

Epidemiological and Clinical Characteristics of Fall-related Injuries: A Retrospective Study

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Research article

Keywords: fall, height, trauma, injury

Posted Date: October 14th, 2019

DOI: <https://doi.org/10.21203/rs.2.16009/v1>

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Version of Record: A version of this preprint was published on July 29th, 2020. See the published version at <https://doi.org/10.1186/s12889-020-09268-2>.

Abstract

BACKGROUND Fall-related injuries are important public health problem worldwide. We aimed to describe the epidemiological and clinical characteristics of fall-related injuries in a level 1 trauma center. **METHOD** A retrospective analysis of Qatar Trauma Registry data was conducted on patients admitted for fall-related injuries between 2010 and 2017. Comparative analyses of data by gender, age-groups and height of falls were performed to describe the epidemiological and clinical characteristics of patients, and in-hospital outcomes. **RESULTS** A total of 4040 patients with fall-related injuries were identified in the study duration which corresponds to the rate of 2.41 per 10,000 population in Qatar. The rate of fall injuries decreased over the years by 39%. The mean age of patients was 32.9 ± 18.26 years. Males were predominant (89%), more likely to fall at workplace, fall from a greater height and experience polytrauma than females ($p=0.001$). Working age-group (20-59 years) were the major victims (73%). Most of the injuries were to the head (36%) followed by spines (29%) and chest (23%). Overall in-hospital mortality was 3%. **CONCLUSION** Fall-related injuries remain as a significant burden in trauma center. Variations in pattern of injuries by age, gender and height of fall provide important information for targeted preventive measures.

Background

Injuries resulting from fall from height (FFH) are a growing public health problem worldwide. According to the World Health Organization (WHO), falls are the second leading cause of unintentional injuries resulting in deaths, with an estimated death rate of 646,000 individuals globally [1]. Each year, approximately 37.3 million falls occurs globally which are severe and requires medical attention. This leads to loss of 17 million disability-adjusted life years (DALYs), i.e. loss of potential years of life due to premature death. Economic burden associated with fall injuries are substantial, especially among the older adults who may require long-term care and institutionalization, for example, costing as high as over 3600 USD in the Republic of Finland. Older adults over 70 years of age, predominantly females, are at increased risk of fall-related mortality. However, significantly higher mortality was reported among pediatric and very young adults aged 15–29 years and children, and children under 15 years of age who accounts almost half of the DALYs lost universally [1].

Epidemiology of fall-related injuries in Qatar remains understudied, however some hospital-based studies on moderate to severe injuries suggest that FFH was the key contributor for work-related injuries (nearly 50%), particularly among the 18-59 age group (97%) [2]. Incidence of fall-related injuries was estimated as 86.7 per 100,000 workers with a mortality rate of 8.44 per 100,000 workers costing over 4.4 million USD, with an average cost of 15,735 USD per patient which is in fact costs 15 times higher than in the United States (1,3). Another study on injury burden among the pediatric population in Qatar revealed that fall was the most common mechanism among the age group of 0-4 years, leading to severe injuries requiring hospitalization (4). Prevalence of fall in the older adults over 60 years based on primary healthcare visits in Qatar was estimated as 34% with recurrent falls in 53% of the subjects (5). Albeit,

there is scarcity of information on epidemiological and clinical characteristics fall-related injuries in Qatar based on a nationally representative sample addressing all the age groups.

Therefore, the primary objective of this study was to describe the epidemiology and trends of unintentional falls requiring hospitalization in Qatar, clinical implications and in-hospital outcomes by gender, age group, and height of fall in the duration between 2010 and 2017.

Methods

The WHO definition of fall was followed in the current study, which refers fall as “inadvertently coming to rest on the ground or other lower level, excluding intentional change of position to lean on furniture, walls or other objects” (6). A retrospective study was conducted among patients admitted to the Hamad Trauma Center (HTC) of Hamad General Hospital (HGH) in Doha, Qatar. The study included all patients admitted to the HTC following fall-related injuries (intentional and unintentional) in the duration between January 2010 and December 2017. Patients with mild injuries following fall and presented to the Emergency Department (ED), and discharged without admission were excluded from the analysis. Brought in Dead (BID) cases were also excluded from the study.

The HTC is the only tertiary care facility in Qatar with 1500-1700 trauma admissions each year [7]. Data included in the study were nationally representative, retrieved from a prospectively maintained national trauma registry of trauma surgery section under the department of surgery in HGH. Qatar Trauma Registry is a mature database that participates in both National Trauma Data Bank and Trauma Quality Improvement Program of Committee on Trauma by the American College of Surgeons.

Data Collection: Data on fall-related injuries required trauma admission in the study duration were collected from the Qatar Trauma Registry. The trauma registry records the fall data using codes by International Classification of Diseases-10th Revision (ICD-10) which classified unintentional falls into 20 subcategories (W00-W19). Ethical approval for the study was granted from the medical research center and institutional review board of Hamad Medical Corporation, Doha, Qatar (IRB#MRC-01-18-004)

Data collected include patients’ demographics such as age, gender, nationality and occupation; locations of falls including workplace, home or recreational-related; heights of fall in meters; body regions injured , clinical characteristics ; vital signs and various injury scores and outcomes including length of stays in intensive care unit (ICU), ventilator and hospital (HLOS), and in-hospital mortality .

Consciousness following head injury was assessed using Glasgow Coma Scale (GCS) ranges from 3 to 15 in which GCS < 8 is severe, 9-12 is moderate and ≥ 13 is minor head injuries [8]. The Abbreviated Injury Scale (AIS) describe the severity of injuries at different body regions; the score ranges from 1-6, representing minor, moderate, serious, severe, critical and non-survivable injuries respectively from 1 to 6 [9]. AIS scores of 3 most severely injured body regions are squared and added together to estimate the Injury Severity Score (ISS) which provides an overall score for polytrauma [10]. The ISS score is ranges from 0 to 75; 1-8 is major, 9-15 is moderate, 16-24 is serious, 50-74 is critical and 75 is non-survivable

[10]. The Revised Trauma Score (RTS) provides information about starting triage based on GCS, systolic blood pressure (SBP) and respiratory rate (RR), ranges from 0 to 12 in which 3-10 indicates immediate, 11 urgent and 12 delayed triages. RTS is calculated using following equation [11]:

$$\text{RTS} = 0.9368 (\text{GCS}) + 0.8326 (\text{SBP}) + 0.2908 (\text{RR})$$

Trauma and injury severity score (TRISS), is an index that determines probability of survival based on RTS, ISS and age of the patient. The survival probability by TRISS is calculated using following formula [12].

Survival probability = $1/(1+ e^{-b})$ where b for blunt and penetrating injuries are

$$b_{\text{Blunt}} = -0.4499 + 0.8085 \times \text{RTS} - 0.0835 \times \text{ISS} - 1.7430 \times \text{Age Index}$$

$$b_{\text{Penetrating}} = -2.5355 + 0.9934 \times \text{RTS} - 0.0651 \times \text{ISS} - 1.1360 \times \text{Age Index}$$

Population data of Qatar was collected from the official website of Ministry of Development Planning and Statistics, Qatar to estimate the rates of injuries in each year [13].

Data Analysis

Data were expressed as rates per 10,000 population, proportions, mean \pm standard deviation or medians whenever appropriate. Percentage change was calculated to express the pattern of burden of fall-related injuries over the years. Comparative analyses were performed by classifying patients into groups by gender; by age-groups (0-19 yrs., 20-59 yrs. and \geq 60 yrs.); and by height of fall in meters (< 1m, 1.0 -2.9m, 3.0 -5.9 m and \geq 6m). Differences in categorical variables between groups were analyzed using Chi square tests or Fisher exact tests when observed cell values $n < 5$. The continuous variables were analyzed using student's t tests and two-tailed p values < 0.05 were considered as significant. One-way ANOVA tests were performed for multiple comparisons of means between the groups using Bonferroni technique when equal variances were assumed with the mean difference is at significant level < 0.05 . Data analysis was carried out using the Statistical Package for Social Sciences version 18 (SPSS Inc. Chicago, Illinois, USA).

Results

There were 4040 patients (31.6%) of all age groups admitted to the HTC following fall-related injuries over 8 years. Nearly 77% of victims were transported to the hospital by ground emergency medical services (GEMS) whereas approximately 3% were transported by helicopter emergency medical services (HEMS).

The average number of fall-related admissions was 505 per year which represents 32% of the trauma admissions. The average rate of fall-related injuries was estimated as 2.41 per 10,000 residents; males had a higher rate 2.88 per 10,000 male residents than females 1.04 per 10,000 female residents. A 39%

decrease was estimated in the overall rate of fall-related injuries over the years from 2010 to 2017. A peak in fall was seen in 2011 (overall rate 3.14 per 10,000 population), especially among the males (3.77 per 10,000 males) whereas a peak in fall among females was observed in 2017 (0.91 per 10,000 females) (**Table 1 & Figure 1**).

The mean age of patients was 32 years and 89% were males. **Figure 2** shows the mean age of patients with fall-related injuries across the years using ANOVA test. The age of patients was constant across the 8 years except for its peak in 2012 and 2015 (34 ± 18) and its drop in 2013 (30 ± 17).

Three out of four fall-related injuries were among the 20-59 age group and 8% were aged 60 years and above. Patients under the age of 20 years represented 18% of the total fall-related injuries. Nearly half of the falls (49%) were occurred at workplace and 37% of the victims were laborers by occupation. Approximately 22% of the falls were from the same level whereas 17% were from a height of 6 meters or above (**Table 2**).

Victims of fall-related injuries were otherwise generally healthy; only 8% had hypertension, 7% diabetes mellitus, 3% congestive heart failure and very few had psychiatric illness (0.3%). Of the victims, 4% were reportedly consumed alcohol; blood alcohol concentration ranged from 1.1 to 130.2 mmol/L.

Most of the injuries were to the head (36%) followed by spines (29%) and chest (23%). Head and chest injuries had a median AIS score 3 ranging from 1 to 5. Injuries to other body regions such as pelvis and abdomen were moderate injuries with median AIS score 2 (1-5). The ISS score revealed that most of the victims had moderate polytrauma (41%) followed by mild polytrauma in 32%. The median ISS was 9 (1-75). The mean RTS score was 7.5 ± 1.2 and the TRISS was 0.98 ± 0.05 (**Table 3**).

In-hospital outcome data showed that the median length of ICU, ventilator and hospital stays were 3 (1-126), 4 (1-43) and 5 (1-254) days respectively. Overall in-hospital mortality was 3% (**Table 3**).

Comparative analysis of fall-injuries by gender demonstrated significant differences in location of fall, height of fall, injured body regions and injury severity. Males were more likely to fall in workplace whereas females were vulnerable at home. Males were more likely to fall from higher heights when compared to females and more likely to experience chest and spinal injuries. Head injuries were comparable among both groups. The GCS among males were also significantly low. Injury severity in terms of ISS was higher among males. There were no significant differences in outcomes such as HLOS and mortality (**Table 4**).

Table 5 shows the results of comparative analysis of fall-related injuries by age group. Working age group was more likely to be injured following falls than other age groups and these falls were frequently from a height of approximately 3 meters. The proportion of females in older adults who got injured following falls was significantly higher than other age groups. Older adults were more likely to get injured following falls at home and these falls were frequently from the same level. Albeit, head injuries were significantly higher in young age group. Chest injuries were more common among the older adults

whereas spinal injuries and abdominal injuries were more often in working age group. The GCS at ED were lower, and ISS were higher in older adults than the other study groups. Worse outcomes including increased HLOS and mortality were observed in older adults.

The comparative analysis of fall-related injuries by height of fall revealed that nearly 17% of the falls were from a height of 6 meters or above. Obviously, falls from height $\geq 6\text{m}$ were occurred more frequently at workplace and falls from height $\leq 1\text{m}$ occurred at home. Proportion of males increased in falls from higher levels. (**Table 6**).

Discussion

To the best of our knowledge, this is a unique study of its kind in our region that describes the moderate to severe fall-related injuries. In addition, population based estimates of fall-related injuries in a small rapidly growing Arab country and its pattern over the years were not available prior to this study. The present study was based on nationally representative data, the major strength of the study, since HTC is the only tertiary care facility in Qatar that provides care for all trauma patients with moderate to severe injuries in the country.

The key findings of this study showed that fall-related injuries remain as an important public health problem among young subjects which accounts for one third of all trauma admissions. The rate of fall-related injuries decreased over the years (39% decreases in 8 years). Working age-group of 20-59 years and males were the main victims, especially falls from greater height at work-place. Older adults were more likely to fall at home from same level or less than 1m height and associated with higher mortality rate and head injuries were more common among pediatric and young adults.

Previously, several studies on trauma patients were conducted in Qatar and the burden of fall-injuries were addressed in some studies, however, these were among some specific groups of patients including work-related trauma, pediatric trauma, head injuries, spinal injuries and neck injuries (**Table 7**) (2-4, 14-21). These observational studies were based on the trauma registry data which prospectively captures epidemiological and clinical characteristics of patients and outcomes. It was demonstrated that 95% of the fall injuries in Qatar were work-related [15] and half of the total injuries at work-place were due to falls [2]. Working age group with a mean age of 33 years and males were the main principal victims [15]. Tuma et al study was on falls at the workplace among the construction workers and the large majority of the victims were migrant workers [15]. Evidence suggests that migrant workers are more likely to involve in high risk occupations such as construction sector. This also represents the workforce structure of Qatar where 94% of the workforce is migrants [22].

Fall was the leading mechanism of injury among the pediatric patients in Qatar which accounts for 36% of the total pediatric trauma [4]. Male predominance was not statistically significant between age-groups under pediatric trauma [4]. El-Menyar et al studied pediatric traumatic brain injuries (TBIs) and found that FFH was the second leading mechanism of TBIs (22%) following motor vehicle crashes (MVCs) [20]. Similar to prior study, there was no significant difference in male preponderances in all age-groups under

pediatric trauma. Although, the age-group classification was not specific to the pediatric population, our study demonstrated that pediatric group and younger adults accounted for the 18% of the total falls in all age-groups. On the other hand, male predominance among the patients under 20 years was comparatively less than the working age-group but higher than the older adults over 60 years.

Abdelrahman et al demonstrated that fall at home was an underestimated mechanism of injury among all age groups in Qatar [21]. However, older adults above 60 years of age were more likely to experience worse consequences following bathroom falls. Interestingly, female representation among this age group was higher among this age group when compared to patients under the age of 60 years [21]. Our study revealed that 8% of the total fall-related injuries in Qatar are among the older adults over 60 years of age.

Falls result in injuries to different body regions and these patterns of injuries varies with age-groups, gender and height of fall. In our study, chest injuries and spinal injuries were more common among males when compared to females whereas head injuries were comparable. El-Faramawy et al showed that 31% of the spinal fractures were due to FFH and lumbar spine injury was more prevalent among this group [14]. In the present study, spinal and abdominal injuries were more common among the working-age group than any other age groups. Chest injuries were more prevalent in older adult age-group. On the other hand, infants and very young adult age-group were more likely to experience head injuries. Tuma et al demonstrated that fall-injuries among working age-group in Qatar resulted mostly in spine (41%), head (38%), and chest (28%) injuries [15]. Al-Thani et al showed that lumbar spine (29%) injuries were more common following falls in working-age group, and chest and head injuries accounted for 28% and 24% of the fall-injuries [2]. Arumugam et al showed that one out of four abdominal injuries in Qatar were due to FFH [19].

A most recent study from China reported that slipping, tripping and stumbling resulting in falls on the same level; falls related to building or structure; and other falls from one level to different level are the leading mechanisms of fatal unintentional falls [23]. Of these, falls on the same level was associated with high mortality rate (29%) followed by falls from building or structure or through it (20%) [23]. These two in fact represents the older adults and worker population involved in high risk occupations. Mortality rate by gender, in our study, showed no significant differences, however, was significantly higher among the older adults. Femoral fracture was the main injury observed among the older adults (63%). A study from Iran showed that the average HLOS among all age-group of fall victims were over 6 days and, in our study, the median HLOS was 5 days [24]. On the other hand, median HLOS among the older adults was 9 days. Comorbidities associated with the older age group could have been contributed to longer duration of hospital stay and higher mortality.

One of the major limitations of the present study is the retrospective design itself; however such a study is much needed to provide an epidemiologic picture of an important public health problem. Secondly, the fall injuries in this study may include intentional falls along with the unintentional falls. Thirdly, information on work-related falls are lacking, however data on location of falls including home, work-place, street and recreational were available. Therefore, injuries occurred at workplace was assumed as

work-related. Finally, more detailed classification of pediatric and very young adults could have been used to provide more accurate information on burden of pediatric trauma; however, this is beyond the scope of the current paper.

Conclusions

Although the rate of fall injuries in Qatar decreased over the years, it still remains as a significant burden in trauma center since it accounts for 32% of the moderate to severe injuries requiring hospital admission. Epidemiologic and clinical characteristics and in-hospital outcomes of the patients by gender, age-group and height of fall provides a knowledge base for effective preventive measures.

Abbreviations

ISS: injury severity score

AIS: abbreviated injury scale

GCS: Glasgow coma scale

FFH: fall from height

TRISS: Trauma ISS

RTS: revised trauma score

Declarations

Ethics approval and consent to participate: This study granted ethical approval from the medical research center and institutional review board of Hamad Medical Corporation, Doha, Qatar (IRB#MRC-01-18-004).

Consent for publication: This study granted ethical approval from the medical research center and institutional review board of Hamad Medical Corporation, Doha, Qatar

Availability of data and material: Not applicable

Competing interests: None

Funding: None

Authors' contributions: AM,AE,AK,SH,KA,TS and HA: All authors contributed to the study design, the analysis and interpretation of data, and manuscript writing. All authors have read and approved the final manuscript

Acknowledgements: we thank trauma registry staff at WCMC at HMC for his cooperation.

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Tables

Table 1. Frequency and rate of fall-related injuries in Qatar by Gender (2010-2017)

Frequency of fall-related injuries			Population in Qatar			Rate of fall-related injuries per 10,000		
Males	Females	Total	Males	Females	Total	Males	Females	Overall
432	60	492	1,296,110	418,988	1,715,098	3.33	1.43	2.87
486	58	544	1,288,590	444,127	1,732,717	3.77	1.31	3.14
450	58	508	1,355,199	477,704	1,832,903	3.32	1.21	2.77
436	53	489	1,477,632	526,068	2,003,700	2.95	1.01	2.44
439	53	492	1,652,037	564,143	2,216,180	2.66	0.94	2.22
487	50	537	1,840,643	597,147	2,437,790	2.65	0.84	2.20
459	43	502	1,975,536	642,098	2,617,634	2.32	0.67	1.92
414	62	476	2,046,047	678,559	2,724,606	2.02	0.91	1.75
					Average rates	2.88	1.04	2.41

Table 2. Baseline characteristics of patients admitted for fall-related injuries	
Mean Age	32.9±18.26
Age group (n=3994;98.9%)	
0-19	726 (18.0)
20-29	1043 (25.8)
30-39	949 (23.5)
40-49	640 (15.8)
50-59	310 (7.7)
60-69	153 (3.8)
70 and above	173 (4.3)
Gender	
Males	3603 (89.2)
Females	437 (10.8)
Type of occupation	
Laborer	1485(36.8)
Agriculture	41 (1.0)
Installation, maintenance & repair	237 (5.9)
Transportation	79 (2.0)
Sales	8 (0.2)
Engineering	17(0.4)
Office & Administration	10 (0.2)
Housekeeper	77 (2.8)
Art, Entertainment, Sports	77(1.9)
Food Preparation & Serving	54 (1.3)
Military, protective services Management	23 (0.6)
Other Occupations	7 (0.2)
	12 (0.3)
Location of fall	
Work	1989 (49.2)
Home	1314 (32.5)
Street	128 (3.2)
Recreational	138 (3.4)
Public Place	82 (2.0)
Other	132 (3.3)
Not Documented	257 (6.4)
Height of fall	
Less than 1m	1064 (26.3)
1.0 -2.9m	875 (21.7)
3.0 -5.9 m	1152 (28.5)
≥ 6m	673 (16.7)

Table 3. clinical characteristics of patients admitted for fall-related injuries	
Variable	value
Injured regions	
· Head	1433 (35.5)
· Spine	1158 (28.7)
· Chest	946 (23.4)
· Pelvis	566 (14.0)
· Abdomen	526 (13.0)
Injury characteristics	
GCS	15 (3-15)
Head AIS	3 (1-6)
Chest AIS	3 (1-5)
Abdomen AIS	2 (1-5)
Pelvis AIS	2 (1-5)
ISS (n=3954, 97.9%)	
· 1-8	1306 (32.3)
· 9-15	1657 (41.0)
· 16-24	578 (14.3)
· 25-49	397(9.8)
· ≥50	16 (0.4)
Trauma Injury Severity Score (TRISS)	0.98 ±0.05
Revised Trauma score (RTS)	7.5 ±1.2
Outcomes	
Hospital LOS (n=4030, 99.8%)	5 (1-254)
ICU stay (n=1018, 25.2%)	3 (1-126)
Ventilator Days (n=493, 12.2%)	4 (1-43)
In-hospital mortality	154 (3.1)

Table 4. Characteristics and outcomes of fall-related injuries aby gender (N= 4040)

	Males	Females	P-value
N (%)	3603 (89.2)	437 (10.8)	
Age	33.2±16.7	31.6±27.9	0.26
Falls at workplace	1935 (53.7)	54 (12.4)	0.001
Falls at home	1015 (28.2)	299 (68.4)	0.001
Median height of fall	3 (0-45)	0.5 (0-15)	0.001
Head injury	1284 (35.6)	149 (34.1)	0.53
Chest injury	881 (24.5)	65 (14.9)	0.001
Spinal injury	1069 (29.7)	89 (20.4)	0.001
Abdominal	490 (13.6)	36 (8.2)	0.001
GCS at ED	13.8±3.3	14.3±2.6	0.001
ISS	12.0±8.7	9.8±6.8	0.001
TRISS	0.98±0.06	0.98±0.03	0.002
RTS	7.5±1.2	7.6±0.9	0.03
HLOS	5 (1-254)	5 (1-119)	0.23
Mortality	123 (3.4)	8 (1.8)	0.08

Table 5. Characteristics and outcomes of patients following fall-related injuries by age-groups between 2010 and 2017 (N=3994)

	0-19 yrs.	20-59 yrs.	≥60 yrs.	P-value
N (%)	726 (18.0)	2942 (72.8)	326 (8.1)	
Males	543 (74.8)	2794 (95.0)	225 (69.0)	0.001
Falls at workplace	39 (5.4)	1896 (64.4)	47 (11.3)	0.001
Falls at home	469 (64.6)	601 (20.4)	237 (72.7)	0.001
Median height of fall	1 (0-15)	3 (0-45)	0 (0-20)	0.001
Head injury	387 (53.3)	926 (31.5)	96 (29.4)	0.001
Chest injury	79 (10.9)	764 (26.0)	91 (27.9)	0.001
Spinal injury	65 (9.0)	1024 (34.8)	60 (18.4)	0.001
Abdominal	70 (9.6)	423 (14.4)	25 (7.7)	0.001
GCS at ED	14.3±2.3	13.8±3.3	14.3±2.4	0.001
ISS	9.4±7.8	12.3±8.7	11.6±7.1	0.001
TRISS	0.99±0.04	0.98±0.06	0.98±0.06	0.001
RTS	7.6±0.8	7.5±1.1	7.6±0.9	0.03
HLOS	2(1-98)	6 (1-254)	9 (1-182)	0.001
Mortality	7 (1.0)	86 (2.9)	19 (5.8)	0.001

Table 6. Characteristics and outcomes of patients following fall-related injuries by height of fall categories between 2010 and 2017 (N =3764)

	< 1m	1.0 -2.9m	3.0 -5.9 m	≥ 6m	P-value
N (%)	1064 (26.3)	875 (21.7)	1152 (28.5)	673 (16.7)	
Mean age	37.2±24.7	29.0±17.3	32.8±12.9	31.8±11.4	0.001
Males	846 (79.5)	787 (89.9)	1106 (96.0)	632 (89.6)	0.001
Falls at workplace	156 (14.7)	411 (47.0)	853 (74.0)	502 (74.6)	0.001
Falls at home	690 (64.8)	284 (32.5)	158 (13.7)	85 (12.6)	0.001
Head injury	436 (41.0)	337 (38.5)	344 (29.9)	208 (30.9)	0.001
Chest injury	171 (16.1)	181 (20.7)	303 (26.3)	246 (36.6)	0.001
Spinal injury	137 (12.9)	215 (24.6)	462 (40.1)	299 (44.4)	0.001
Abdominal	79 (7.4)	109 (12.5)	154 (13.4)	140 (20.8)	0.001
GCS at ED	14.4±2.3	14.3±2.5	13.9±3.0	12.5±4.6	0.001
ISS	10.2±7.3	10.8±7.7	12.3±8.7	15.0±10.6	0.001
TRISS	0.98±0.04	0.99±0.05	0.98±0.06	0.97±0.08	0.001
RTS	7.66±0.74	7.64±0.83	7.56±0.98	7.01±1.9	0.001
HLOS	4 (1-182)	4 (1-87)	6 (1-137)	8 (1-217)	0.001
Mortality	28 (2.6)	10 (1.1)	34 (3.0)	43 (6.4)	0.001

Table 7. Burden of fall-related injuries in Qatar from previous studies

Study	Study population	Study duration	Total injuries	Fall injuries
El-Faramawy et al (2012) [14]	Spinal fractures	2007 to 2009 (26 months)	442 spinal injuries	31% FFH
Tuma et al (2013) [15]	Work-related fall injuries (WRFI)	2007-2008 (12 months)	315 total falls	95% WRFI
El-Matbouly et al (2013) [16]	Traumatic brain injury (TBI)	2008-2011 (48 months)	1665 TBI	35% FFH
Al-Thani et al (2014) [2]	Work-related injuries (WRI)	2010-2012 (36 months)	1496 WRI	51% FFH
Parchani et al (2014) [17]	Traumatic subarachnoid hemorrhage (TSAH)	2008 -2012 (55 months)	403 TSAH	35% FFH
Mahmood et al (2014) [3]	Intubated patients in trauma intensive care unit (TICU)	2009-2010 (24 months)	343 Intubated in TICU	18% Falls
Alyafei et al (2015) [4]	Pediatric trauma	2011 (12 months)	163	36%
Al-Thani et al (2015) [18]	Traumatic neck injury (TNI)	2008-2012 (60 months)	51	10%
Arumugam et al (2015) [19]	Abdominal trauma	2008-2011 (48 months)	1036	25%
El-Menyar et al (2017) [20]	Pediatric TBI	2010-2014 (60 months)	945 TBI	22% Falls
Abdelrahman et al (2018) [21]	Falls at home (FH)	2008-2011 (36 months)	98 FH	-

Trauma registry was the data source in all studies; FFH: Fall from height

Figures

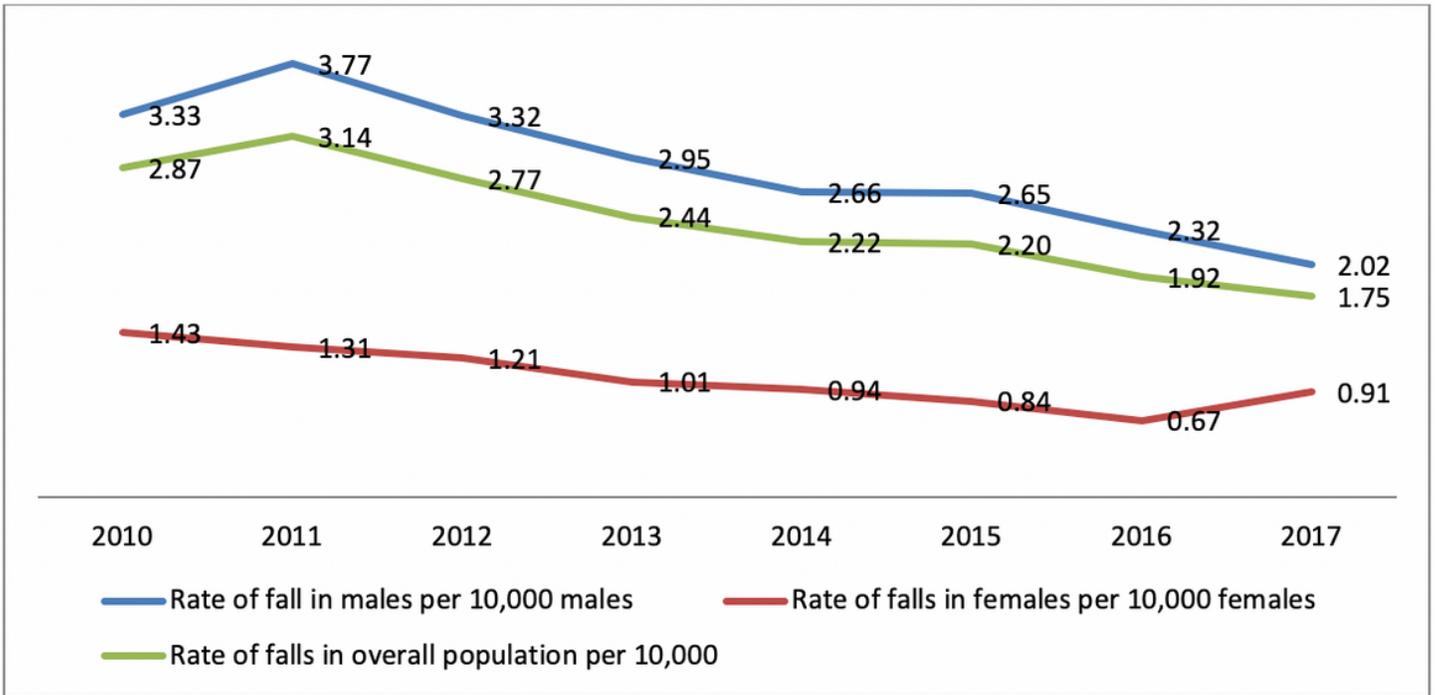


Figure 1

Trends in rate of fall-related injuries in Qatar by gender (2010-2017)

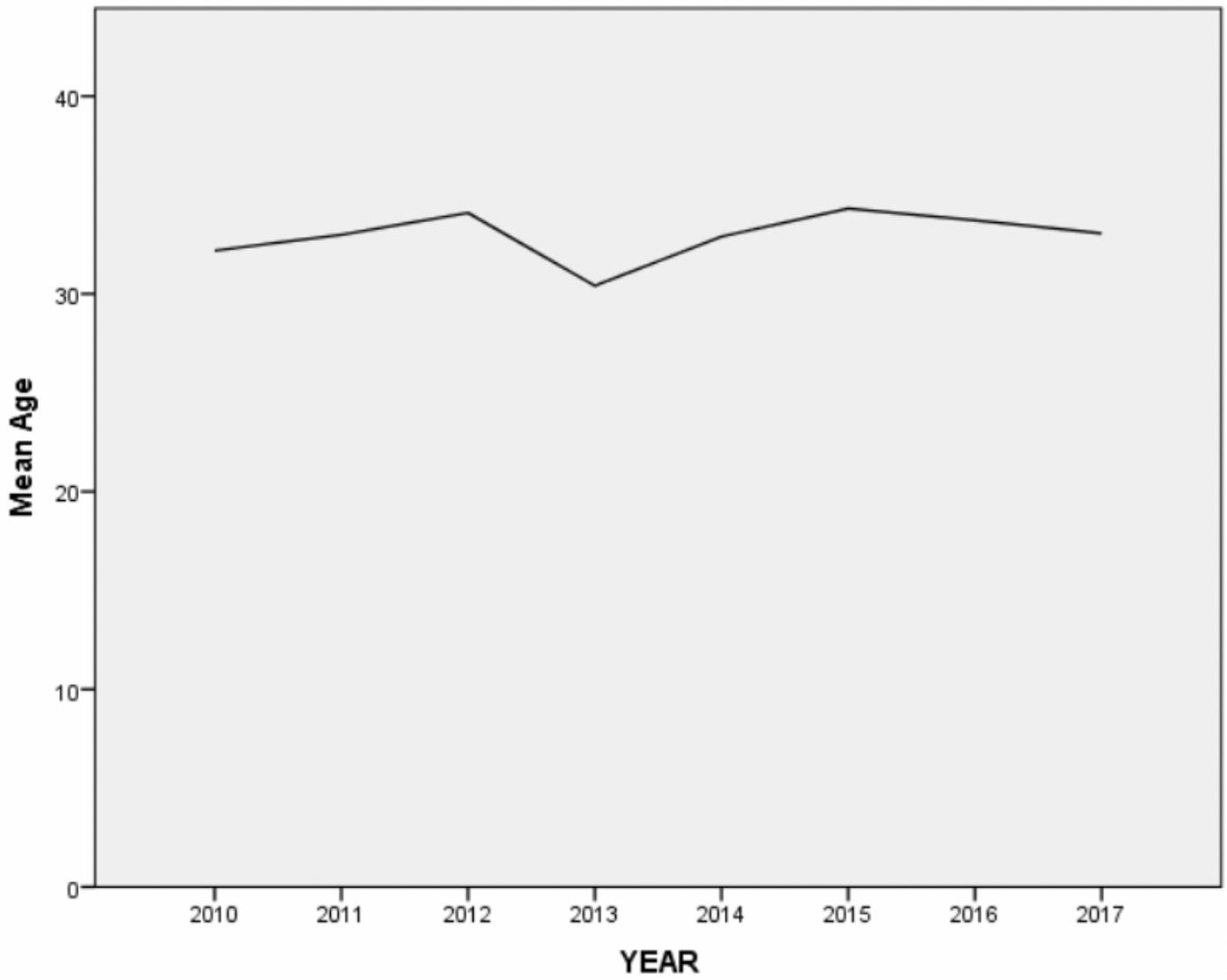


Figure 2

The mean age of patients with fall-related injuries across the years using ANOVA test ($p=0.02$)