ISSN: 2690-9189

Research Article

International Journal of Orthopaedics Research

An Epidemiological Analysis of Orthopedic Fractures, a Retrospective Single-Center Study from Jordan

Ahmad Almigdad[1]*, Sattam Alazaydeh[1], Mu'men Alshawish[1], Hamza Alfukaha[1], Mohammad Bani Mustafa[1] and Fadi AlRousan[1]

[1] *Department of Orthopedic, Royal Medical Services, Amman, Jordan*

***Corresponding Author**

Ahmad Almigdad, Department of orthopedic, Royal Medical Services, Amman, Jordan

.

Submitted: 29 Nov 2022; **Accepted**: 07 Dec 2022; **Published**: 15 Dec 2022

Citation: Ahmad Almigdad, Sattam Alazaydeh, Mumen Alshawish, Hamza Alfukaha, Mohammad Bani Mustafa et al. (2022). An Epidemiological Analysis of Orthopedic Fractures, a Retrospective Single-Center Study from Jordan. *Int J Ortho Res*, 5(4), 126-134.

Abstract

Background: *Studies on musculoskeletal fractures are limited in Jordan. Therefore, this study includes all orthopedic fractures in the tertiary center from Jordan. Fractures are evaluated for etiologies, age distribution, gender, mechanism of injury, and associated injuries. Therefore, this could assist in discovering the needs of our healthcare system and endorse recommendations on fracture treatment and prevention.*

Materials and Methods: *This retrospective study reviewed 3,387 fractures admitted from July 2018 to December 2021 at King Hussein Medical City in Amman, the capital of Jordan. Fractures were assessed regarding age, gender, mechanism of injury and variation across years. Fractures were allocated into eleven bones where forearm, hand, leg and foot were considered individual bones to facilitate analysis.*

Results: *The males represented 57.8% of patients. The lower limb was affected in 47.4%, the femur was the most commonly affected bone (26.6%), and the proximal femur accounted for 20.9% of all fractures. Men were more likely to sustain injuries to long bone, hand and foot injuries, while women were at higher risk of fragility fractures. Most hospitalizations were in patients over the age of fifty. Two-thirds of injuries were induced by simple falls. Open fractures were reported in 7.3% of fractures and neurological and vascular injuries in 1.9% and 1.5%, respectively.*

Conclusions: *Multicenter and epidemiological studies are needed to adequately assess orthopedic fractures in Jordan so that we can establish guidelines for fracture prevention and treatment.*

Keywords: Epidemiology, Fractures, Musculoskeletal, Jordan, Trauma.

Introduction

Musculoskeletal injuries are common and represent a leading cause of morbidity and mortality worldwide [1, 2]. In addition to the personal impact of trauma, the treatment of fractures represents a significant economic burden on any country's healthcare system [3, 4]. Fractures can be complicated by serious medical conditions such as neurovascular injury, compartment syndrome, and thromboembolic events, in addition to local effects such as malunion and nonunion, joint stiffness, and infection [5-8]. Many conditions play an important role in fracture patterns, such as the mechanism of injury, the age of the patients, the bone quality, and pre-existing bone pathologies [9-12]. Falls, road traffic accidents, sports injuries and violence are important causes of fractures [13, 14]. Pathologic fractures can occur without preceding trauma [15].

Certain fractures are associated with specific age groups, and some occupations are more prone to some fractures than others [16, 17]. The fracture treatment depends on the patient's age, the fracture pattern, associated conditions and the condition of the soft tissues. In Jordan, studies of musculoskeletal fractures are limited to specific bones or age groups. Therefore, this is the first study to include all musculoskeletal fractures in a tertiary center in Jordan. We review orthopedic fractures concerning etiologies, age distribution, gender, injury mechanism, and associated injuries. However, this may help identify the needs of our healthcare system and recommend guidelines on specific fracture patterns treatment and prevention.

Material and Method

This retrospective study reviewed the clinical and radiological records of all orthopedic fractures admitted to the Royal Rehabilitation Center (RRC) at King Hussein Medical City (KHMC) in Amman, capital of Jordan, from July 2018 to December 2021. KHMC is a medical compound affiliated with Jordanian Royal Medical Services, which has a wide network of hospitals covering different provinces across Jordan's kingdom. RRC is a tertiary hospital specializing in orthopedic and plastic surgery covering military-insured individuals and their families and the referral cases from public health and university hospitals.

We include in this study all in-hospital-treated orthopedic fractures, including all age groups, during 3.5 years. Patients discharged from the emergency department and readmitted patients for reoperation and infection were excluded. Sociodemographic data were extracted from patients' records, and their radiographs were reviewed using Picture Archiving and Communication System (PACS) to analyze fracture locations and patterns.

The patients' age, gender, mechanism of injury, type of fracture, and associated injuries were obtained. Age groups are defined as 'children' ($\leq$16 years), 'adults' (>16 and <50 years) and 'seniors' ($\geq$50 years).

Fractures were located into eleven bones; the forearm and leg were considered one bone each. Similarly, the hand and foot were considered one bone. Each bone is then classified according to anatomical position into the proximal, shaft, and distal. The spine was classified into cervical, thoracic, and lumber. Sacral and coccygeal were accounted with pelvic fractures. In our institute, cervical fractures are treated at the neurosurgery unit. Therefore, their frequency is not represented actually. Hand and foot were classified into carpal or tarsal, metacarpal or metatarsal, and phalangeal.

Fractures characteristics such as being pathological or open, as well as associated injuries, were documented. We classify the mechanism of injury into Simple falls (from ground level), fall from height, road traffic accidents, Sports injuries, bullets injuries, quarrel, and industrial and direct trauma. Descriptive statistics (mean, frequency, and percentages) were used to describe study population characteristics in terms of gender, age, fracture location, and mechanism. All statistical tests are two-tailed, and the significance level is $p < 0.05$. Comparison between categorical variables is performed with a chi-square test and Yates continuity correction was used for a 2 × 2 contingency table order to avoid type I error. The statistical analysis was performed using the Statistical Package for Social Sciences (version 23.0, SPSS Inc., Chicago, IL, USA).

Results

Over 3.5 years, from June 2018 to December 2021, 3213 patients with 3387 fractures that required hospitalization for fixation or observation were enrolled in the study. Males represented the majority, with a percentage of 57.8%. The femur was the most commonly affected bone (26.6% of all fractures), followed by the humerus (15.5%) and leg and spine fractures (15.1% each). However, the scapula (0.5%) and patella (0.9%) were the least hospitalized fractures. When considering the anatomical site of the fractures, the proximal femur was the most frequent (20.9%), followed by the distal humerus (12.1%), lumbar spine (9.9%), and distal leg (9.7%), respectively. Descriptive statistics for all fracture site and frequency according to gender is shown in [Table1 and Figure 1].

Table 1. Descriptive statistics of gender for all fractures.					
	Total	**Male**	**Female**	**Test statistics**	***P*-value**
Upper Limb					
Scapula	**17 (0.5)**	**15 (88.2)**	**2 (11.8)**	$X^2(1) = 5.3$	$P = .021$
Clavicle	**36 (1.1)**	**29 (80.6)**	**7 (19.4)**	$X^2(1) = 6.82$	$P = .009$
Humerus (n=523, 15.4%)					
Proximal	**88 (2.7)**	**40 (45.5)**	**48 (54.5)**	$X^2(1) = 5.12$	$P = .024$
Shaft	**43 (1.3)**	**31 (72.1)**	**12 (27.9)**	$X^2(1) = 3.09$	$P = .079$
Distal	**392 (12.1)**	**251 (64)**	**141 (36)**	$X^2(1) = 6.81$	$P = .009$
Forearm (n=358, 10.6%)					
Proximal	**50 (1.5)**	**34 (68)**	**16 (32)**	$X^2(1) = 1.77$	$P = .184$
Shaft	**134 (4.1)**	**110 (82.1)**	**24 (17.9)**	$X^2(1) = 32.77$	$P < .001$
Distal	**174 (5.4)**	**118 (67.8)**	**56 (32.2)**	$X^2(1) = 7.15$	$P = .008$
Hand (n=180, 5.3%)					
Carpal	**16 (0.55)**	**14 (87.5)**	**2 (12.5)**	$X^2(1) = 4.66$	$P = .031$
Metacarpal	**44 (1.4)**	**36 (81.8)**	**8 (18.2)**	$X^2(1) = 9.59$	$P = .002$
Phalangeal	**120 (3.7)**	**100 (83.3)**	**20 (16.7)**	$X^2(1) = 32.22$	$P < .001$
Lower limb					
Femur (n=901, 26.6%)					
Proximal	**707 (20.9)**	**266(37.6)**	**441 (62.4)**	$X^2(1) = 147.76$	$P < .001$
Shaft	**128 (3.8)**	**81 (63.3)**	**47 (36.7)**	$X^2(1) = 1.42$	$P = .233$
Distal	**66 (1.9)**	**26 (39.4)**	**40 (60.6)**	$X^2(1) = 8.58$	$P = .003$
Patella	**30 (0.9)**	**15 (50)**	**15 (50)**	$X^2(1) = 0.46$	$P = .496$
Leg (n=510, 15.1%)					
Proximal	**83 (2.6)**	**58 (69.9)**	**25 (30.1)**	$X^2(1) = 4.61$	$P = .032$
Shaft	**111 (3.4)**	**83 (74.8)**	**28 (25.2)**	$X^2(1) = 12.89$	$P < .001$
Distal	**316 (9.7)**	**168 (53.2)**	**148 (46.8)**	$X^2(1) = 2.84$	$P = .092$
Foot (n=165, 4.9%)					
Tarsal	**96 (3.0)**	**70 (72.9)**	**26 (27.1)**	$X^2(1) = 8.65$	$P = .003$
Metatarsal	**40 (1.25)**	**25 (62.5)**	**15 (37.5)**	$X^2(1) = 0.2$	$P = .655$
Phalangeal	**29 (0.9)**	**21 (72.4)**	**8 (27.6)**	$X^2(1) = 1.10$	$P = .157$
Spine (n=510, 15.1%)					
Cervical	**9 (0.3)**	**8 (88.9)**	**1 (11.1)**	$X^2(1) = 2.42$	$P = .120$
Thoracic	**178 (5.5)**	**82 (46.1)**	**96 (53.9)**	$X^2(1) =10.06$	$P = .002$
Lumber	**323 (9.9)**	**178 (55.1)**	**145 (44.9)**	$X^2(1) = .92$	$P = .336$
Pelvis	**157 (4.6)**	**98 (62.4)**	**56 (35.6)**	$X^2(1) = 1.26$	$P = .262$
Total	**3387**	**1957 (57.8)**	**1430 (42.2)**	$X^2(21) = 287.04$	$P < .001$

** Numbers within brackets represent the percentage of individual fractures in the total column and the percentage within the subcategory in other columns.*

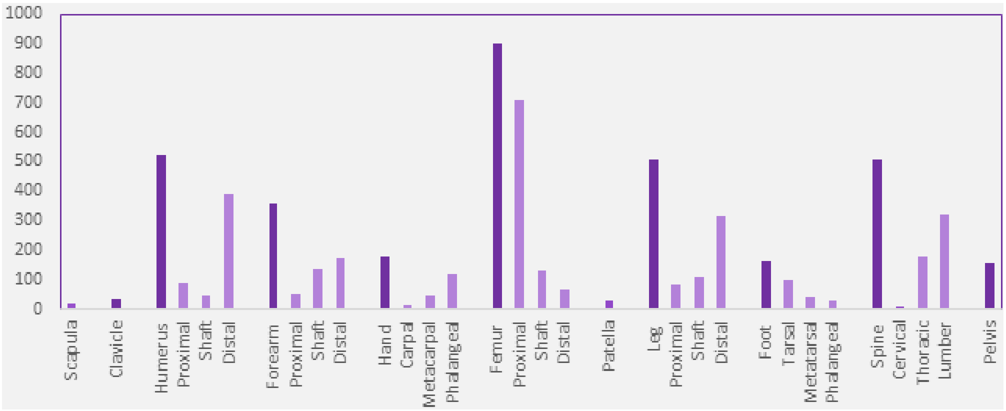

Figure 1: Distribution of bone fractures, including the broad and narrow classification. The X-axis presents the frequency of bone fractures, dark columns present the percentage of the bone fractures, and light columns present the percentage of the specific bone region fractures.

When comparing both genders regarding body location fractures, males more significantly developed the following fractures: scapula, clavicle, distal humerus, forearm, hand, leg, tarsal fractures and thoracic spine. However, females were more prone to develop proximal humerus and proximal and distal femur fractures.

There were more fractures in the left extremities than the right, as the percentage of total fractures was (42,6%) and (38,1%) respectively. Fractures in the axial skeleton occur in 19.3%. All extremities fractures have a significant left predominance except for the patella, which has a right-side predominance, and the scapula does not have a side predominance of fractures. presents descriptive statistics for the body-sided fracture distributions [Figure 2].

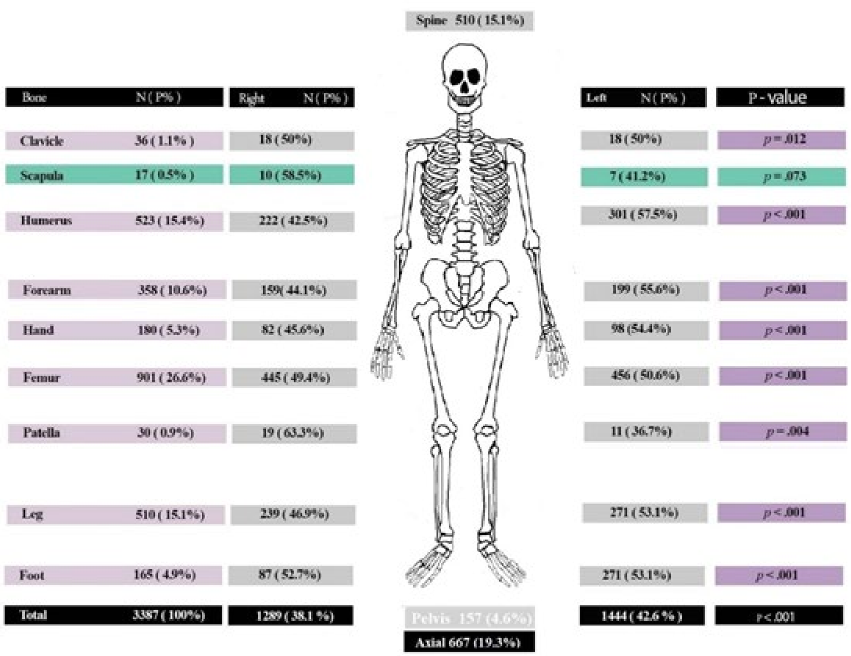

Figure 2: Side-distribution of bone fractures according to bone segments. The right- and left extremities are distributed according to the bone segments. Segments that do not have significant side predominance fractures are presented in green.

Fractures occur more frequently in patients older than fifty, representing 42% of all fractures. However, adults and children were affected by 34 % and 24%, respectively. When comparing fracture distribution in different age groups, senior patients were significantly more prone to proximal humerus, proximal femur, patella and lumbar spine fractures. Moreover, they have increased frequency of distal forearm, femur shaft, distal leg, thoracic spine and pelvic fractures [Table 2].

Table 2. Fractures distribution across age categories.

	Children (≤16)	Adult (16 < and < 50)	Senior (≥ 50)	Test statistics	*P*-value
Upper limb					
Scapula	**1 (5.9)**	**15 (88.2)**	**1 (5.9)**	$X^2(2) = 22.38$	*P< .001*
Clavicle	**3 (8.3)**	**23 (63.)**	**10 (27.8)**	$X^2(2) = 14.98$	*P*= .001
Humerus					
Proximal	**5 (5.7)**	**26 (29.5)**	**57 (64.8)**	$X^2(2) = 24.19$	*P< .001*
Shaft	**4 (9.3)**	**25 (58.1)**	**14 (32.6)**	$X^2(2) = 12.25$	*P*= .002
Distal	**343 (87.5)**	**25 (6.4)**	**24 (6.1)**	$X^2(2) = 985.17$	*P< .001*
Forearm					
Proximal	**16 (32)**	**25 (50)**	**9 (18)**	$X^2(2) = 12.16$	*P*= .002
Shaft	**97 (72.4)**	**30 (22.4)**	**7 (05.2)**	$X^2(2) = 187.63$	*P< .001*
Distal	**45 (25.9%)**	**71 (40.8)**	**58 (33.3)**	$X^2(2) = 6.07$	*P*= .048
Hand					
Carpal	**1 (6.3)**	**14 (87.5)**	**1 (6.3)**	$X^2(2) = 20.49$	*P< .001*
Metacarpal	**5 (11.4)**	**33 (75)**	**6 (13.6)**	$X^2(2) = 33.62$	*P< .001*
Phalangeal	**25 (20.8)**	**77 (64.2)**	**18 (15)**	$X^2(2) = 55.29$	*P< .001*
Lower limb					
Femur					
Proximal	**25 (3.5)**	**42 (5.9)**	**640 (90.5)**	$X^2(2) = 861.93$	*P< .001*
Shaft	**61 (47.7)**	**35 (27.3)**	**32 (2)**	$X^2(2) = 42.29$	*P< .001*
Distal	**16 (24.2)**	**12 (18.2)**	**38 (57.6)**	$X^2(2) = 8.84$	*P*= .012
Patella	**1 (3.3)**	**13 (43.3)**	**16 (53.3)**	$X^2(2) = 7.05$	*P*= .03
Leg					
Proximal	**3 (3.6)**	**56 (67.5)**	**24 (28.9)**	$X^2(2) = 46.08$	*P< .001*
Shaft	**27 (24.3)**	**60 (54.1)**	**24 (21.6)**	$X^2(2) = 24.89$	*P< .001*
Distal	**52 (16.5)**	**152 (48.1)**	**112 (35.4)**	$X^2(2) = 31.96$	*P< .001*
Foot					
Tarsal	**17 (17.7)**	**63 (65.5)**	**16 (16.7)**	$X^2(2) = 45.68$	*P< .001*
Metatarsal	**9 (22.5)**	**27 (67.5)**	**4 (10)**	$X^2(2) = 23.23$	*P< .001*
Phalangeal	**12 (41.4)**	**15 (51.7)**	**2 (6.9)**	$X^2(2) = 15.01$	*P*= .001
Spine					
Cervical	**0**	**9 (100)**	**0**	$X^2(2) = 17.48$	*P< .001*
Thoracic	**12 (6.7)**	**85 (47.8)**	**81 (45.5)**	$X^2(2) = 34.08$	*P< .001*
Lumber	**16 (5)**	**132 (40.9)**	**175 (54.2)**	$X^2(2) = 71.07$	*P< .001*
Pelvis	**14 (8.9)**	**88 (56.1)**	**55 (35)**	$X^2(2) = 40.84$	*P< .001*
Total	**810 (23.9)**	**1153 (34)**	**1424 (42)**		

* *Numbers within brackets represent the percentage.*

Most children's admissions were secondary to the distal humerus, forearm and femur shafts fractures. However, they have an increased frequency of distal forearm and leg fractures. On the other hand, adult patients are more significantly associated with most body bone fractures, namely: scapula, clavicle, humerus shaft, proximal and distal forearm, hand, leg and foot fractures, in addition to pelvic and cervical and lumbar spine fractures. Adults have an increased frequency of femur shaft, patella and lumbar spine fractures.

Around two-thirds of injuries occurred due to falls from the ground level. Falling from height and road traffic accidents accounted for 15% and 11.5%, respectively. However, all other causes accounted for less than 10% of injuries. Simple falls are statistically correlated with most injuries except scapula, clavicle, tarsal and pelvic fractures. Tarsal fractures were more frequent with falls from height, while road traffic accidents were more significantly associated with clavicle, scapula, cervical spine and pelvic fractures. However, hand injuries were more likely due to direct trauma [Table 3].

Table 3. Fracture distribution across mechanism of injury.

	Simple fall	Falls from height	RTA	Bullet injury	Quarrel	Sport	Industrial	Direct trauma	Test statistics	*P*-value
Upper limb										
Scapula	**1 (5.9)**	**6 (35.3)**	**10 (58.8)**	---	---	---	---	---	$X^2(7) = 48.41$	*P< .001*
Clavicle	**9 (25)**	**11 (30.6)**	**14 (38.9)**	---	**1 (2.8)**	**1 (2.8)**	---	---	$X^2(7) = 55.85$	*P< .001*
Humerus										
Proximal	**68 (77.3)**	**9 (10.2)**	**8 (9.1)**	**1 (1.1)**	---	---	---	**2 (2.3)**	$X^2(7) = 6.393$	*P*= .495
Shaft	**23 (53.3)**	**5 (11.6)**	**13 (30.2)**	---	---	---	---	**2 (4.7)**	$X^2(7) = 16.04$	*P*= .025
Distal	**341(87)**	**41(10.5)**	**6 (1.5)**	---	---	**2 (0.5)**	---	**2 (0.5)**	$X^2(7) = 98.31$	*P< .001*
Forearm										
Proximal	**34 (68)**	**8 (16)**	**5 (10)**	---	**1(2)**	**1 (2)**	---	**1 (2)**	$X^2(7) = 11.65$	*P*= .113
Shaft	**92 (68.7)**	**17 (12.7)**	**10 (7.5)**	**3 (2.2)**	---	**3 (2.2)**	**1 (0.7)**	**8 (6)**	$X^2(7) = 8.88$	*P*= .262
Distal	**133 (76.4)**	**31 (17.8)**	**8 (6.6)**	---	---	**1 (0.6)**	---	**1 (0.6)**	$X^2(7) = 21.44$	*P*= .003
hand										
Carpal	**8 (50)**	**2 (12.5)**	**2 (12.5)**	---	---	---	**4 (25)**	---	$X^2(7) = 83.40$	*P< .001*
Metacarpal	**15 (34.1)**	**2 (4.5)**	**3 (6.8)**	**4(9.1)**	**1(2.3)**	---	**4 (9.1)**	**15 (34.1)**	$X^2(7) = 180.78$	*P< .001*
Phalangeal	**44 (36.7)**	**1 (0.8)**	**4 (3.3)**	**3 (2.5)**	---	---	**20(16.7)**	**48 (40)**	$X^2(7) = 714.37$	*P< .001*
Lower limb										
Femur										
Proximal	**672(95)**	**16 (2.3)**	**8 (1.1)**	---	---	**11(1.6)**	---	---	$X^2(7) = 350.92$	*P< .001*
Shaft	**73 (57)**	**16 (12.5)**	**28 (21.9)**	**2 (1.6)**	---	**6 (4.7)**	---	**3 (2.3)**	$X^2(7) = 34.24$	*P< .001*
Distal	**52 (78.8)**	**4 (6.1)**	**7 (10.6)**	**2 (3)**	---	**1 (1.5)**	---	---	$X^2(7) = 12.25$	*P*= .093
Patella	**18 (60)**	**3 (10)**	**4 (13.3)**	---	**1 (3.3)**	---	---	**4 (13.3)**	$X^2(7) = 25.27$	*P*= .001
Leg										
Proximal	**35 (42.2)**	**23 (27.7)**	**14(16.9)**	**4(4.8)**	**1(1.2)**	**1 (1.2)**	**1 (1.2)**	**4 (4.8)**	$X^2(7) = 38.06$	*P< .001*
Shaft	**52 (46.8)**	**19 (17.1)**	**24(21.6)**	**3(2.7)**	---	---	**5 (4.5)**	**8 (7.2)**	$X^2(7) = 36.96$	*P< .001*
Distal	**221(69.9)**	**41 (13.0)**	**38(12.0)**	**4(1.3)**	**1(0.3)**	**6 (1.9)**	---	**5 (1.6)**	$X^2(7) = 13.96$	*P*= .052
Foot										
Tarsal	**24 (25)**	**53 (55.2)**	**14 (14.6)**	**1 (1.0)**	---	**1 (1.0)**	**1 (1.0)**	**2 (2.1)**	$X^2(7) = 133.72$	*P< .001*
Metatarsal	**21 (52.5)**	**11 (27.5)**	**1 (2.5)**	**1 (2.5)**	---	---	**1 (2.5)**	**5 (12.5)**	$X^2(7) = 15.74$	*P*= .013
Phalangeal	**12 (41.4)**	---	**1 (3.4)**	**3 (10.3)**	---	---	**1 (3.4)**	**12 (41.4)**	$X^2(7) = 140.65$	*P< .001*
Spine										
Cervical	---	**1 (11.1)**	**8 (88.9)**	---	---	---	---	---	$X^2(7) = 53.48$	*P*= .495
Thoracic	**85 (47.8)**	**51(28.7)**	**38 (21.3)**	---	---	---	---	**4 (2.2)**	$X^2(7) = 56.24$	*P*= .495
Lumber	**161 (49.8)**	**89 (27.6)**	**65 (20.1)**	---	---	**1 (0.3)**	---	**7 (2.2)**	$X^2(7) = 87.52$	*P*= .495
Pelvic										
Pelvis	**47 (29.9)**	**48 (30.6)**	**58 (36.9)**	---	---	**1 (0.6)**	---	**3 (1.9)**	$X^2(7) = 157.02$	*P< .001*
Total	**2241 (66.2)**	**508 (15.0)**	**391 (11.5)**	**31 (0.9)**	**6 (0.2)**	**36 (1.1)**	**38 (1.1)**	**136 (4.0)**		

On the other hand, when considering the frequency of fractures across study years, the lowest admission was during 2018 because the data collection started in June 2018. However, similar admission frequencies were in 2019 and 2020, while most admissions occurred in 2021. Although there was a year-to-year variation in the number of total admissions, there are no statistical differences among years except for a few fractures. There were more distal humerus and distal forearm fractures and more hand phalangeal fractures in 2020; this may be explained by many people working manually at their homes during the COVID-19 lockdown. In 2021, there were more frequent scapula, clavicle, proximal femur and tarsal fractures, which may arise from recovery from COVID-19 restrictions and increased road traffic and industrial injuries, [Table 4].

Table 4. Fractures distribution across years.							
	2018	**2019**	**2020**	**2021**	**Total**	**Test statistics**	***P*-value**
Upper limb							
Scapula	**5 (29.4)**	**1 (5.9)**	**---**	**11 (64.7)**	**17 (0.6)**	$X^2(3) = 22.82$	*P< .001*
Clavicle	**4 (11.1)**	**---**	**6 (16.7)**	**26 (72.2)**	**36 (1.3)**	$X^2(3) = 24.56$	*P< .001*
Humerus							
Proximal	**6 (6.6)**	**23 (26.1)**	**24 (27.3)**	**35 (39.8)**	**88 (3.2)**	$X^2(3) = 0.295$	*P*= .961
Shaft	**4 (9.3)**	**12 (27.9)**	**12 (27.9)**	**15 (34.9)**	**43 (1.6)**	$X^2(3) = 0.323$	*P*= .956
Distal	**2 (1)**	**137 (20.6)**	**109 (13.7)**	**144 (13.5)**	**392 (14.3)**	$X^2(3) = 36.34$	*P< .001*
Forearm							
Proximal	**2 (4)**	**11 (22)**	**17 (34)**	**20 (40)**	**50 (1.8)**	$X^2(3) = 2.23$	*P*= .526
Shaft	**9 (6.7)**	**51 (38.1)**	**34 (25.4)**	**40 (29.9)**	**134 (4.9)**	$X^2(3) = 7.49$	*P*= .058
Distal	**19 (10.9)**	**61 (35.1)**	**45 (25.9)**	**49 (28.2)**	**174 (6.4)**	$X^2(3) = 11.11$	*P*= .011
Hand							
Carpal	**2 (12.5)**	**2 (12.5)**	**8 (50)**	**4 (25)**	**16 (0.6)**	$X^2(3) = 5.55$	*P*= .136
Metacarpal	**2 (4.5)**	**13 (29.5)**	**12 (27.3)**	**17 (38.6)**	**44 (1.6)**	$X^2(3) = 0.51$	*P*= .916
Phalangeal	**4 (3.3)**	**26 (21.7)**	**49 (40.8)**	**41 (34.2)**	**120 (4.4)**	$X^2(3) = 12.6$	*P*= .006
Lower limb							
Femur							
Proximal	**53 (7.5)**	**155 (21.9)**	**200 (28.3)**	**299 (42.3)**	**569 (20.8)**	$X^2(3) = 18.96$	*P< .001*
Shaft	**13 (10.2)**	**40 (31.3)**	**38 (29.7)**	**37 (28.9)**	**128 (4.7)**	$X^2(3) = 4.79$	*P*= .188
Distal	**8 (12.1)**	**15 (22.7)**	**25 (37.9)**	**18 (27.3)**	**66 (2.4)**	$X^2(3) = 7.24$	*P*= .064
Patella	**2 (6.7)**	**7 (23.3)**	**9 (30)**	**12 (40)**	**30 (1.1)**	$X^2(3) = 0.37$	*P*= .946
Leg							
Proximal	**8 (9.6)**	**21 (25.3)**	**14 (16.9)**	**40 (48.2)**	**83 (3)**	$X^2(3) = 7.267$	*P*= .064
Shaft	**9 (8.1)**	**42 (37.8)**	**24 (21.6)**	**36 (32.4)**	**111 (4.1)**	$X^2(3) = 6.37$	*P*= .095
Distal	**28 (8,9)**	**103 (32.6)**	**87 (27.5)**	**98 (31)**	**316 (11.5)**	$X^2(3) = 7.69$	*P*= .053
Foot							
Tarsal	**10 (10.4)**	**26 (27.1)**	**22 (22.9)**	**38 (39.6)**	**69 (3.5)**	$X^2(3) = 2.37$	*P*= .499
Metatarsal	**4 (10)**	**9 (22.5)**	**14 (35)**	**13 (32.5)**	**40 (1.5)**	$X^2(3) = 1.83$	*P*= .594
Phalangeal	**2 (6.9)**	**10 (34.5)**	**11 (37.9)**	**6 (20.7)**	**29 (1.1)**	$X^2(3) = 3.72$	*P*= .293
Pelvis	**12 (7.6)**	**39 (24.8)**	**35 (22.3)**	**71 (45.2)**	**157 (5.7)**	$X^2(3) = 5.21$	*P*= .157
Total	**208 (7.2)**	**804 (27.9)**	**795 (27.6)**	**1070 (37.2)**	**2877 (100)**		

* Numbers within brackets represent the percentage of individual fractures within the year.
** Spine fractures were excluded from this analysis.

Compound fractures were documented in 7.3% of fracture admissions, while the bony pathology was identified in 2.8%. Neurological and vascular injuries were documented in 1.9 % and 1.5 %, respectively, [Table 5].

Table 5. Associated injuries.		
Complicated fracture	**N**	**(%)**
Open fracture	**246**	**7.3**
Pathological fracture	**96**	**2.8**
Neurological injury	**62**	**1.9**
Vascular injury	**51**	**1.5**

Joint dislocations that required hospitalization are shown in the table. Half admissions were due to hip dislocation, followed by the elbow (15.9%), ankle (13.6%) and shoulder dislocations (11.4%) [Table 6].

Table 6. Joint dislocation distribution.		
	N	**(%)**
Ankle dislocation	6	13.6
Elbow dislocation	7	15.9
Hip dislocation	22	50
Perilunate dislocation	3	6.8
Shoulder dislocation	5	11.4
Acromioclavicular dislocation	1	2.3

Discussion

Epidemiological fracture studies are lacking in Jordan; thus, this is the first epidemiological study on orthopedic fractures admitted to a tertiary hospital in Amman, the capital of Jordan. King Hussein Medical City is a major part of Jordanian Royal Medical Services which is composed of a compound of hospitals and a vast network of hospitals distributed in different regions across the kingdom of Jordan. KHMC is a referral center for all healthcare hospitals in Jordan and is the biggest hospital in the kingdom. Therefore, studies from such centers are representative of trauma distribution in Jordan.

This review includes in-hospital orthopedic fracture admission; fractures treated conservatively and discharged from the emergency department were not included. Therefore, the actual incidence of these fractures is expected to be much higher. For the same reason, joint dislocations are also not accurately represented because they are mostly discharged from the emergency department and not counted. Further, certain fractures pattern as complex fractures, pelvic fractures, and spine fractures, in addition to fractures associated with other injuries such as vascular injuries, are supposed to be a higher incidence in this review because our institute is a tertiary and referral center for all district and other healthcare hospitals in Jordan. Military injuries from terrorists are usually referred to as KHMC; therefore, their incidence should be higher too.

In our study, 3213 patients were reviewed; out of them, 174 patients had multiple fractures. Therefore, we analyzed 3387 fractures and assessed them regarding gender, age, mechanism of injury and distribution over four consecutive years. Males are more prone to injuries from road traffic accidents, work-related injuries and sports participation; thus, they represent 57.8% of all injuries.

Most injuries occurred in the lower extremity, which accounted for 47.4% of all injuries, followed by the upper extremity, which was affected in 22.3%. When comparing fractures between genders, women were more prone to fragility fractures such as fractures of the proximal humerus, proximal and distal femur, and spine. Fractures of long bones, shoulder blades, and hand and foot injuries were observed more frequently in men; because males are at greater risk for higher energy injuries and consequently develop these types of fractures.

The left limb is affected more often than the right side; this could be explained by the fact that around 90% of people are right-handed and when there is an injury, the dominant limb is usually used while the non-dominant limbs play a protective role [18, 19]. However, this explained the upper extremity injuries and, to some extent, the lower extremity injuries.

Most hospital admissions with fractures were in patients older than 50 years who were more prone to fragility fractures, namely fractures of the proximal humerus, proximal femur, patella, and lumbar spine. Adults accounted for one-third of admissions and were more likely to sustain fractures from high-energy mechanisms, such as fractures of the long bones, scapula, pelvis, and hand and foot injuries. Most pediatric fractures are treated conservatively in the emergency department and are not admitted to the hospital; Therefore, our results do not represent true prevalence. However, most childhood hospital admissions were secondary to the distal humerus, forearm, and femoral shaft fractures.

Cervical spine fracture in our review is much lower than the actual incidence because they are admitted to the neurosurgery department and those included are just concomitant injuries to other injuries. Sacral and coccygeal fractures were counted with pelvic fractures as they are often associated with pelvic ring fractures.

Simple fall from the ground level was the most common mechanism of bone injuries across all age groups. Traffic accidents are a major health problem in Jordan and the second leading cause of death and fractures. However, in our review, traffic accidents were responsible for 11.5% of fractures hospitalizations, which is much less than the actual incidence since only isolated bone injuries are admitted to the orthopedic department of our institute. In contrast, those associated with other injuries and multiple fractures are usually admitted to trauma and surgical wards and are not counted.
In 2020 there were worldwide restrictions and measures to control the spread of the COVID-19 virus. The Jordanian government announced a complete national-wide lockdown and implemented new measures to enforce strict social distancing on March 15, 2020; these include preventing transportation, working from home, and

closing many facilities. Therefore, traffic accidents and industrial injuries are expected to be lower. In 2021, there was an increase in the total number of admissions, which may have contributed to a decrease in COVID-19-related restrictions and a consequent increase in traffic accidents and industrial injuries. We conducted a study to measure the impact of social distancing on geriatric hip fractures among the Jordanian population during the COVID-19 pandemic and we conclude that during the complete lockdown and social distancing due to COVID-19, there was a decrease in the total number of trauma patients and an increase in the proportion of geriatric hip fractures [20].

The limitation of this study is the retrospective design and the lack of adequate documentation regarding the mechanism of injury in the archiving system, which precludes a detailed analysis of the etiology. Therefore, in this study, we grouped the mechanisms of fractures into broad categories such as simple falls, falls from a height, and traffic accidents. Therefore, we recommend proper documentation and adding a mandatory category in the computer filing system that describes the nature of the injury so that we can identify the causes and take preventative action in the future. Furthermore, classifying bone into regional anatomies such as forearm, hand, leg and foot prevents detailed analysis of each fracture alone. However, we recommend performing separate regional analyses, e.g., upper extremity fractures alone or by individual anatomical sites, to avoid lengthy analysis details.

Conclusions

The incidence of fractures varies according to age and gender and mechanism of injury. Understanding the distribution of each fracture within each group is critical for healthcare system planning. The actual incidence of fractures is expected to be higher than our results and requires more comprehensive studies from different centers in Jordan. This study is a single-center study. Nevertheless, it gives insight into fractures in Jordan. However, multicenter and epidemiological studies are needed to adequately assess orthopedic fractures so we can build guidelines for the prevention and treatment of fractures.

References

1. DIAS LOPES, A., HESPANHOL JUNIOR, L. C., YEUNG, S. S., & PENA COSTA, L. O. (2012). What are the Main Running-Related Musculoskeletal Injuries?: A Systematic Review. Sports medicine (Auckland), 42(10), 891-905.
2. Søreide, K. (2009). Epidemiology of major trauma. Journal of British Surgery, 96(7), 697-698.
3. Seifert, J. (2007). Incidence and economic burden of injuries in the United States.
4. Parrott S. The economic cost of hip fracture in the UK. A Paper Commissioned by the Department of Trade and Industry. York: Centre for Health Economics, University of York; 2000.
5. Dean, B. J. F., Kothari, A., Uppal, H., & Kankate, R. (2012). The Jones fracture classification, management, outcome, and complications: a systematic review. Foot & Ankle Specialist, 5(4), 256-259.
6. Jackson, L. C., & Pacchiana, P. D. (2004). Common complications of fracture repair. Clinical techniques in small animal practice, 19(3), 168-179.
7. Cooper, C. (1997). The crippling consequences of fractures and their impact on quality of life. The American journal of medicine, 103(2), S12-S19.
8. Melton III, L. J. (2003). Adverse outcomes of osteoporotic fractures in the general population. Journal of Bone and Mineral Research, 18(6), 1139-1141.
9. Schwarz PD. Biomechanics of fractures and fracture fixation. Semin Vet Med Surg Small Anim. 1991 Feb;6(1):3-15.
10. Robinovitch, S. N., Hsiao, E. T., Sandler, R., Cortez, J., Liu, Q., & Paiement, G. D. (2000). Prevention of falls and fall-related fractures through biomechanics. Exercise and sport sciences reviews, 28(2), 74-79.
11. Close, J. C., Lord, S. L., Menz, H. B., & Sherrington, C. (2005). What is the role of falls?. Best Practice & Research Clinical Rheumatology, 19(6), 913-935.
12. Wang, H., Liu, H., Wu, J., Li, C., Zhou, Y., Liu, J., ... & Xiang, L. (2019). Age, gender, and etiology differences of sports-related fractures in children and adolescents: A retrospective observational study. Medicine, 98(4).
13. Warriner, A. H., Patkar, N. M., Yun, H., & Delzell, E. (2011). Minor, major, low-trauma, and high-trauma fractures: what are the subsequent fracture risks and how do they vary?. Current osteoporosis reports, 9(3), 122-128.
14. Marine, M. B., & Forbes-Amrhein, M. M. (2021). Fractures of child abuse. Pediatric radiology, 51(6), 1003-1013.
15. Brennan, M., O'Shea, P. M., O'Keeffe, S. T., & Mulkerrin, E. C. (2019). Spontaneous insufficiency fractures. The journal of nutrition, health & aging, 23(8), 758-760.
16. Valentin, G., Friis, K., Nielsen, C. P., Larsen, F. B., & Langdahl, B. L. (2021). Fragility fractures and health-related quality of life: does socio-economic status widen the gap? A population-based study. Osteoporosis International, 32(1), 63-73.
17. Smith, G. S., Timmons, R. A., Lombardi, D. A., Mamidi, D. K., Matz, S., Courtney, T. K., & Perry, M. J. (2006). Work-related ladder fall fractures: identification and diagnosis validation using narrative text. Accident Analysis & Prevention, 38(5), 973-980.
18. Scharoun, S. M., & Bryden, P. J. (2014). Hand preference, performance abilities, and hand selection in children. Frontiers in Psychology, 5, 82.
19. Papadatou-Pastou, M., Ntolka, E., Schmitz, J., Martin, M., Munafò, M. R., Ocklenburg, S., & Paracchini, S. (2020). Human handedness: A meta-analysis. Psychological bulletin, 146(6), 481.
20. AlRousan, F. M., Alkhawaldah, A., Altarawneh, R. Y., Al-Qudah, A. K., & Almigdad, A. K. (2022). Impact of social distancing on geriatric hip fractures among Jordanian population during COVID-19 pandemic. Materia Socio-Medica, 34(1), 37.