



Epidemiological and Clinical Characteristics of Fall Injuries in East Azerbaijan, Iran; A Cross-Sectional Study

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ABSTRACT

Objective: To describe the epidemiological and clinical characteristics of fall injuries in East Azerbaijan, Iran.

Methods: This cross-sectional study was based on Hospital Information System (HIS) data for patients referred to the Imam Reza Hospital between 2008 and 2013. We recorded the demographic characteristics and epidemiological patterns of patients who were admitted to our center due to fall injuries. To standardize the reports the International Classification of Diseases (ICD), the International Classification of Diseases 9 Clinical Modification (ICD-9-CM) was used. Equally, the hospitalization period and number, admission ward, and the final status of victims after discharge from the hospital were extracted from the HIS.

Results: Overall we included a total number of 3397 patients with mean age of 39.2±22.7 years. There were 2501 (73.6%) men among the patients. Long bone fracture (48.1%) and intracranial injury (24.2%) were the most frequent injuries among fall injury victims. Operations on spinal cord and spinal canal structures (12.0%), Operations on nose (11.6%) were the most common operations being performed in these patients. The survival was significantly lower in patients with age more than 60 years when compared to other age groups ($p=0.001$). The survival rate was significantly lower in age group of >60 years, compared to other age groups ($p=0.001$).

Conclusion: Given the high rate of fall injuries and death among the elderly that increases with age, appropriate measures must be taken to control and prevent injuries while prioritizing the elderly.

Keywords: Epidemiology; Fall injury; Traumatic brain injury; Mortality; Iran.

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Introduction

Injury epidemiology is defined as the study of the distribution and determinants of injuries and safety related states or events in specified population, and the application of this study to prevent injuries and to promote safety [1]. Annually, more than 420,000 people die because of fall which ranks the second-most common cause of injury related mortality worldwide [2]. One half of all falls results in injury and 10% of them are serious [3,4]. The incidence rate of falls is at 5.6 per 100,000 worldwide and 2.1 per 100,000 in the Eastern Mediterranean Region [5].

The elderly are at higher risk exposure, with the prevalence of falls reported at 35% in those over 65 years old [6]. Falls are the most important public health problems in the low and middle income countries, and are the main cause of injury, hospitalization, disability, poor quality of life, depression, and mortality [7,8]. From the people who fall, 20-30% suffers from injuries such as fractures or head trauma and 2% hip fracture, which causes a decline in the level of functioning, mobility, independence and quality of life. These injuries increase the death rate [9]. Falls can have a significant psychosocial impact on the individuals, resulting in physical inactivity and subsequent functional decline [10]. Morbidity from falls is a significant threat to independence among the elderly. Risk factors for falls may lead to loss of autonomy, the way of walking, balance, medications, depression, loss of confidence in ambulation and family member's anxiety, knee osteoarthritis, urinary incontinence, visual impairments, environmental hazards, and stroke [11-14]. In the USA the costs of treatment of falls totals 19 billion dollars per year [15].

As the data from Iran is scarce regarding the fall injuries, the objective of this study was to describe some of the epidemiological characteristics of fall injuries at East Azerbaijan for recognizing high risk groups and suggesting appropriate measures to improve and prevent health problems.

Materials and Methods

Study Population

This cross-sectional study was conducted in Imam Reza hospital during a 5-year period from 2008 to 2013. Data were gathered from Hospital Information System (HIS). The study population comprised all unintentional fall injuries and hospitalized victims in this hospital from 2008 to 2013. Imam Reza hospital is the largest hospital and referral center in East Azerbaijan province, North-West of Iran. We used the definition of World Health Organization (WHO) as fall is "inadvertently coming to rest on the ground or other lower level, excluding intentional change of position to lean on furniture, walls or other objects" [16]. Inclusion criteria were fall injury victims referred to Imam Reza hospital, inpatients

victims, and the victims with completed information in the HIS. Exclusion criteria outpatients and patients misclassified as injuries. The study protocol was approved by both medical ethics committee and institutional review board (IRB) of Tabriz University of Medical Sciences. As this was retrospective study, no informed written consents were required.

Study Protocol

The variables of interest in this study were age, gender, site of physical injury, type of injury (according to the international classification of diseases (ICD-10) followed by 3 digit word: [S01-T98] [17], the clinical services given to the patients complied with International Classification of Diseases 9 Clinical Modification (ICD-9-CM), length of hospitalization, number of admission, admission ward, and final outcome of the victims after discharge from hospital.

The codes belong to the XIX chapter of "the injury, poisoning and certain other consequences of external causes" of ICD-10 codes including "(S00-S09) Injuries to the head; (S10-S19) Injuries to the neck; (S20-S29) Injuries to the thorax; (S30-S39) Injuries to abdomen, lower back, lumbar spine, and pelvis; (S40-S49) Injuries to the shoulder and upper arm; (S50-S59) Injuries to the elbow and forearm; (S60-69) Injuries to the wrist and hand; (S70-S79) Injuries to the hip and thigh; (S80-89) Injuries to the knee and lower leg; (S90-S99) Injuries to the ankle and foot; (T00-T07) Injuries involving multiple body regions" and followed XX chapter of "external causes of morbidity and mortality": W (W00-W19) for "other external causes of accidental injury" were used.

Statistical Analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS Inc, Illinois, and USA) version 19. Parametric variables are presented as mean \pm SD while nonparametric variables are presented as frequency and percentage. The age was categorized into five groups: less than 7 year, 7-18, 18-40, 40-60 and 60 or more. Chi-Square and Fisher's exact test were applied to determine the probable association between categorical variables. One way ANOVA was used to compare means among more than two groups. To calculate survival rates, Kaplan-Meier method was applied and the survival probability was estimated for different age groups. In order to compare survival rates among age groups Breslow test for trends was used. A two-sided *p*-value less than 0.05 were considered as criterion level of statistical significance.

Results

A total of 3,397 fall victims during the study period were recorded. The mean age of the victims was 39.16 \pm 22.7 (ranging from 1 to 104) years. The age group 18-40 comprised the greatest percentage of

fall injuries. Furthermore, there was a significant difference between age groups and gender ($p=0.001$). There were 2501 (73.6%) men and 896 (26.4%) women among the victims. The mean age of men and women was 39 ± 21.96 and 36.6 ± 24.64 , respectively ($p=0.51$). The mean of length of hospital stay was 6.22 ± 29.03 days (ranging from 0 to 1636). The length of hospital stay was significantly higher in surgery ICU, trauma ward and neurosurgery ward when compared to ear, nose and throat (ENT) ward ($p=0.009$). The mean service costs were 4404010.97 ± 10961788.2 (Ranging from 18806866 to 172138887) Rials and its interquartile range (IQR) were (2,784,154 Rials).

The baseline characteristics of the study population are summarized in Table 1.

Regarding the admission ward, 50.2% of victims were hospitalized in trauma ward, 11.3% in ENT ward, and 11% in surgery ward. Regarding the outcome, 1242 (37%) of victims improved, 1857 (55.3%) completely recovered or recovered with certain complications, and 261 (7.8%) died. The majority of mortalities were recorded in age group of more than 60 years (Figure 1). In other words, the survival rate was significantly lower in age group of >60 years when compared to other age groups ($p=0.001$). The mean age of victims, based on the

Table 1. Baseline characteristics of 3397 patients with fall injuries who were admitted to our center in East Azerbaijan, Iran.

Variable	Value
Age (years)	39.16 ± 22.69
<7 (%)	302 (8.9%)
7-18 (%)	342 (10.1%)
18-40 (%)	1279 (37.7%)
40-60 (%)	814 (24.0%)
>60 (%)	660 (19.4%)
Gender	
Men (%)	2501 (73.6%)
Women (%)	896 (26.4%)
Hospital stay (days)	6.29 ± 29.03
Surgery ICU (days)	7.94 ± 9.09
Trauma ward (days)	6.81 ± 8.63
Neurosurgery ward (days)	6.31 ± 8.88
ENT ward (days)	1.57 ± 1.42
Service costs (Rials)	4404010.97 ± 10961788.2

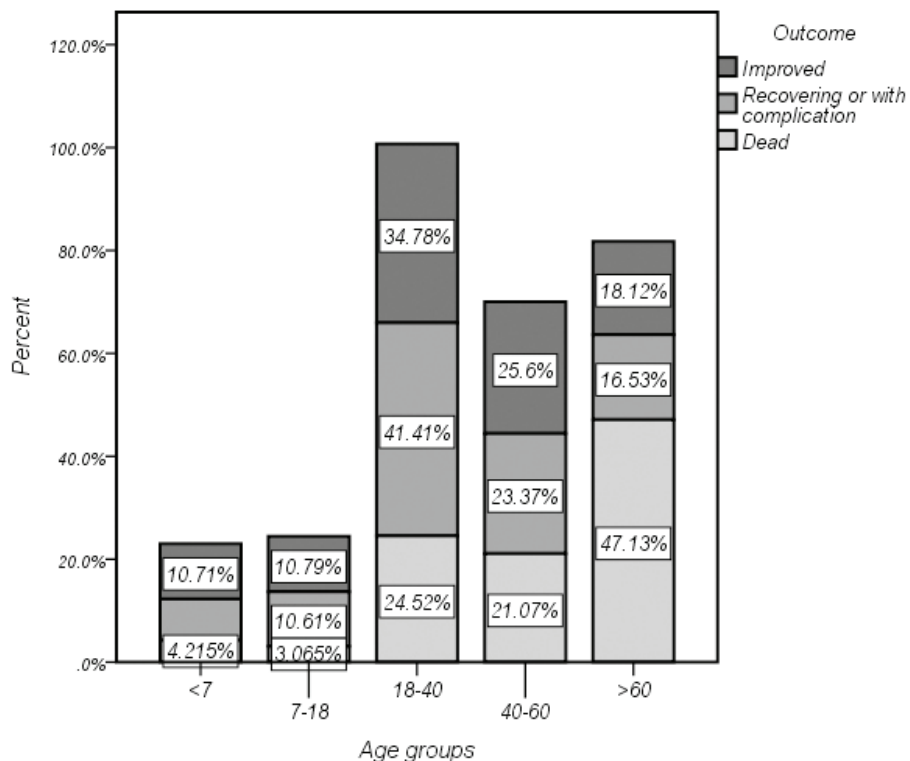


Fig. 1. Distribution of final status of patients after admission in hospital in different age groups, at Imam Reza hospital, East Azerbaijan province, Iran.

final outcome was 38.42 ± 22.7 years in those who improved 37.47 ± 22.7 years in those who recovered or with complications, and 55.68 ± 24.7 in those who died. The mean age was significantly higher in those who died ($p=0.001$) (Table 2).

Operations on spinal cord and spinal canal structures, and cranial puncture comprised the majority of clinical services provided for victims (Table 3).

Fracture bones, and intracranial injuries were the most frequent type of injuries induced to the fall victims (Table 4). Fall from one level to another, and fall on and from stairs and steps included the most common sites of falls (Table 5). Injuries to the head, Injuries to abdomen, lower back, lumbar spine, and pelvis, and Injuries to the thorax consisted the greatest proportion of injuries (Table 6).

Table 2. The survival of patients with fall injuries referring to our center in East Azerbaijan, Iran, in different age groups.

Age groups	Survival	p value ^a
<7 years	48.24±3.76 (40.86-55.62)	0.001
7-18 years	44.12±4.64 (35.02-53.22)	
18-40 years	103.29±8.67 (86.29-120.28)	
40-60 years	53.43±4.85 (43.91-62.96)	
>60 years	38.67±3.70 (31.41-45.94)	
Total	61.21±6.03 (49.38-73.05)	

^ap value is calculated using Breslow (Generalized Wilcoxon) test.

Table 3. Clinical services provided for fall victims at Imam Reza hospital, East Azerbaijan province, Iran between 2008 and 2013.

Operation Codes	Definition	Frequency (%)
03	Operations on spinal cord and spinal canal structures	378 (12.0%)
21	Operations on nose	365 (11.6%)
01	Cranial puncture	363 (11.5%)
34	Operations on chest wall, pleura, mediastinum and diaphragm	292 (9.3%)
79	Reduction of fracture and dislocation	277 (8.8%)
81	Repair and plastic operations on joint structures	243 (7.7%)
78	Other operations on bones, except facial bones	228 (7.2%)
93	Physical therapy , respiratory therapy rehabilitation, and related procedures	172 (5.5%)
76	Operation on facial bones and joints	174 (5.5%)
96	No operative intubation and irrigation	160 (5.1%)
80	Incision and excision of joint structures	136 (4.3%)
54	Other operations on abdominal region	127 (4.0%)
02	Other operation on skull, brain and cerebral meninges	103 (3.3%)
86	Operations on skin and subcutaneous tissue	85 (2.7%)
38	Incision, excision, and occlusion of vessels	45 (1.4%)

Table 4. Distribution of types of injuries to the fall victims admitted to Imam Reza hospital, East Azerbaijan province, Iran between 2008 and 2013.

Type of injuries	Frequency (%)
Fracture bones	2260 (48.1%)
Intracranial injury	1135 (24.2%)
Other and unspecified injuries to the: head, neck, thorax, shoulder and upper arm, forearm, wrist and hand, hip and thigh, lower leg, ankle and foot	631 (13.4%)
Injury of other and unspecified intrathoracic organs	253 (5.4%)
Injury of intra-abdominal organs	191 (4.1%)
Dislocation, sprain and strain of joints and ligaments	64 (1.4%)
Injury of urinary and pelvic organs	59 (1.3%)
Superficial injury	37 (0.8%)
Open wound	37 (0.8%)
Injury of nerves	26 (0.6%)
Injury of blood vessels	23 (0.5%)
Injury of muscle and tendon	14 (0.3%)

Table 5. Distribution of site of falls in accordance with chapter XX “external causes of morbidity and mortality” patients admitted to Imam Reza hospital, East Azerbaijan province, Iran between 2008 and 2013.

Code	Definition	Frequency (%)
W17.9	Other fall from one level to another	2584 (76.1%)
W10.9	Fall on and from stairs and steps	390 (11.5%)
W14.9	Fall from tree	159 (4.7%)
W11.9	Fall on and from ladder	132 (3.9%)
W13.9	Fall from, out of or through building or structure	114 (3.4%)
W12.9	Fall on and from scaffolding	18 (0.5%)

Table 6. Distribution of region of the body injuries in accordance with XIX chapter of ICD-10 [overall codes allocated], among patients admitted to Imam Reza hospital, East Azerbaijan province, Iran between 2008 and 2013.

Definition	Frequency (%)
Injuries to the head	2268 (48.3%)
Injuries to abdomen, lower back, lumbar spine, and pelvis	892 (19.0%)
Injuries to the thorax	647 (13.8%)
Injuries to the elbow and forearm	165 (3.5%)
Injuries involving multiple body regions	162 (3.5%)
Injuries to the neck	145 (3.1%)
Injuries to the hip and thigh	125 (2.7%)
Injuries to the shoulder and upper arm	113 (2.4%)
Injuries to the knee and lower leg	83 (1.8%)
Injuries to the ankle and foot	61 (1.3%)
Injuries to the wrist and hand	34 (0.7%)

Discussion

Falls have been known to rank the first or second among all types of injuries [18,19] which is one of the prevalent causes of major injuries responsible for many hospital admissions in Iran [20,21].

In the present study, the majority of victims have been classed under the age groups of 18-40. Falls are the major common causes of traumatic injuries among different age groups [22]. In a study in carried out in Qom province (center of Iran) on epidemiology of accidents and trauma, fall and strike were the most common accidents under 12 years old [23]. In the study conducted by Alexander and Knight, the majority of falls occurred at the later stage of life especially at the age of 65 years and over [24]. The older adults are involved in fall injuries [25,26]. Falls are most common for younger children and usually occur at home [27]. The likelihood of all kinds of fall injuries increases with age. Older adults are five times more likely to be hospitalized due to falls than other injuries [28].

Results of the current study also showed that males were more involved in fall injuries than females. Other studies concluded that the risk of falls was over three times higher for females than males [12,29].

According to our study, “Injuries to the head”, and “Injuries to abdomen, lower back, lumbar spine, and pelvis” were the most common and frequent kinds of fall injuries. Iranfar *et al.* in a study in Iran reported that the most common type of injury was fractures of thigh [30]. Another study by Grisso in America

showed that 90% of injuries of older subjects were fractures of thigh due to falling [31]. Our findings are consistent with studies that represented injuries to the head as being more frequent [29,32]. Another study in Iran found head, spine, extremities and fracture as the greatest of fall injuries [33]. Naghavi *et al.* reported that the higher incidence of femoral neck fracture related to fall in Iranian elder population [34]. Falls account for two out of five adverse events in hospitals, and its frequency varies from 1.4 to 13.0 in 1000 patients-days [35]. In general, these events aggravate health problems and the main consequences are trauma such as fracture; unscheduled removal of catheters, drains and probes; fear of falling again; emotional changes; clinical worsening; and even death [36].

The median of hospital length of stay in this study was 4 days. Furthermore, comparing the average length of stay in hospital between the admission wards showed a significant difference. In a similar study, Richard and colleague reported that the mean length of hospitalization was 11.6 days and for hip fracture (15.5 days), for skull fracture/intracranial injury (9.8 days), for all other fractures (11.2 days), and for all other injuries (9.1 days) [37]. In another study conducted in America the length of hospitalization for fall related injuries was more common in children and elderly [38]. It seems that the average length of stay in hospital is correlated with the severity of injury.

In our study, fall from one level to another, and fall on and from stairs and steps comprised the most

common sites of falls. In a study by Shin et al. in Korean the majority of falls occurred when the elder adults slipped, lost balance and tripped when walking and only 4.2% of falls were related to complaints of dizziness [39]. In another study in Iran, falls were the greatest proportion of injury mechanism in home accidents [40]. It is customary of Iranian women to do some special house cleaning activities during the weeks ending to Nowruz (Iranian New Year) [33]. These findings probably showed that most of the falls occur due to imbalance and aging.

In this study 8.3% of men and 6.4% of women died. Furthermore, the majority of deaths pertained to the age group over 60. According to report of Center for Disease Control (CDC) falls are the main cause of death among adults of 65 years or older [41]. Karbakhsh *et al.* conducted a study about the injury epidemiology in Kermanshah (west of Iran) on trauma patients in which 7.8% of the patients died, mostly due to head injuries. The most important causes of death were striking with blunt objects (13.3%), and road traffic injuries (10.1%) (18). The mortality rate in this study was higher than other studies [42-44]. In general, these results are in agreement with other studies with higher mortality rate in the age group over 60 [45,46]. It seems that the higher mortality rate was considerably associated with head injuries, age, and length of transmitting of patients to the clinics. In a study in Vietnam about costs in the injury patients the victims injured due to falls were

more likely to face catastrophic expenditure than burn patients or road crashes patients. The risk of catastrophic expenditure considerably increased with severity and injuries to the head [33].

The limitation of the current study was that it was not population-based; rather it was a hospital-based study. Yet it clarified some interesting patterns of fall injuries. Another limitation of this study was that it did not include minor injuries due to falls.

In conclusion, falls and fall-related injuries put an enormous burden on individuals, society and on our health care system. In this study of injuries by fall, the lowest survival belonged to elders over 60 years old and considering the fact that Iranian society is aging, it is necessary to pay more attention to falls and injuries of them. Creating safe environments for the elderly and training them and their families on how to prevent falls can be helpful beside other preventive measures. We also suggest developing an integrated information system for fall and injury registry which can provide the patterns of fall and injury and can help policy makers in evidence based decisions.

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