

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

Ahammed Mekkodathil

Hamad Medical Corporation

Ayman El-Menyar (✉ aymanco65@yahoo.com)

Hammad General Hospital & Weill Cornell Medical College <https://orcid.org/0000-0003-2584-953X>

Ahad Kanbar

Hamad Medical Corporation

Suhail Hakim

Hamad General Hospital

Khalid Ahmed

Hamad Medical Corporation

Tariq Siddiqui

Hamad Medical Corporation

Hassan Al-Thani

Hamad Medical Corporation

Research article

Keywords: fall, height, trauma, injury

Posted Date: January 8th, 2020

DOI: <https://doi.org/10.21203/rs.2.16009/v2>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

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 2.34 per 10,000 population in Qatar. Although the rate of fall injuries decreased over the years, the average number of patients per year still accounts for 32% of the moderate and severe injuries requiring admission. Most of the injuries were to the head (36%) followed by spines (29%) and chest (23%). Males were predominant (89%), more likely to fall at workplace, fall from a greater height and experience polytrauma than females. Working age-group (20-59 years) were the major victims (73%), more likely to fall at work place, fall from height comparing to older adults who tend to fall at home, fall from the same level. Overall in-hospital mortality was 3%. Outcomes including longer length of hospital stay and mortality were generally associated with the height of falls. **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, the average cost per fall injury in the Republic of Finland was reported as 3600 USD [1]. Older adults over 70 years of age are at increased risk of fall-related mortality [1]. However, significantly higher mortality was reported among pediatric and very young adults aged 15–29 years 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. Such studies will contribute to policy-makers and developing preventive strategies.

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

Setting and subjects: 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. 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 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).

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; vital signs; various injury scores and outcomes including length of stays in intensive care unit (ICU), ventilator and hospital length of stay (LOS), 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 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, numbers, percentages, mean \pm standard deviation or medians with interquartile range whenever appropriate. Percentage change in the rate of fall injuries per 10,000 population was calculated to express the pattern of burden of fall-related injuries in the study duration. Comparative analyses were performed by classifying patients into groups by gender; by age-groups (0-19 years (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 between different gender groups were compared 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 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 (505/1600). The average rate of fall-related injuries was estimated as 2.34 per 10,000 residents; males had a higher rate 2.78 per 10,000 male residents than females 1.00 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 the rate of fall injuries 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 injuries among females was observed in 2010 (1.43 per 10,000 females) (**Table 1 & Figure 1**).

The mean age of patients was 32 years and 89% were males (Table 2). **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). About 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 (Table 2).

More than half of the fall injuries (53%) were occurred at workplace and 72% of the victims were laborers by occupation. Nearly half (49%) of the data on type of occupation was missing. Data on the height of fall was available in 93 percent. Approximately 28% of the fall injuries were from the same level whereas 18% were from a height of 6 meters or above (**Table 2**). Victims of fall-related injuries were otherwise generally healthy (82%); only 8% had hypertension, 7% diabetes mellitus, 3% congestive heart failure and very few had psychiatric illness (0.3%) (Table 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 6. 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 (42%) followed by mild polytrauma in 33%. 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 frequently injured following falls in workplace whereas females were vulnerable at home. Falls resulted in injuries among males occurred more commonly from higher heights when compared to that in females and males experienced chest and spinal injuries more often. 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 were the major victims of the fall injuries when compared to 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 got injured more often 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 higher, and ISS were lower in older adults. Worse outcomes including increased HLOS and mortality were observed in older adults. In the working age group, mortality was comparable between the age-groups 20-34 years, 35-44 years and 45-64 years. However, longer LOS in hospital was observed in both young age-groups (20-34 and 35-44 years) when compared to 45-64 years ($p=0.001$) (Supplementary table).

The comparative analysis of fall-related injuries by height of fall revealed that fall from the same level ($<1\text{m}$) was associated with poor outcomes when compared to falls from height groups ($>1\text{m}$) (Table 6). Notably, the proportion of older adults and pediatric patients were higher in this group. In fall from height cases ($>1\text{m}$), an increasing trend in ISS and poor outcomes in terms of LOS and mortality was observed. Nearly 18% 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**).

Table 7 illustrates the burden of fall-related injuries in Qatar based on previous studies published in different duration of time. Although the objectives and study populations in these studies were different, fall was one of the main mechanisms of injuries.

Discussion

To the best of our knowledge, this is a unique study of its kind in the Arabian Gulf region that describes moderate to severe fall-related injuries based on a nationally representative data. Previously, multiple studies among trauma patients in Qatar revealed the burden of fall injuries, 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). The present study described epidemiological and clinical characteristics of fall-related injuries, also by gender, age groups and height of fall. It provided new data on fall-related injuries based on a nationally representative sample across all age groups which is of significance in providing important information for falls prevention.

The present study revealed that the rate of fall injuries in Qatar was 2.34 per 100,000 population. The rate of fall injuries decreased by 39% from 2010 to 2017, however, the average number of patients per year still accounted for 32% of the moderate and severe injuries requiring admission. Working age-group of 20-59 years and males were the main victims, especially due to falls from greater height at workplace. Outcomes including longer LOS and higher mortality were associated with the height of falls. Older adults were more frequently injured following falls at home from same level or less than 1m height and had a higher mortality.. Head injuries were more common among pediatric and young adults.

Hospital cost associated with traumatic injuries following falls in Qatar was published earlier which demonstrated that it costs approximately 15,735 USD per patient. Our finding that more than one out of three (32%) trauma admissions were fall-related, poses a significant impact on the health financial system in the country. It was demonstrated that 95% of the fall injuries in Qatar were work-related [15] and half of the total injuries at workplace were due to falls [2]. Working age group with a mean age of 33 years and males were the main principal victims [15]. These facts support our findings about age group of the major victims. 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]. Our findings about injuries due to fall from greater height among working age-group are in line with these migrant worker characteristics such as male predominance, young age and greater involvement in riskier jobs like construction works. The present study, however, demonstrated that the rate of fall injuries decreased over the years which may be linked to the increased safety awareness among the construction workers and companies. In addition, the infrastructure projects that had started almost 10 years back in preparation for FIFA world cup football-2022 is currently at the final stage, and therefore exposure to work-related injuries reduced over the years.

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]. Both studies on pediatric trauma

revealed that there were no significant differences in male preponderances across all pediatric age-groups [4, 20]. 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.

Although the major victims of fall injuries in our study was working age-group, older adults over 60 years of age (8%) could not be underestimated because of the worse outcomes including increased length of stay and mortality when compared to other age-groups. As mentioned earlier, older adults were injured more commonly following falls from same level that occur at home. A previous study in Qatar explored falls at home among all age groups and found that older adults above 60 years of age were more likely to experience worse consequences following bathroom falls [21]. Interestingly, female representation among this age group was higher among this age group when compared to patients under the age of 60 years which is also similar to our findings [21]. Our study revealed that fall injuries at home were more frequent in females than males (Table 4).

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]. In our study, although the older adults had injuries following falls at home more frequently and had worse outcomes, the major victims were working age-group and falls from greater height resulted in higher mortality. 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. This will not affect the main objectives of the study because of insignificantly low number of intentional falls (1.4%); however, it may have impact on the pattern of injuries. 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. Recently, the trauma registry and other hospital records in our institute included the field of work-place injuries. 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.

List Of 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 HMC for their cooperation.

References

1. World Health Organization: Falls Available at <https://www.who.int/news-room/fact-sheets/detail/falls>
2. Al-Thani H, El-Menyar A, Abdelrahman H, Zarour A, Consunji R, Peralta R, Asim M, El-Hennawy H, Parchani A, Latifi R. Workplace-related traumatic injuries: insights from a rapidly developing Middle Eastern country. *J Environ Public Health*. 2014;2014:430832.
3. Mahmood S, Alani M, Al-Thani H, Mahmood I, El-Menyar A, Latifi R. Predictors of reintubation in trauma intensive care unit: qatar experience. *Oman Med J*. 2014;29(4):289-93.
4. Alyafei KA, Toaimah F, El Menyar A, Al Thani H, Youssef B, Mollazehi M, Consunji R. Analysis of pediatric trauma data from a hospital based trauma registry in Qatar. *Int J Crit Illn Inj Sci*. 2015;5(1):21-6.
5. Almawlawi E, Al Ansari A, Ahmed A. Prevalence and Risk Factors for Falls Among the Elderly in Primary Healthcare Centers (PHC) in Qatar. *Qatar medical journal*. 2011;20(1):12-7.
6. Yoshida, S. A Global Report on Falls Prevention: Epidemiology of Falls. Geneva, Switzerland: World Health Organization. Available at <http://www.who.int/ageing/projects/1.Epidemiology%20of%20falls%20in%20older%20age.pdf>

7. Al-Thani H, Jabbour G, El-Menyar A, Wahlen BM, Asim M, Abdelrahman H, Nabir S, Al-Jogol H, Mahmood I, El-Faramawy A, Parchani A, Afifi I, Peralta R. Traumatic sternal injury in patients with rib fracture: A single-center experience. *Int J Crit Illn Inj Sci* 2019;9:75-81
8. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet*. 1974 Jul 13;2(7872):81-4.
9. Copes WS, Sacco WJ, Champion HR, Bain LW. Progress in Characterizing Anatomic Injury, In Proceedings of the 33rd Annual Meeting of the Association for the Advancement of Automotive Medicine, Baltimore, MA, USA 205-218.
10. Baker SP, O'Neill B, Haddon W Jr, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma*. 1974 Mar;14(3):187-96.
11. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. *J Trauma*. 1989 May;29(5):623-9.
12. Boyd CR, Tolson MA, Copes WS. Evaluating trauma care: the TRISS method. Trauma Score and the Injury Severity Score. *J Trauma*. 1987 Apr;27(4):370-8.
13. Ministry of Development Planning and Statistics, Qatar (MDPS) available at: <https://www.mdps.gov.qa/en/statistics1/Pages/default.aspx>
14. El-Faramawy A, El-Menyar A, Zarour A, Maull K, Riebe J, Kumar K, Mathew J, Parchani A, Al-Thani H, Latifi R. Presentation and outcome of traumatic spinal fractures. *J Emerg Trauma Shock*. 2012 Oct;5(4):316-20.
15. Tuma MA, Acerra JR, El-Menyar A, Al-Thani H, Al-Hassani A, Recicar JF, Al Yazeedi W, Maull KI. Epidemiology of workplace-related fall from height and cost of trauma care in Qatar. *Int J Crit Illn Inj Sci*. 2013 Jan;3(1):3-7.
16. El-Matbouly M, El-Menyar A, Al-Thani H, Tuma M, El-Hennawy H, AbdulRahman H, Parchani A, Peralta R, Asim M, El-Faramawy A, Zarour A, Latifi R. Traumatic brain injury in Qatar: age matters—insights from a 4-year observational study. *ScientificWorldJournal*. 2013 Jul 22;2013:354920.
17. Parchani A, El-Menyar A, Al-Thani H, El-Faramawy A, Zarour A, Asim M, Latifi R. Traumatic subarachnoid hemorrhage due to motor vehicle crash versus fall from height: a 4-year epidemiologic study. *World Neurosurg*. 2014 Nov;82(5):e639-44.
18. Al-Thani H, El-Menyar A, Mathew S, Khawar M, Asim M, Abdelrahman H, Peralta R, Parchani A, Zarour A. Patterns and outcomes of traumatic neck injuries: A population-based observational study. *J Emerg Trauma Shock*. 2015;8(3):154-8.
19. Arumugam S, Al-Hassani A, El-Menyar A, Abdelrahman H, Parchani A, Peralta R, Zarour A, Al-Thani H. Frequency, causes and pattern of abdominal trauma: A 4-year descriptive analysis. *J Emerg Trauma Shock*. 2015;8(4):193-8.
20. El-Menyar A, Consunji R, Al-Thani H, Mekkodathil A, Jabbour G, Alyafei KA. Pediatric Traumatic Brain Injury: a 5-year descriptive study from the National Trauma Center in Qatar. *World J Emerg Surg*. 2017 Nov 7;12:48.
21. Abdelrahman H, Almadani A, El-Menyar A, Shunni A, Consunji R, Al-Thani H. Home-related falls: An underestimated mechanism of injury. *J Family Community Med*. 2018;25(1):48-51.
22. Mekkodathil A, El-Menyar A, Al-Thani H. Occupational injuries in workers from different ethnicities. *Int J Crit Illn Inj Sci*. 2016 Jan-Mar;6(1):25-32.
23. Cheng P, Wang L, Ning P, Yin P, Schwebel DC, Liu J, Qi J, Hu G, Zhou M. Unintentional falls mortality in China, 2006-2016. *J Glob Health*. 2019;9(1):010603.

24. Ghaffari-Fam S, Sarbazi E, Daemi A, Sarbazi MR, Riyazi L, Sadeghi-Bazargani H, Allahyari A. Epidemiological and Clinical Characteristics of Fall Injuries in East Azerbaijan, Iran; A Cross-Sectional Study. Bull Emerg Trauma. 2015;3(3):104-110

Tables

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

Year	Number of fall-related injuries			Estimated population in Qatar			Rate of fall-related injuries per 10,000		
	Males	Females	Total	Males	Females	Total	Males	Females	Overall
2010	432	60	492	1,296,110	418,988	1,715,098	3.33	1.43	2.87
2011	486	58	544	1,288,590	444,127	1,732,717	3.77	1.31	3.14
2012	450	58	508	1,355,199	477,704	1,832,903	3.32	1.21	2.77
2013	436	53	489	1,477,632	526,068	2,003,700	2.95	1.01	2.44
2014	439	53	492	1,652,037	564,143	2,216,180	2.66	0.94	2.22
2015	487	50	537	1,840,643	597,147	2,437,790	2.65	0.84	2.20
2016	459	43	502	1,975,536	642,098	2,617,634	2.32	0.67	1.92
2017	414	62	476	2,046,047	678,559	2,724,606	2.02	0.91	1.75
average	3603	437	4040	12,931,794	4,348,834	17,280,628	2.78	1.00	2.34

Table 2. Baseline characteristics of patients admitted for fall-related injuries between 2010 and 2017 (N= 4040)	
Mean age ± SD	32.9±18.26
Age group in years (n=3994; 98.9%)*	
0-19	726 (18.2)
20-29	1043 (26.1)
30-39	949 (23.8)
40-49	640 (16.0)
50-59	310 (7.8)
60-69	153 (3.8)
70 and above	173 (4.3)
Gender (n=4040; 100%)*	
Males	3603 (89.2)
Females	437 (10.8)
Type of occupation (n=2059; 50.9%)*	
Laborer	1485(72.1)
Installation, maintenance & repair	237 (11.5)
Transportation	79 (3.8)
Housekeeper	77 (3.7)
Agriculture	41 (2.0)
Military, protective services Management	23 (1.1)
Engineering	17(0.8)
Management	12 (0.6)
Office & Administration	10 (0.5)
Other occupations**	78 (3.8)
Location of fall (n=3783; 93.6%)*	
Work	1989 (52.6)
Home	1314 (34.8)
Street & public place	210 (5.6)
Recreational	138 (3.6)
Other	132 (3.4)

Height of fall (meters) (n=3764; 93.2%)*

Less than 1m	1064 (28.3)
1.0 -2.9m	875 (23.2)
3.0 -5.9 m	1152 (30.6)
≥ 6m	673 (17.9)

Data expressed as numbers, and valid percentages in bracket; SD: Standard deviation; *available data; **other occupations include: sales, art, entertainment, sports, and food preparation and serving

Table 3. Clinical characteristics of patients admitted for fall-related injuries (N= 4040)	
Comorbidities (n=4040, 100%)*	
• Hypertension	320 (7.9)
• Diabetes mellitus	272 (6.7)
• Congestive heart failure	106 (2.6)
• Psychiatric illness	13 (0.3)
• None reported	3329 (82.3)
Injured regions (n=4040, 100%)*	
• Head	1433 (35.5)
• Spine	1158 (28.7)
• Chest	946 (23.4)
• Pelvis	566 (14.0)
• Abdomen	526 (13.0)
Injury characteristics	
GCS at ED	15 (IQR 15-15)
Head AIS	3 (IQR 3-4)
Chest AIS	3 (IQR 2-3)
Abdomen AIS	2 (IQR 2-3)
Pelvis AIS	2 (IQR 2-2)
ISS (n=3954, 97.9%)*	
• 1-8	1306 (33.0)
• 9-15	1657 (41.9)
• 16-24	578 (14.6)
• 25-49	397(10.0)
• ≥50	16 (0.5)
TRISS	0.98 ±0.05
RTS	7.5 ±1.2
Outcomes	
Hospital LOS days (n=4030, 99.8%)*	5 (IQR 2-11)
ICU stay days (n=1018, 25.2%)	3 (IQR 2-8)
Ventilator days (n=493, 12.2%)	4 (IQR 1-9)
In-hospital mortality	154 (3.1)
Data expressed as numbers and valid percentages in brackets, or mean± standard deviation, or median with interquartile range (IQR) in bracket; *available data; GCS: Glasgow Coma Score; ED: Emergency Department; AIS:Abbreviated Injury Scale; TRISS: Trauma Injury Severity Score ; RTS: Revised Trauma score; LOS: Length of Stay; ICU: Intensive Care Unit	

Table 4. Characteristics and outcomes of patients following fall-related injuries by gender between 2010 and 2017 (N= 4040)			
	Males (n=3603, 89.2%)	Females (n=437, 10.8%)	P-value
Mean age \pm SD (years)	33.2 \pm 16.7	31.6 \pm 27.9	0.26
Location of fall			0.001
Work	1935 (53.7)	54 (12.4)	
Home	1015 (28.2)	299 (68.4)	
Street/public place	185 (5.1)	25 (5.7)	
Recreational	111 (3.1)	27 (6.2)	
Other	357 (9.9)	32 (7.3)	
Median height of fall (meters)	3 IQR (0.5-5)	0.5 IQR (0-0.5)	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 \pm 3.3	14.3 \pm 2.6	0.001
ISS	12.0 \pm 8.7	9.8 \pm 6.8	0.001
TRISS	0.98 \pm 0.06	0.98 \pm 0.03	0.002
RTS	7.5 \pm 1.2	7.6 \pm 0.9	0.03
Hospital LOS (days)	5 (IQR 2-11)	5 (IQR 2-12)	0.23
Mortality	123 (3.4)	8 (1.8)	0.08
Data expressed as numbers and valid percentages in bracket, or mean \pm standard deviation (SD), or median with interquartile range (IQR) in bracket; GCS: Glasgow Coma Score; ED: Emergency Department; ISS: Injury Severity Score; TRISS: Trauma Injury Severity Score ; RTS: Revised Trauma score; LOS: Length of Stay			

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

	0-19 yrs. (n=726, 18.2%)	20-59 yrs. (n=2942, 73.7%)	≥60 yrs. (n= 326, 8.1%)	P-value
Males	543 (74.8)	2794 (95.0)	225 (69.0)	0.001
Location of fall				0.001
Work	39 (5.4)	1896 (64.4) 601	47 (11.3)	
Home	469 (64.6)	(20.4)	237 (72.7)	
Street/public place	77 (10.6)	110 (3.7)	21 (6.4)	
Recreational	75 (10.3)	61 (2.1)	2 (0.6)	
Other	66 (9.1)	274 (9.3)	29 (8.9)	
Median height of fall (meters)	1 IQR (0-2.5)	3 IQR (1.5-5.0)	0 (0-0.5)	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
Hospital LOS (days)	2 (IQR 1-5)	6 (IQR 3-13)	9 (IQR 4-21)	0.001
Mortality	7 (1.0)	86 (2.9)	19 (5.8)	0.001

Data expressed as numbers and valid percentages in bracket, or mean± standard deviation or median with interquartile range (IQR) in bracket; GCS: Glasgow Coma Score; ED: Emergency Department; ISS: Injury Severity Score; TRISS: Trauma Injury Severity Score ; RTS: Revised Trauma score; LOS: Length of Stay

	< 1m (n=1064, 28.3%)	1.0 -2.9m (n=875, 23.2%)	3.0 -5.9 m (n=1152, 30.6%)	≥ 6m (n=673 , 17.95)	P-value
Mean age± SD(years)	37.2±24.7	29.0±17.3	32.8±12.9	31.8±11.4	0.001
Age groups					
0-19 yrs.	275 (25.8)	226 (25.8)	110 (9.5)	53 (7.8)	0.001
20-59 yrs.	566 (53.2)	621 (70.9)	1002 (86.9)	584 (86.8)	
≥60 yrs.	222 (20.9)	51 (5.8)	35 (3.0)	11 (1.6)	
Males	846 (79.5)	787 (89.9)	1106 (96.0)	632 (89.6)	0.001
Location of fall	156 (14.7) 690 (64.8)	411 (47.0) 284 (32.5)	853 (74.0) 158 (13.7)	502 (74.6) 85 (12.6)	0.001
• Workplace	218 (20.4)	180 (20.6)	141 (12.2)	86 (12.8)	
• Home					
• Other					
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
Hospital LOS (days)	4 (IQR 2-10)	4 (IQR 2-8)	6 (IQR 3-13)	8 IQR (3-20)	0.001
Mortality	28 (2.6)	10 (1.1)	34 (3.0)	43 (6.4)	0.001
Data expressed as numbers and valid percentages in bracket, or mean± standard deviation or median with interquartile range in bracket; GCS: Glasgow Coma Score; ED: Emergency Department; ISS: Injury Severity Score; TRISS: Trauma Injury Severity Score ; RTS: Revised Trauma score; LOS: Length of Stay					

Study	Study characteristics	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]	WRFI	2007-2008 (12 months)	315 total falls	95% WRFI
El-Matbouly et al (2013) [16]	TBI	2008-2011 (48 months)	1665 TBI	35% FFH
Al-Thani et al (2014) [2]	(WRI)	2010-2012 (36 months)	1496 WRI	51% FFH
Parchani et al (2014) [17]	TSAH	2008 -2012 (55 months)	403 TSAH	35% FFH
Mahmood et al (2014) [3]	Intubated patients in 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]	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]	FH	2008-2011 (36 months)	98 FH	-

Trauma registry was the data source in all studies; FFH: Fall from height; WRFI: **work-related fall injuries**; TBI: traumatic brain injury; WRI: work-related injuries; TASH: traumatic subarachnoid hemorrhage; TICU: trauma intensive care unit; TNI:traumatic neck injury; FH: falls at home

Figures

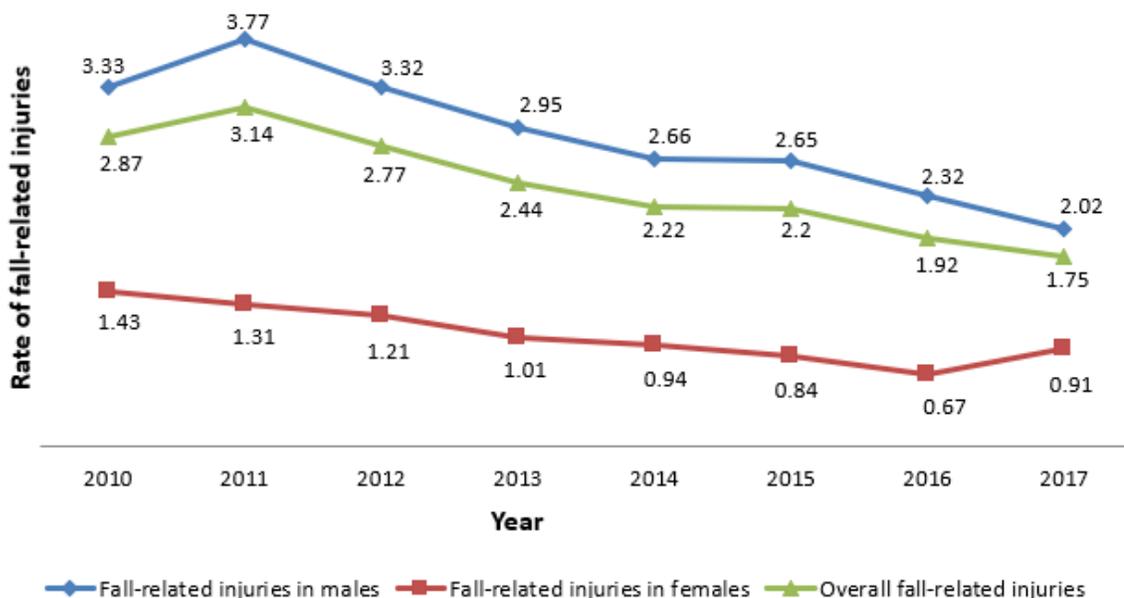


Figure 1

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

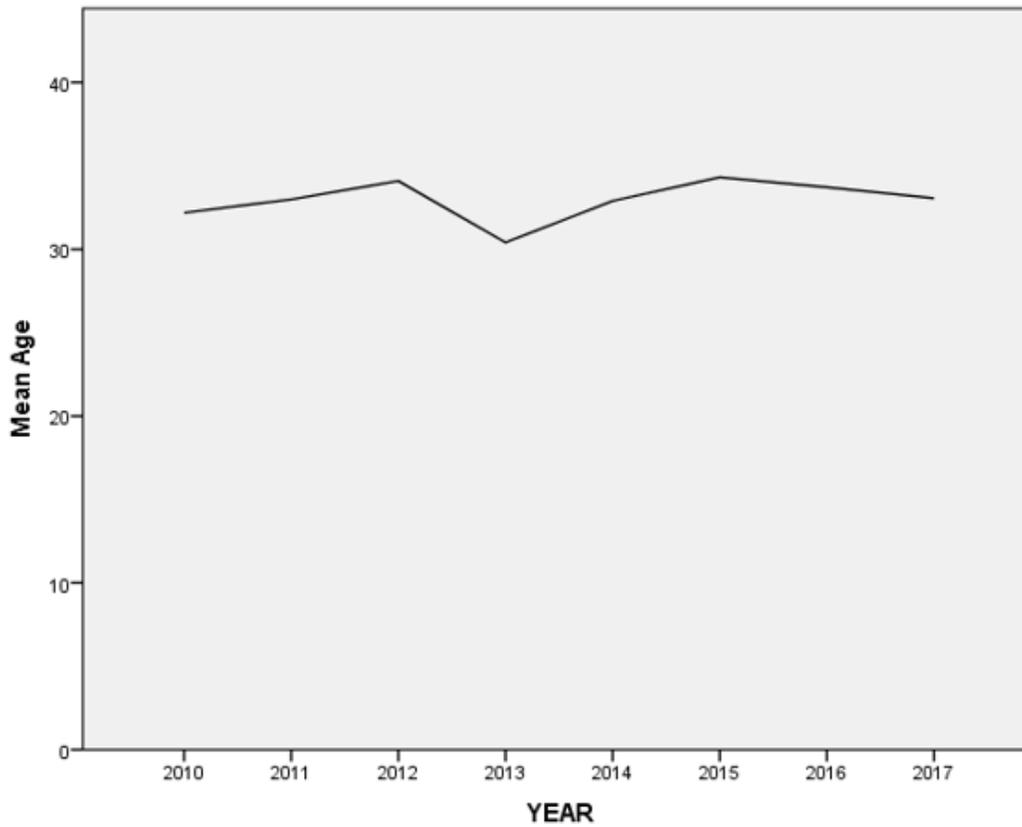


Figure 2

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

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Supplementarytable.docx](#)