

Profile and outcome of patients with ground-level falls

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ABSTRACT

Background: A ground-level fall is one of the most common modes of injury sustained across all age groups. For older adults, ground level falls can result in multiple injuries and are associated with significant morbidity and mortality. **Methodology:** This retrospective observational study included all patients presenting with fall from a ground level to our emergency department (ED) from January 2018 to December 2018. Demographics, details of incident, severity of injury, and outcome were analyzed. **Results:** During the study period, 596 patients with a mean age of 40.9 (standard deviation [SD]: 25.9) years were included in the analysis. A quarter (23%) were aged less than 15 years, while the elderly (>60 years) comprised of 29.5%. Half the patients were triaged as priority 2 (53.8%). The lower limbs (36.6%), upper limbs (23.9%), and face (15.3%) were the body areas that were most commonly injured. The new injury severity score (NISS) was more than 8 in 28% of patients. Multivariate logistic regression analysis showed the elderly (>60 years) to have a higher odds (2.51 95% confidence interval [CI]: 1.57–4.02) of sustaining a fracture of a dislocation. One fifth of the patients (120/596; 20.1%) required hospital admission with only one fatality. Fifteen patients (2.5%) left the hospital against medical advice. Two-thirds (66.3%) required only conservative management, while 19.9% required major surgical intervention. **Conclusion:** A ground-level fall is a common mode of injury in children (<15 years) and the elderly (>60 years). The extremities and face are the most common areas of the body that are prone to injuries. Age-friendly infrastructure modifications at home, work places, and in public areas for elders and ensuring playground safety for children are the needs of the hour to decrease falls on level ground.

Keywords: Emergency department, falls, fall from level ground, level ground falls, trauma

Introduction

Falls are a major cause of injury in all ages, and account for 10% to 15% of emergency department (ED) visits.^[1] In elderly patients, a fall on level ground may represent a high-risk group for injury and concurrent comorbidities that warrant trauma service evaluation. They should be triaged appropriately as they have higher rates of mortality when compared with younger adults.^[2] The most effective means of reducing the incidence of any injury is prevention. Identifying characteristics and relating factors to severe fall injuries in the elderly population is necessary to select management targets and establish a prevention strategy. There have been many studies on injuries associated with

low-velocity falls or ground level falls in the elderly population. However, studies on the characteristics and relating factors to severe injuries caused by falls on level ground are lacking. In the elderly population, injuries most commonly occur in residential and medical facilities. The most frequent indoor area where elderly patients fell was bedroom followed by the living room, ground-level falls injuries also occur mainly when performing daily activities.^[3] In our community, children are often left to play unmonitored in open playgrounds with uneven terrain and premises of colonies and hence frequently sustain injuries because of falls.

It is important to know the severity of injuries and outcome of patients who sustain injuries because of this particular mechanism to be better prepared to manage these emergencies. Hence, we conducted this study to determine the incidence of fall on level ground presenting as acute emergencies and to study the profile and outcome of these patients.

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Methods

Study design

We conducted this retrospective study of patients presenting with trauma to the emergency department in 1 year.

Setting

The study was conducted in the ED of Christian Medical College Hospital, Vellore, which is a large tertiary care hospital in South India. The ED is a 50-bed department and tends to about 300 patients per day, including trauma and nontrauma patients.

Participants

We recruited all patients presenting with fall on level ground to our ED during the study period. In addition, we reviewed a total of 596 patient's charts over a period of 12 months (January 2018 to December 2018).

Variables

The charts were reviewed and the relevant details of history, clinical findings, laboratory investigations, and X-rays findings were documented in the study form. The management in ED, either conservative or surgical, were noted. The patients' outcomes from the ED about admission, discharged, and leave against medical advice were documented.

Outcome variable

Severity of injuries, hospital admission, and requirement of major surgical interventions.

Bias: This was a retrospective study; therefore, we could not control exposure or outcome assessment and instead relied on others for accurate recordkeeping.

Statistical analysis

Statistical analysis was done using the Statistical Package for the Social Science (SPSS), Windows (SPSS Inc. released 2015, version 26.0. Armonk NY, USA). Continuous variables were presented as mean and standard deviation (SD). Categorical and nominal variables were presented as percentages. Factors for associations with patients aged more than 60 years were determined by bivariate analysis, followed by multivariate logistic regression analysis, and their 95% confidence intervals (CIs) were calculated. For all tests, a two-sided $P < 0.05$ was considered statistically significant.

Ethical considerations

The institutional review board approved this study prior to the commencement of the study (IRB Min no: 12222 dated August 22, 2019). Patient confidentiality was maintained using unique identifiers and by password protected data entry software with restricted users.

Results

During the study period, 74,486 patients presented to the ED with 7661 (10.2%) being trauma cases. Patients with fall on level ground comprised of 596 (7.8%) patients and were included in the analysis [Figure 1]. The mean age was 40.9 (25.9) years with an equal male: female ratio. A quarter (23%) were aged less than 15 years while the elderly (>60 years) comprised of 29.5%. The baseline characteristics, including triage priority level and examination findings at admission, are shown in Table 1. The lower limbs (36.6%), upper limbs (23.9%), and face (15.3%) were the areas of the body most commonly injured. A detailed graphic representation is shown in Figure 2. The type of injuries sustained is shown in Figure 1. Major injuries like fractures or dislocations were seen in 251 (42.2%) patients, while 21 (3.5%) sustained traumatic brain injury and presented with a Glasgow Coma Scale (GCS) of less than 15. The Injury severity score (ISS) and new injury severity score (NISS), which are internationally validated scoring systems, were used to determine severity of injury. One hundred and twenty-seven (21%) of the patients had an ISS of more than 8, while 167 (28%) had an NISS of more than 8. We performed a bivariate and multivariate logistic regression analysis for factors associated with patients aged more than 60 years [Table 2]. The elderly were found to have a statistically significant odds of sustaining a fracture or dislocation (odds ratio [OR]: 2.51; 95% CI: 1.57–4.02) and lower limb extremity injuries (OR: 2.14; 95% CI: 1.31–3.50). More than a quarter (26.5%) of the patients were managed and discharged when stable by the ED team alone, while the rest were referred to different trauma specialty departments for evaluation and further management. The main trauma specialty departments involved in the management of these patients were orthopedics (41.4%), plastic surgery (8%), pediatric orthopedics (7.7%), and neurotrauma (7.2%) [Figure 3]. One

Table 1: Baseline Characteristics (n=596)

Demographic Details	Number (%)
Mean age (SD) in years	40.9 (25.9)
Male	304 (51%)
Female	292 (49%)
Age Distribution	
Less than 15 years	137 (23%)
15 to 40 years	154 (25.8%)
40 to 60 years	129 (21.6%)
More than 60 years	176 (29.5%)
Triage Priority Level	
Priority 1	20 (3.4%)
Priority 2	321 (53.8%)
Priority 3	255 (42.8%)
Vital signs at admission	
Tachycardia (Heart rate >100 bpm)	165 (27.7%)
Hypotension (SBP <90 mmHg)	42 (7.1%)
Hypertension (SBP >140 mmHg)	37 (6.2%)
Tachypnea (Respiratory Rate >20/min)	406 (68.1%)
Hypoxia (SpO ₂ <94%)	19 (3.2%)

SD=Standard deviation, bpm=beats per minute, SBP=Systolic blood pressure, SpO₂=Oxygen saturation

Discussion

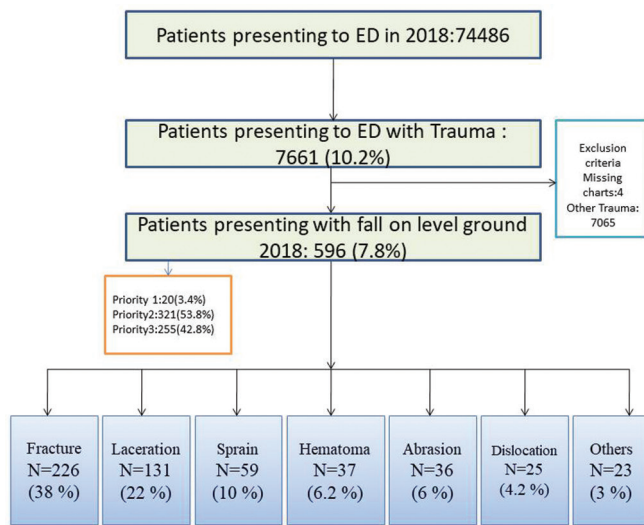


Figure 1: STROBE diagram

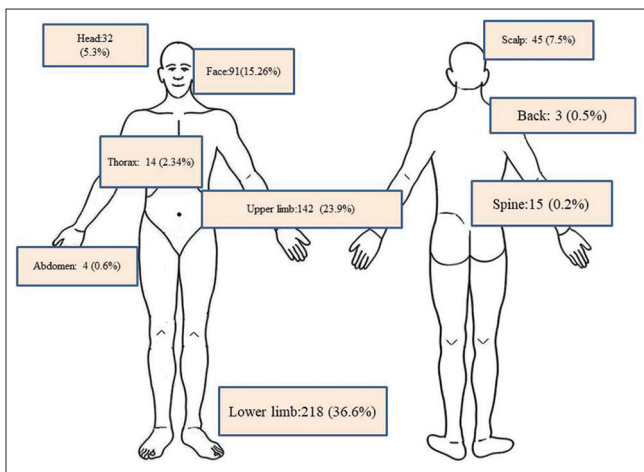


Figure 2: Region of body involved in injuries

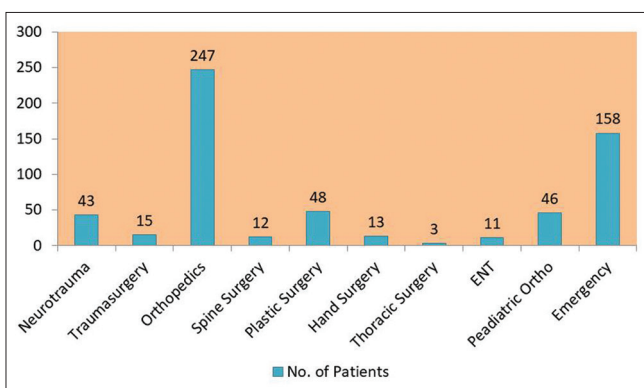


Figure 3: Various departments involved in the management of the patients

fifth (120; 20.1%) of the patients required hospital admission with only one fatality. Fifteen patients (2.5%) left the hospital against medical advice. Two-thirds (395; 66.2%) of the patients required only conservative management, while 119 (19.9%) required major surgical intervention.

Ground-level fall is one of the most common injuries, often ignored because of low-velocity impact and presents to the health care centers only when severe. According to the World Health Organization (WHO) falls are the second leading cause of accidental or unintentional injury deaths worldwide after road traffic injuries. Over 80% of fall-related fatalities occur in low- and middle-income countries, and the largest morbidity occurs in people aged 65 years or older, young adults aged 15–29 years, and children aged 15 years or younger.^[4,5] There have been studies, which look at the outcome of ground-level falls, done in the West, but no studies from the Asia Pacific regions are available. According to a study about the American population aged above 65 years in 2008 about mortality associated with ground level, 43% all falls occurred in the patients older than 65 years and were associated with significant mortality. Unfortunately, death rates have increased considerably over the years.^[4] Children less than 15 years constitute one fourth of the falls.^[5] Thus, falls are a growing public health problem that needs to be addressed. It is very important to study the incidence, pattern, outcome, and mechanism of injury of the ground-level falls that can provide possible insights into its prevention and timely intervention at the earliest to reduce severe consequences, especially in developing countries.

In children, falls occur largely because of their evolving developmental stages and uninstructed behavior. In the low socioeconomic countries, play areas are often not restricted to parks or playgrounds, but children commonly use the little available space at the premises, crowded public places, and even uneven terrains in the community for their recreation. These undesignated places make them more vulnerable to falls and trauma.^[5] Most often, children are left alone while at home or at playgrounds because of social and cultural reasons. We noted in our ED that more women suffered from ground-level falls. Hence, we presume this is because in the Indian society, elderly women spend most of their time at home.^[6] In the developing world, overcrowded living places and suboptimal infrastructure and facilities within the house and premises increase the risk of falls. Bertocci *et al.*, Thierauf *et al.*, and Thomas *et al.* in their studies showed that injury severity and risk increase with age because of impaired balance, poor nutritional status, physical inactivity, and associated chronic disabling medical conditions with neurological problems and poor vision can aggravate the risk of falls.^[7-9]

The findings from our study reinforce that level ground falls associated with extremity skeletal injuries involving hip and upper extremity followed by spine injuries.^[10] However, brain and spine injuries are not uncommon, reported as high as 25% although the mechanical impact of falls is lesser.^[10,11] Orthopedic surgery is the dominating form of surgery in fall victims and makes up three-quarters of patients with ground-level falls, 13% abdominal, 5% neuro, 3% thoracic, and 1% vascular surgery.^[12] The hospital length of stay (LOS) and intensive care unit (ICU)

Table 2: Bivariate and multivariate analysis for factors associated with patients aged more than 60 years

Variables	Age >60 n=176	Age <60 n=420	Bivariate analysis		Multivariate analysis	
			P	Unadjusted OR	P	Adjusted OR
Priority 1	12 (6.8%)	8 (1.9%)	0.002	3.76 (1.51-9.38)	0.001	5.72 (2.12-15.45)
Fracture or dislocation	115 (65.3%)	167 (39.8%)	0.001	2.85 (1.97-4.12)	0.001	2.51 (1.57-4.02)
Upper limb injuries	30 (17%)	110 (26.2%)	0.016	0.58 (0.38-0.90)	0.121	0.62 (0.34-1.13)
Lower limb injuries	101 (57.4%)	116 (27.6%)	0.001	3.52 (2.44-5.09)	0.002	2.14 (1.31-3.50)
Requirement of surgical intervention	60 (34.1%)	59 (14%)	0.001	3.16 (2.08-4.79)	0.146	1.45 (0.88-2.38)

OR=Odds ratio

LOS increase with age^[13] and comorbidities^[14] and are also greater for at-home fallers (as opposed to at-work fallers), probably because of them being older.^[15] In another study by Velmahos *et al.* on level ground fall, both demography and injury pattern is similar in different cultures^[16]

Health care providers should have guidelines to manage patients with falls on the ground. If the patient meets activation criteria such as age less than 5 years and above 65 years with traumatic brain injury, long bone fractures, tachycardia with hypotension, and people on blood thinners, a trauma activation that will help improve patient outcomes, decrease morbidity, and mortality, especially in the geriatric population. Many studies have shown that less than one fifth of the pediatric trauma patient are requiring hospital admission and the rest were discharged after initial care. This is an encouraging result and causing less burden to the health care system.^[17-19] Hence, it is important to understand the injury profile of this special age groups to be better prepared to handle emergencies.^[20,21]

It is challenging to manage trauma in primary care centers nevertheless it is important to do the first aid and initial treatment before definitive treatment is sought. Hence, it is essential for primary care physicians to have good knowledge in management of these patients to avoid a life threatening situation.^[22]

For prevention of falls in children, play areas should be fenced and preventive safety measures should implement at schools, home and play areas. Parents of children and extended family members are educated about safety rules, and they actively supervise young children and help them in selecting appropriate equipment. These measures might decrease unnecessary emergency visits because of trauma among children. Health care providers should be taught preventive strategies and the education of individuals, families and communities to build risk awareness.^[18] Falls among elderly people occur in clinical and community settings, effective strategies to be taken to reduce fall-related risk.^[23,24] At homes and aged care centers, elderly people friendly infrastructure modification such as hand rails on stairs, ramps; guard rails and protective barriers on elevated platforms, better lighting, walking stick and providing western type commodes in the toilets. In addition to all these encouraging regular physical exercises and being compliant with medications for their disease conditions are simple measures in injury prevention. The primary care physicians should identify vulnerable and

frail populations like elderly and propagate awareness regarding injury prevention in our community as this helps in improved quality of living with lesser disability.^[25] Even though, aged care homes are few in developing countries, they should be well staffed to supervise and care for them.^[24] The way forward for elderly falls prevention is multifactorial interventions which is the upcoming prevention Strategy.^[26] It would be beneficial to look at the spectrum of fall and develop a registry with injuries and their description in our population, as registry would facilitate in continuous monitoring of care.^[27]

Our study has certain limitations, being a tertiary care center and located in the southern part of India, there may have been a patient selection and referral pattern bias. Missing information is another limitation of our retrospective study. Nonetheless, our study provides a detailed insight into the profile and outcome of falls from the level ground patients presenting with emergencies.

Conclusion

Fall on level ground is a common mode of injury in children (<15 years) and the elderly (>60 years). The extremities and the face are the most common areas of the body prone for injuries. The elderly population have statistically significant odds of sustaining a fracture or a dislocation, especially of the lower limbs and hence must take great precautions in avoiding injuries. We recommend elderly people friendly infrastructure modification at home, work places, and ensuring playground safety for children with constant monitoring to prevent falls on level ground.

Research quality and ethics statement

The authors of this manuscript declare that this scientific work complies with reporting quality, formatting and reproducibility guidelines set forth by the EQUATOR Network. The authors also attest that this clinical investigation was determined to require Institutional Review Board/Ethics Committee review, and the corresponding protocol/approval number is IRB Min no: 12222 dated August 22, 2019. We also certify that we have not plagiarized the contents in this submission and have done a plagiarism check.

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Conflicts of interest

There are no conflicts of interest.

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