted in fractures, and 3.9% resulted in traumatic brain injury. Injuries mainly occurred on the upper limbs (29.2%), lower limbs (27.0%), and the head/face (26.1%). The most frequent types of injuries and injury location were the same for women and men. After the emergency response, 79.4% of patients were discharged; 7.1% were hospitalized.

The correspondence analysis showed that two dimensions (sets of associated variables) explained 81% of the total variation; the first explained 52%, and the second explained 29%. Thus, we concluded that there is an association between certain demographic variables and certain characteristics of falls. Dimension 1 consists of the age categories zero to nine years (35%), 20 to 39 years (21%); victims with at least nine years of schooling (11%); and the categories of alcohol (16%), trade/service (15%), residence (12%), and industry/construction (6%). Dimension 2 comprises the age categories of 10 to 14 years, 15 to 19 years, and 60 and above, which contributed 61% of the total, and the categories school and sports facility (67%).

These associations can be better observed when they are represented graphically. Figure 1 shows the association (proximity between points) between demographic variables (age, gender, and schooling), disability, alcohol use reported by the victim, place of fall, and type of fall. This figure brings together the variables that showed an association. This technique helped us to visualize the associations between the low-frequency variables, which cannot be adequately observed with other techniques. Figure 1 shows five groups. The first group shows that falls are associated with sports facilities for adolescents and youth between the ages of 15 and 19. The second group shows an association

Table 2. Emergency service visits resulting from falls, according to characteristics of the fall. Brazil, September-November 2009.

Variable	Male (n=7125)		Female (n=5492)		Total (n=12617)	
	n	%	n	%	n	%
Work-related event						
Yes	1157	16.2	551	10.0	1708	13.5
Consumption of alcoholic beverage[a]						
Yes	635	8.9	155	2.8	790	6.3
Location of fall						
Home	3495	49.1	3559	64.8	7054	55.9
School	596	8.4	369	6.7	965	7.6
Sports activity area	649	9.1	118	2.1	767	6.1
Street	1182	16.6	891	16.2	2073	16.4
Trade/services site	495	6.9	263	4.8	758	6.0
Industry/construction site	247	3.5	11	0.2	258	2.0
Other	356	5.0	233	4.2	589	4.7
No information	105	1.5	48	0.9	153	1.2
Type of fall						
At the same level	3744	52.5	3222	58.7	6966	55.2
Into a hole	206	2.9	162	2.9	368	2.9
From bed	266	3.7	334	6.1	600	4.8
From other furniture	353	5.0	303	5.5	656	5.2
From scaffolding	211	3.0	9	0.2	220	1.7
From step/ladder	943	13.2	905	16.5	1848	14.6
From tree	239	3.4	64	1.2	303	2.4
From roof	301	4.2	49	0.9	350	2.8
From other levels	708	9.9	358	6.5	1066	8.4
No information	154	2.2	86	1,6	240	0.6
Type of injury						
No injury	380	5.3	338	6.2	718	5.7
Bruise	1521	21.3	1472	26.8	2993	23.7
Cut/Laceration	1578	22.1	818	14.9	2396	19.0
Sprain/Dislocation	1726	24.2	1580	28.8	3306	26.2
Fracture	1253	17.6	870	15.8	2123	16.8
Brain trauma	303	4.3	184	3.4	487	3.9
Multiple traumas	124	1.7	59	1.1	183	1.5
Other	152	2.1	97	1.8	249	2.0
No information	88	1.2	74	1.3	162	1.3
Part of body affected						
Head, face, and chest	2033	28.5	1257	22.9	3290	26.1
Spinal cord/column	165	2.3	157	2.9	322	2.6
Torso	437	6.1	364	6.6	801	6.3
Upper limbs	2187	30.7	1500	27.3	3687	29.2
Lower limbs	1691	23.7	1712	31.2	3403	27.0
Multiple organs/regions	245	3.4	151	2.7	396	3.1
Other or not applicable	264	3.7	241	4.4	505	4.0
No information	103	1.4	110	2.0	213	1.7

To be continued

Table 2 continuation

Variable	Male (n=7125)		Female (n=5492)		Total (n=12617)	
	n	%	n	%	n	%
Treatment at hospital[b]						
Discharged	5594	78.5	4425	80.6	10019	79.4
Outpatient referral	502	7.0	373	6.8	875	6.9
Hospitalization	559	7.8	336	6.1	895	7.1
Referral to other services	278	3.9	209	3.8	487	3.9
Avoidance/escape	62	0.9	47	0.9	109	0.9
Death	4	0.1	4	0.1	8	0.1
No information	126	1.8	98	1.8	224	1.8

[a] Alcohol use reported by interviewee
[b] Treatment in emergency care within 24 hours

between children in the 10 to 14 age range, falls from trees, and the location of school. The third group shows that accidents among adults aged 20 to 59 are associated with the workplace (industry/construction and commerce/service), alcohol consumption, and falls from scaffolding, the roof, ladders/steps, and into holes. The fourth group shows an association between reported disabilities and falls among people aged 60 and above. Finally, the fifth group shows associations between falls among children aged 0-9, home residence, falls from the bed and other furniture, 0-4 years of schooling, and female gender.

Figure 2 shows the associations between type of fall, type of injury, location of injury, and treatment at the emergency room. Two groups summarize the observed associations between the variables. The events that led to discharge or hospitalization are different in these opposing groups. The group on the right shows that falls on the same level are associated with less serious injuries, such as sprains and bruises on the upper and lower limbs, and resulted in hospital discharge within 24 hours. The group on the left shows associations between falls from scaffolding and roofs and more serious injuries, such as multiple traumas, injuries to

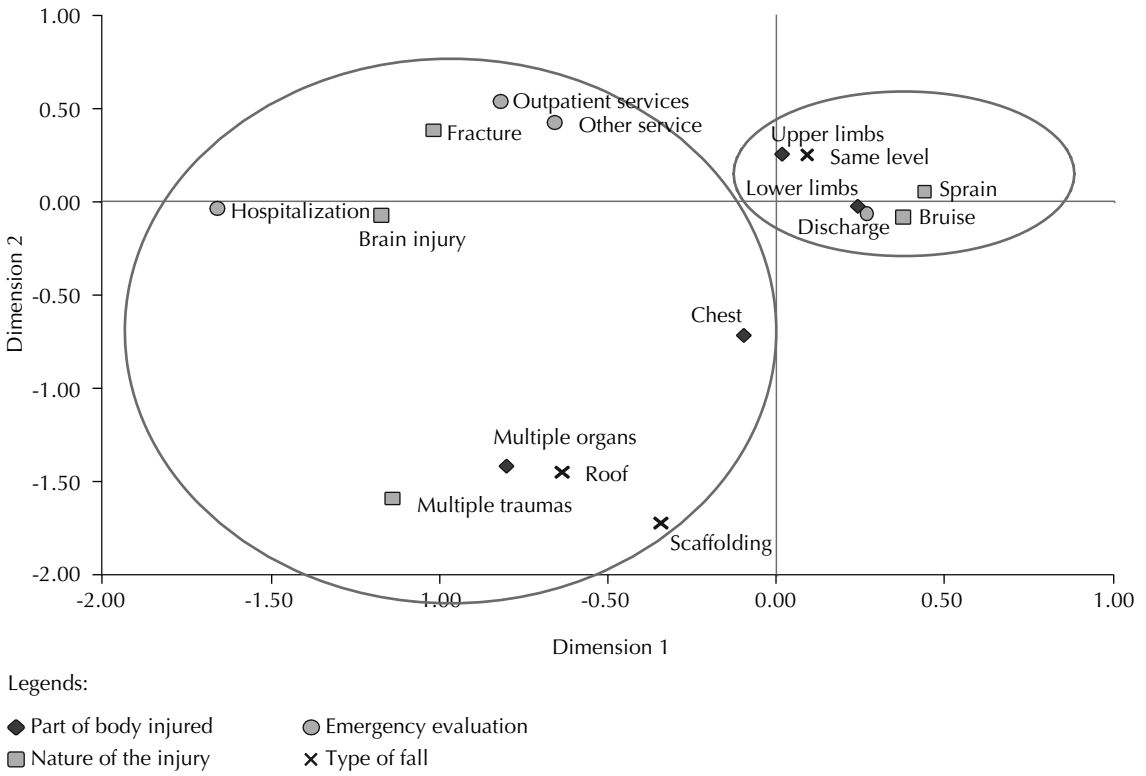

Figure 1. Bi-plot graph of the demographic characteristics for the types of non-intentional falls treated in emergency services. Brazil, September-November 2009.

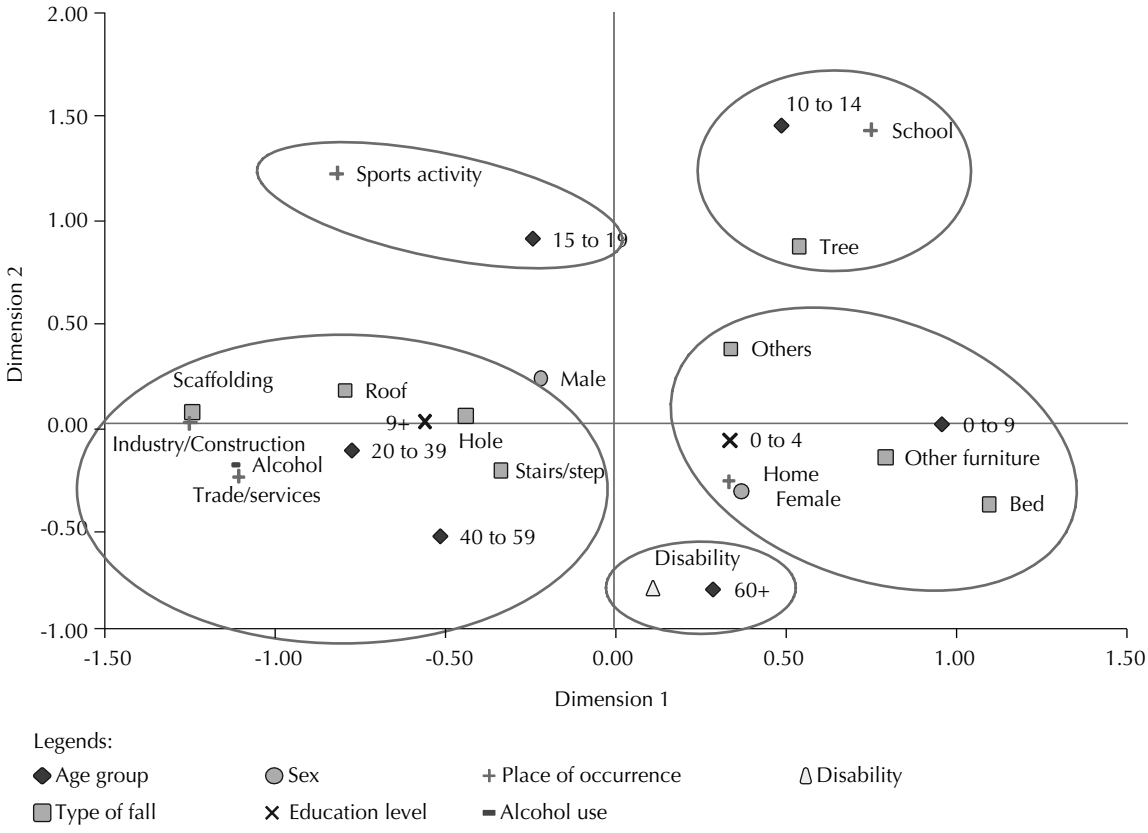

Figure 2. Bi-plot graph of the characteristics related to the treatment and type/location of injuries from unintentional falls treated in emergency services. Brazil, September-November 2009.

multiple organs, fractures, and intracranial injuries, which caused the victims to be hospitalized or referred to out-patient units and other services.

DISCUSSION

This study provides a general picture of non-fatal fall victims who sought treatment in emergency care centers. The results suggest that prevention programs and future studies should be priorities in healthcare services. Although the results provide a considerable range of information about victims, circumstances, and places of occurrence, we discuss the issues that we consider the most relevant or most novel.

The majority of the studied fall victims were males, which is normal in studies of injuries due to external causes. However, the male/female ratio depends on the external cause; for example, the ratio is much higher for males in homicides.[5] Although falls that require emergency care demonstrate a more even ratio between men and women, the proportional difference between gender is apparent in the mortality and morbidity data for external causes in the public health system.[5] The association between falls among individuals over 60 and some type of reported disability (physical or mental) is consistent with the data from the literature, which reports that impaired functional capacity, cognitive disorders, changes in gait, impaired vision, and other disabilities are risk factors for falls in this age group.[3,13]

The findings from the descriptive study and the correspondence analysis were complementary, especially given that children, adolescents, and youth aged up to 19 represent more than half (56.8%) of all visits. Furthermore, home residences were the most frequent location for falls, which is consistent with the national[4,8] and international literature.[12] Additionally, the correspondence analysis showed an association between children younger than 9 and falls from beds or other pieces of furniture. Naturally, children spend more of their time at home than the adult population does, so the home is a frequent location for accidents and falls. These results are consistent with children's expected stage of development because they are at a high risk of falling from beds, chairs, sofas, and other furniture. However, studies have shown that simple interventions in the home can be effective in preventing these falls.[12,19] In this context, it is important to educate families about supervising their children, especially given that an increasing number of women are in the work force. Healthcare professionals should also be involved in these programs because they play an important role in promoting childcare and children's health.

The association between falls in schools and adolescents in the 10 to 14 age group suggests that homes and schools should be the primary targets for strategies to reduce these occurrences among high-risk groups. For victims between 15 and 19, falls were associated with sports, which is consistent with the data from other countries.[6] Young people's participation in sports and other physical activities should be encouraged as part of a healthy life style, and actions that target the schools, clubs, and other venues where such activities take place may help to reduce injuries from falls.

The high frequency of work-related falls, approximately 15% of the total, is worrisome. For victims in the economically active age group (15 to 59 years), this proportion reaches almost 30%. The correspondence analysis showed that most falls from scaffolding and roofs, which affect young adults and adults, occurred at the workplace. These falls caused the most serious health problems, including multiple traumas, head injuries, and injuries to multiple organs. Information about the severity of these accidents represents a knowledge gap in this area. Information from the Ministry of Social Welfare shows that a considerable proportion (80.4%) of the 545,268 Reports of Workers' Compensation filed in 2008 (Comunicações de Acidentes de Trabalho, CAT) were classified as typical, which means that they occurred in the workplace.[d] Most of these victims were aged 20 to 29, which is consistent with our findings. However, we cannot speculate how many of these accidents resulted from falls because the available data only contained information about the nature of the injury (Chapter 19 of the International Classification of Diseases, Tenth Revision, ICD 10), not the cause of accident (Chapter 20 of ICD 10). Furthermore, there is no information about the severity of these accidents. The data from these CATs show that 75% of these typical accidents resulted in work leave for 15 days or more, which suggests that the accidents were serious. A study conducted in Salvador, BA (northeastern Brazil), found high rates of serious occupational accidents that resulted in emergency care, hospitalizations, and ICU treatment, especially among workers in the fields of transport and trade.[15] Employers who cannot protect their workers in the workplace are neglecting one of their basic responsibilities.

Alcohol consumption is widely recognized as a risk factor for injuries due to external causes,[2] but little is known about its role in falls. Our results showed that 6.4% of the victims reported having consumed alcohol prior to their fall. This proportion increases to 11.4% when we include the cases where the interviewers suspected alcohol consumption. A study conducted in a hospital in Minas Gerais (southeastern Brazil) showed that a third of trauma patients, mostly males, had consumed alcoholic beverages.[2] Proportionally, alcohol use was more frequent in patients who were victims of violence, and this number reached 19.3% for fall victims. The authors also found that most victims of injuries due to external causes after alcohol consumption were not occasional drinkers, but probably chronic users or alcoholics.[2]

Our study has some limitations and some strengths. One of the limitations is that the data are from a convenience sample and therefore cannot be generalized to Brazil or used to construct rates. Among the strengths, we emphasize our reliable and comprehensive data. A low proportion of our variables showed "no information", ranging from 0.3% for the age group variable and 4.0% for schooling.

The results of this study provide a general picture of the urgent care and emergency service visits that result from falls and identify associations that could not be observed in a descriptive study. It is important to clarify these associations to better understand falls and their contributing factors. Having a broad perspective on urgent care and its characteristics will also increase our understanding of work-related accidents. The information regarding falls from SIM, SIH/SUS and Social Security are underestimated because they are limited to works in formal sector. Therefore, we believe our findings can help to guide fall prevention efforts, particularly strategies to reduce risk factors in homes, schools, and workplaces.

[d] Ministério da Previdência Social, Empresa de Tecnologia e Informações da Previdência Social. Anuário estatístico da previdência social. Brasília (DF); 2008. Seção 4; Acidentes do trabalho [cited 2010 Nov 01]. Available from: http://www.mps.gov.br/conteudoDinamico.php?id=865

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