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Epidemiology of the Upper Extremity Trauma in a Traumatic Center in Iran

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Abstract

Introduction: Orthopedic injuries are the most common types of traumatic injuries and present as fractures of the limbs, pelvis, and vertebrae or lesions in soft tissues, muscles, ligaments, and tendons. The upper limb fractures occur in distal radius and ulna, metacarpals, fingers, scapula, and carpal bones, Proximal, diaphysis, distal humerus, clavicle, proximal ulna and radio and distal humero and humero, radio, ulna, and metacarpo. The objective of this project was to accurately describe the occurrence of injuries of the upper extremity and the mechanisms of such injuries in a representative sample of Iranian population.

Method: This prospective case series was performed on the patients admitted to Shafa Yahyaian Hospital through the emergency ward within 6 months. Patients' demographic features, the information about the mechanism of injury in soft tissues, bones and joints which obtained using clinical examination and imaging techniques, also the findings during the surgery were recorded in the information form. All analyses were performed using SPSS software, version 21. The independent t test or Mann-Whitney test and the Chi-square test or Fisher's exact test was used to compare the data. The results were significant at $P<0.05$.

Results: This study was performed on 1287 patients with upper limb fracture. The male and female patients respectively comprised of 998 (77.5%) and 289 (22.5%) subjects. About 113 patients suffered injuries at shoulder joint or its surrounding bones. The most common traumatic mechanisms in this group included falls from the standing position (49.2%), direct hit (19.5%), and then falling down (12.58%). Humerus fractures were observed in 68 patients. There was a significant correlation between humerus fractures and the mechanisms ($P=0.000$). The patients with traumas around the elbow comprised of 182 individuals. Sex distribution of fractures around the elbow shows a significant correlation between sex and elbow fractures. Forearm fractures were observed in 233 patients, and there was a significant correlation between age groups and forearm fractures. Fractures around the wrist were observed in 333 patients**.** There was a significant correlation between patients with fractures around the wrist (36.88±23.81 years) and patients without fractures (30.84±18.99 years) around the wrist in terms of the mean age. Hand fractures were observed in 358 patients**.** There was a significant correlation between hand fractures and sex**.**

Conclusion: The result of the current study which shows the epidemiology of these injuries and how such injuries occur in this area can well help the healthcare planners to design preventive and therapeutic measures.

Keywords: upper extremity, trauma, epidemiology, Iran

1. Introduction

Orthopedic injuries are the most common types of traumatic injuries and present as fractures of the limbs, pelvis, and vertebrae or lesions in soft tissues such as muscles, ligaments, and tendons (Amin et al., 2014; Regel et al., 1995) and impose financial and spiritual costs to the societies (Bergen et al., 2008). According to the statistics, the most frequent fracture occurs in distal radius and then respectively in proximal femur, metacarpals, phalanges, and ankles (Court-Brown & Caesar, 2006). The fractures of distal radius, proximal femur, metacarpals, phalanges, and ankles, comprise 57.5% of the total fractures. The upper limb fractures occur in distal radius and ulna, metacarpals, fingers, proximal, diaphysis, distal humerus, clavicle, upper forearm and

shaft, scapula, and wrist (Court-Brown & Caesar, 2006; Mehrpour et al., 2015).

In a study in US in 2009 from 87 million Americans, 590,193 fractures of the upper extremity were determined, therefore the annual incidence of fractures of upper extremities was 67.6 fractures per 10,000 persons (Karl et al., 2015). Distal radius fractures are one of the most prevalent fractures with the rate of about 25% of fractures in the pediatrics and around 18% of all fractures in the elderly. For the pediatric population, this increase is related to sport and for elderly the growth of it is related to the elderly population and a rise in the number of active elderly. In another study the incidence of distal radius and ulna fractures were the most common upper extremity fractures (16.2 fractures per 10,000) (Karl et al., 2015). The annual Incidence Rate of metacarpal fractures is 13.6 per 100,000 person and it is highly occurs in 10-19 age group. Metacarpal fractures are found more commonly in men than women. Contact with a wall or door, and falls are the most frequent mechanisms of injury (Nakashian et al., 2012). 2.6% of all fractures are related to clavicle fractures and they are mostly seen in men (68%). Traffic accidents were the most common cause of the clavicle fractures (Postacchini et al., 2002). Scapula fractures account for 3% to 5% of all fractures of the shoulder girdle and occur after high-energy trauma (Zlowodzki et al., 2006). Distal humerus fractures are unusual and account for about 2% to 6% of all fractures and for almost 30% of all elbow fractures. It is mostly seen in males age 12 to 19 years and in females age 80 or more (Korner et al., 2003).

While many studies have focused on developing predictors of outcomes following lower extremity trauma in order to guide clinical treatment, there is a limited data on the epidemiology and outcomes for the upper extremity trauma. Although the importance of the subject is clear, there are few epidemiological studies appropriate for quantitative and qualitative evaluation of such injuries in different societies (Urquhart et al., 2006; Court-Brown & Caesar, 2006; Menon et al., 2008; Amin et al., 2014). Moreover, the epidemiology of such injuries differs from one society to another, and cannot be generalized (Scholes et al., 2014). The relevant statistics are not identical even in urban and rural areas of a certain country (Amin et al., 2011). Obviously, knowing the prevalence and epidemiology of these injuries and how such injuries occur in each country can well help the healthcare planners to design preventive and therapeutic measures. There is no single epidemiological study of upper extremity injuries exists in Iran. The objective of this project was to accurately describe the occurrence of injuries of the upper extremity including shoulder, elbow, forearm, hand, humerus, wrist injuries and the mechanisms of such injuries in a representative sample of Iranian population.

2. Methods

This prospective epidemiology study was performed on the patients admitted to Shafa Yahyayian Hospital through the emergency ward within 6 months from April 21st, 2013 to October 23rd, 2013. Samples were collected using convenient sampling method. The inclusion criteria were upper extremity injuries as fractures including fractures of shoulder, elbow, forearm, wrist, and hand and joint dislocation and joints and soft tissue injuries including rupture of tendons, muscles, vessels and nerves and the exclusion criterion was isolated fracture of the spine, however, when it was accompanied by fracture in other limbs they were included in the study. Ethical principles were considered according to the declaration of Helsinki. A written consent was obtained from the patients. The information of the patients admitted due to upper limb injury, including demographic specifications, the exact mechanism of the lesion in soft tissues, bones, and joints were collected based on clinical examination and imaging procedures, such as radiography, CT scan, MRI, and ultrasound and also intraoperative findings were accurately recorded on forms designed for data collection during admission by the orthopedic residents involved in treatment of the patients. The mentioned forms were compared with the information extracted from the patients' medical records and imaging results and the ambiguous points were resolved. Any changes made in the primary diagnosis or new information obtained from the complementary investigations was recorded in the forms.

2.1 Statistical Analysis

The quantitative data were presented in Mean±SD values, and the qualitative data (including sex, age, …) were presented in number and percentage. The independent t test or Mann-Whitney test was used to compare the quantitative data depending on whether the data distributions were normal or not. The Chi-square test or Fisher's exact test was used to compare the qualitative data. All analyses were performed using SPSS software, version 21. The results were significant at $P<0.05$ at confidence level of 95%.

3. Results

This study was performed on 1287 patients with upper limb fracture. The data was collected from medical report of patients. The male and female patients respectively comprised of 998 (77.5%) and 289 (22.5%) subjects. Hand and wrist fractures were the most common fractures followed by forearm, elbow, shoulder and humerus (Figure 1).

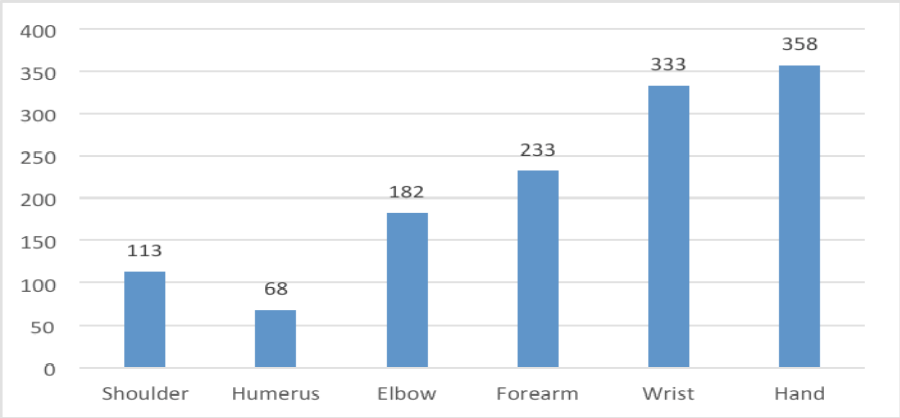

Figure 1. The frequency of upper extremity fractures

3.1 Shoulder Injuries

About 113 patients suffered injuries at shoulder joint or its surrounding bones. Based on this study, shoulder injuries were more frequent in males (4.7% vs. 4.2%). The most common traumatic mechanisms in this group included falls from the standing position, falling down, and then a direct hit (Table 1). Ninety-nine patients had shoulder dislocation, mostly anterior dislocation (97 cases), which mostly occurred in the third decade of life. The injuries occurred mostly in the third (33.62%) and fourth (15%) decades and rarely in the first decade of life. The mean age of the patients with shoulder injuries was higher than that of the patients without shoulder injuries considering (39.93±21.15 years v. 31.25±19.66 years) (P=0.00).

Table 1. The information about shoulder injuries

Variables	No. (%)	P Values
Sex		0.000
Male	89 (78.8)	
Female	24 (21.2)	
Age, Mean±SD	39.92±21.15	
Mechanisms of Injury, No. (%)		0.000
Fall standing	58 (51.78)	
Fall stairs	0 (0)	
Fall height	2 (1.78)	
Direct	33 (29.46)	
Sport	5 (4.46)	
MVA	0 (0)	
Pedestrians	4 (3.57)	
Motorcyclists	10 (8.92)	
Cyclists	0 (0)	

95% confidence interval.

3.2 Humerus Injuries

Humerus fractures were observed in 68 patients. There was a significant association between humerus fractures and sex (male or female) (P=0.00). The most frequent traumatic mechanisms respectively included falling from a standing position, falling from heights, and motorcycle crashes, and there was a significant association between humerus fractures and the mechanisms (P=0.000) (Table 2). These fractures mostly occurred in the fourth (20.6%), second (19.1%), and third (14.7%) decades of life. The mean age of the patients with humerus fractures was higher than that of the patients without humerus fractures (38.14±21.70 vs. 31.46±19.73, P=0.06).

Table 2. The information about humerus injuries

Variables	No. (%)	P Values
Sex		0.000
Male	53 (77.9)	
Female	15 (22.1)	
Age, Mean±SD	38.14±21.70	
Mechanisms of Injury, No. (%)		0.000
Fall standing	29 (42.6)	
Fall stairs	4 (5.9)	
Fall height	11 (16.2)	
Direct	4 (5.9)	
Sport	2 (2.9)	
MVA	6 (8.8)	
Pedestrians	2 (2.9)	
Motorcyclists	10 (14.7)	
Cyclists	0 (0)	

3.3 Elbow Injuries

The patients with traumas around the elbow comprised of 182 patients. The most frequent traumatic mechanisms respectively included falling from a standing position (59.7%) and falling from the stairs (17.1%), and there was a significant correlation between fractures around the elbow and the mechanisms ($P<0.05$) (Table 3).

The most frequent fractures around the elbow respectively included supracondylar fracture, olecranon fracture, and fracture of lateral condyle of humerusin. These fractures mostly occurred in the first (56.04%), second (18.13%), and third (9.89%) decades of life.

Table 3. The information about elbow injuries

Variables	No. (%)	P Values
Sex		0.000
Male	124 (68.1)	
Female	58 (24.9)	
Age, Mean±SD	39.22±16.60	
Mechanisms of Injury, No. (%)		< 0.05
Fall standing	108 (59.66)	
Fall stairs	31 (17.12)	
Fall height	13 (7.18)	
Direct	4 (2.2)	
Sport	9 (4.97)	
MVA	4 (2.2)	
Pedestrians	7 (3.86)	
Motorcyclists	5 (2.76)	
Cyclists	0 (0)	
Type of Fracture, No. (%)		
supracondylar	99 (54)	
olecranon	31 (17)	
lateral condyle of humerusin	23 (12.6)	

3.4 Forearm Injuries

Forearm fractures were observed in 233 patients. These fractures included the simultaneous fractures of radius and ulna, radial fracture, ulna fracture, Monteggia fracture, and Galeazzia fracture. The most frequent traumatic mechanism included falling from a standing position and there was no significant correlation between different types of forearm fractures and the mechanism (P=0.62) (Table 4). Fractures of forearm mostly occurred in the second decade (33.04%), the first decade (27.03%), and the third decade (13.03%), respectively and there was a significant correlation between age groups and forearm fractures (P=0.00). The mean age of the patients with forearm fractures (21.87±19.45 years) was lower than that of the patients without forearm fractures (32.40±19.64 years, P=0.000).

The most frequent fractures in both sex groups respectively included two bone fracture and radial fracture, and there was no significant correlation between different types of forearm fractures and sex (P=0.64).

Table 4. The information about forearm injuries

Variables	**No. (%)**	**P Values**
Sex		0.000
Male	175 (75.1)	
Female	58 (24.9)	
Age, Mean±SD	21.87±19.45	
Mechanisms of Injury, No. (%)		0.01
Fall standing	147 (63)	
Fall stairs	18 (7.72)	
Fall height	15 (6.43)	
Direct	10 (4.29)	
Sport	13 (5.57)	
MVA	7 (3)	
Pedestrians	8 (3.43)	
Motorcyclists	12 (2.15)	
Cyclists	3 (1.28)	
Type of fractures		-
radius and ulna	131 (56.2)	
radial	56 (24)	
ulna	21 (9)	
Monteggia	19 (8.2)	
Galeazzia	6 (2.6)	

3.5 Wrist Injuries

These fractures were observed in 333 patients and comprised 13.4% of the total injuries. The most frequent traumatic mechanism included falling down in 204 patients and there was a significant correlation between wrist fractures and the mechanism. The most frequent fractures of this type occurred in distal radius of 315 cases (94.6%). The distal radial fracture was frequent mostly in the second decade in 64 cases (19.2%) and then in the fourth and sixth decades in 53 cases (15.9%). There was no significant correlation between age group and fractures around the wrist (P=0.08).

Table 5. The information about wrist injuries

Variables	No. (%)	P Values
Sex		0.000
Male	251 (75.4)	
Female	82 (24.6)	
Age, Mean±SD	36.88±23.81	
Mechanisms of Injury, No. (%)		0.62
Fall standing	204 (61.81)	
Fall stairs	16 (4.84)	
Fall height	40 (12.12)	
Direct	8 (2.42)	
Sport	16 (4.84)	
MVA	6 (1.82)	
Pedestrians	9 (2.72)	
Motorcyclists	31 (9.39)	
Cyclists	0 (0)	

The mean age of the patients with fractures around the wrist was higher than that of the patients without fractures around the wrist (36.88±23.81 vs. 30.84±18.99, P=0.00).

3.6 Hand Injuries

These fractures were observed in 358 patients and comprised 14.4% of the total injuries. There was a significant correlation between hand fractures and sex, as the hand fractures were more frequent in males rather than females (P=0.047). The most frequent traumatic mechanisms included direct hits in 192 patients (58.7%) and falling from a standing position in 88 cases (22.3%). There was no significant correlation between hand fractures and the mechanisms (P=0.08) (Table 6).

Table 6. The information about hand injuries

Variables	No. (%)	P Values
Sex		0.047
Male	306 (85.8)	
Female	52 (14.5)	
Age, Mean±SD	29.73±16.68	
Mechanisms of Injury, No. (%)		0.08
Fall standing	88 (24.64)	
Fall stairs	8 (2.24)	
Fall height	4 (1.12)	
Direct	192 (53.78)	
Sport	21 (5.88)	
MVA	12 (3.36)	
Pedestrians	10 (2.8)	
Motorcyclists	20 (5.6)	
Cyclists	2 (0.56)	

Phalangeal fractures were the most frequent fractures of this type observed in 247 patients (69%). Metacarpal fractures were frequent mostly in the third decade of life in 49 cases (44.14%) and then in the fourth decade of life in 32 cases. Phalangeal fractures were frequent mostly in the third decade of life in 79 cases (35.8%) and then in the fourth decade of life in 60 cases (24.2%). There was no significant correlation between hand fractures and age groups (P=0.159).

The mean age of the patients with hand fractures (29.73±16.68 vs. 31.97±20.28, P=0.049) was lower than that of the patients without hand fractures.

4. Discussions

There are remarkable differences among studies performed on the epidemiology of fractures (Donaldson et al., 1990; Donaldson et al., 2008). A reason for such differences is the different methods of data collection. In some reports, all the patients going to a medical center were studied, while, some other studies, including the present study, examined the hospitalized patients with severe traumas (Urquhart et al., 2006). Moreover, the location of a specific medical center, different seasons of the year, racial differences, the level of welfare in different populations and countries influence the number of traumatic patients (Menon et al., 2008; Amin et al., 2011; Donaldson et al., 1990; Koo et al., 2013).

The present study was performed in an orthopedic center, located in an urban area far from places where severe road traumas occur, to which patients from other centers were referred, and thus, the obtained statistics might be different from those of hospitals located on a distance from large cities.

Almost all studies have reported higher prevalence of fractures in men than in women, as the prevalence of fractures has been reported as 10%-41% in men and 8.1%-31% in women (Donaldson et al., 1990; Donaldson et al., 2008; Johnell & Kanis, 2005). In this study, the prevalence of fractures was 77.5% in men and 22.5% in women, which confirms to the result of other studies. It seems that higher incidence of fractures in men is due to their more engagement in occupational activities outside the home such as using motor vehicles also they do more sport than women.

In current study hand and wrist fractures were the most common fractures followed by forearm, elbow, shoulder and humerus. In a study by karl et al. distal radius and ulna fracture were the most prevalent fractures (Karl et al., 2015).

In this study, fractures in both sexes were frequent mostly in the third decade (24.9%), second decade (16.3%), and fourth decade (16.2%), respectively. This diffusion curve might be due to the young population of Iran. The result of Singer et al. study revealed that the rate of incidence in men are higher at 20 to 24 and 90 to 94 years and in women it reaches to its peak at age 90 to 94 years (Singer et al., 1998).

The first mechanism has been the most frequent mechanism in different studies. In this study, the most frequent mechanisms in order were falling from a standing position or down to the ground (37.4%), direct trauma (21.5%), and motorcycle crashes (7.9%) which were consistent with previous studies. In a study by Koo et al. the main mechanism of injury was falling from standing passion (Koo et al., 2013). In a study by Schwartz et al. the most prevalent mechanism of injury was falling (Schwartz et al., 2005).

Based on the statistical analysis of the data, sex significantly correlated with shoulder injuries, humerus fractures, and hand fractures. Moreover, there was a significant correlation between age and shoulder injuries, humerus fractures, elbow injuries, forearm fractures. The result is similar to previous studies such as Sanders et al. study that showed that the fracture in males was around double the rate in females (Sanders et al., 1999).

The mechanism of trauma significantly correlated with humerus fractures, and wrist fractures. No significant difference was observed in relation to other parameters. In a study by Nguyen et al. study the significant risk factors for humerus fracture, wrist and forearm fractures were femoral neck bone mineral density, height loss, and a history of falls (Nguyen et al., 2001).

Despite the considerable prevalence of such injuries, there is no clear image in this regard, and the studies performed in different countries and medical centers show absolutely different results. The reason is related to the nature of lesions, the admission method of medical centers, and the population covered by medical centers.

5. Conclusion

The result of the current study which shows the prevalence and epidemiology of injuries including shoulder, elbow, forearm, humerus, hand and wrist and how such injuries occur in this area can well help the healthcare planners to design preventive and therapeutic measures. Although the results of this study cannot be generalized to the entire country, they can provide an image of the patients treated in an urban university medical center. Similar studies in different medical centers and on more patients will contribute to medical plans made by the health managers.

Competing Interests Statement

The authors declare that there is no conflict of interests regarding the publication of this paper.

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