



INTERNATIONAL JOURNAL OF
PHYSICAL THERAPY RESEARCH & PRACTICE

AN OFFICIAL JOURNAL OF SAUDI PHYSICAL THERAPY ASSOCIATION



الجمعية السعودية للعلاج الطبيعي
Saudi Physical Therapy Association

Original Article

Age and Gender Differences in Fracture Patterns at King Fahad Hospital, Al-Baha: A Retrospective Study

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DOI: <https://doi.org/10.62464/ewk4s275>

Abstract

Background: Fractures represent a significant public health concern worldwide, contributing to substantial morbidity, healthcare utilization, and economic burden. The distribution and type of fractures vary across demographic groups, particularly with respect to age and gender, reflecting differences in bone density, activity levels, and exposure to trauma. **Objective:** To examine the association between age and gender and the pattern of fractures among patients presenting to King Fahad Hospital in Al-Baha, Saudi Arabia. **Methods:** A retrospective cross-sectional study was conducted on 886 patients with radiologically confirmed fractures who presented between January 2023 and January 2024. Data on patient demographics (age and gender) and fracture characteristics (anatomical site and type) were extracted from electronic medical records. Patients were categorized into age groups for comparative analysis. Statistical associations between demographic variables and fracture patterns were assessed using chi-square tests, with a significance level set at $p < 0.05$. **Results:** The mean age of patients was 32.94 ± 22.42 years, indicating a wide age distribution, with males accounting for 68.8% of cases. The most frequently observed fractures involved the forearm and elbow (19.5%), followed by the humerus (18.7%) and foot (17.8%). A statistically significant variation in fracture patterns was observed across different age groups ($p = 0.001$), suggesting age-specific vulnerability to certain fracture types. In contrast, no significant association was found between gender and fracture distribution ($p = 0.680$), despite the higher overall proportion of male patients. **Conclusion:** Fracture patterns differ significantly by age but not by gender in this population. These findings underscore the importance of implementing age-specific preventive measures, resource allocation, and clinical management strategies to reduce fracture incidence and improve patient outcomes.

Keywords: Orthopedic, Fractures, Epidemiology, Age-related differences, Gender differences, Trauma.

Article info : Received: **March 16, 2026;** Accepted: **March 27, 2026;** Published: **April 30, 2026**

To Cite: Alzahrani FM et al. Age and Gender Differences in Fracture Patterns at King Fahad Hospital, Al-Baha: A Retrospective Study. International Journal of Physical Therapy Research & Practice, 5(4):216-216. <https://doi.org/10.62464/ewk4s275>

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Introduction

Injuries in both developed and developing countries significantly impact individuals' health and well-being, with fractures representing a major concern. Beyond causing physical limitations, fractures adversely affect quality of life and mental health, while also placing a considerable burden on healthcare systems and caregivers (Liang & Chikritzhs, 2016). Globally, understanding fracture patterns is essential for guiding prevention strategies and optimizing healthcare resource allocation.

Fractures can occur at any age, with their type and anatomical distribution influenced by factors such as bone health, mechanism of injury, age, and gender. Evidence suggests that fracture risk is not uniform across populations but varies considerably between demographic groups. For example, osteoporosis—an important determinant of fracture susceptibility—disproportionately affects women after menopause, whereas men experience a more gradual increase in risk with age (Liang & Chikritzhs, 2016). Consequently, age and gender are consistently identified as key factors influencing fracture occurrence and outcomes (Harris et al., 2008).

Epidemiological studies further demonstrate variability in fracture patterns across different populations. Fractures are particularly common among boys aged 10–15 years, often involving the upper extremities, especially the wrist, hand, and elbow, typically resulting from falls (Aygün, 2020). Similarly, pediatric data indicate that boys sustain significantly more fractures than girls, with a predominance in the upper limbs and frequent involvement of the distal radius (Aygün, 2020). In contrast, adult populations show different trends, as illustrated by data from the Swedish Fracture Register, where the mean age at fracture was 57.9

years and the majority of cases occurred in women (Bergh et al., 2020). Additionally, findings from Western Australia highlight gender differences in injury and fracture incidence rates, reinforcing the role of demographic factors in shaping fracture epidemiology (Liang & Chikritzhs, 2016). Collectively, these studies emphasize that fracture patterns vary by age and gender, though findings differ across settings, underscoring the need for context-specific data.

Despite this global evidence, the epidemiology of fractures in Saudi Arabia remains insufficiently characterized. Existing studies are limited in scope, often focusing on specific fracture types or anatomical sites rather than providing a comprehensive overview of fracture patterns within the population (Ghouri et al., 2021; Bigham-Sadegh & Oryan, 2015). As a result, there is a lack of integrated data that captures how demographic factors such as age and gender influence fracture distribution at the regional level.

Addressing this gap is essential for improving understanding of fracture patterns and supporting the development of targeted prevention and management strategies within the Saudi healthcare context.

This study aimed to examine the association between age and gender and fracture patterns among patients presenting to King Fahad Hospital in the Al-Baha region.

Methodology

Study design and Settings

This retrospective study was conducted at a government hospital in the Al-Baha region, utilizing data collected between January 1, 2023, and January 1, 2024.

Study Population and Sampling

A total population sampling approach was used, in which all patients of different ages and genders who presented with fractures during the study period were included. Cases were reviewed consecutively, and all eligible records were included after applying the inclusion and exclusion criteria.

Inclusion criteria comprised all patients with confirmed fractures at any anatomical location. Fracture diagnosis was based on standard radiological imaging modalities, including X-rays, computed tomography (CT), and magnetic resonance imaging (MRI).

Exclusion criteria included fractures related to congenital abnormalities or developmental disorders, as well as patients with incomplete medical records. Records that did not meet the inclusion criteria were excluded during the review process.

Data Source and Case Identification

Data were obtained from the hospital's electronic medical records (EMR) system. Cases were identified using medical record numbers (MRNs), and only patients with clearly documented and confirmed fracture diagnoses were included. Each case was manually reviewed by the research team, who have expertise in the field, to ensure eligibility and accuracy.

Data Collection and Classification

Data were extracted using a standardized data collection form developed via Google Forms. The form was designed prior to data collection and was consistently used for all cases. Extracted data were subsequently reviewed and double-checked by the authors to ensure accuracy and consistency.

Fractures were primarily recorded as documented in the medical records. In cases where classification was applicable, fractures were grouped based on anatomical location.

Sample Size Consideration

Although a minimum sample size of 384 was initially calculated using the Raosoft calculator (95% confidence level, 5% margin of error) based on an estimated population of 487,108, all available eligible cases during the study period were included in the final analysis.

Handling of Missing Data

Missing data were minimal, as key variables—age, gender, and fracture type—were consistently documented across all included records. Cases with incomplete essential data were excluded during the initial screening process.

Statistical Analysis

Data were cleaned and organized using Microsoft Excel and subsequently analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize patient characteristics and fracture distributions.

The Chi-square test was used to assess associations between categorical variables. A p -value of <0.05 was considered statistically significant, while $p <0.01$ was considered highly significant.

Although effect size measures (e.g., Cramer's V), confidence intervals, and multivariable analyses can provide additional insight, these were not performed in the present study, as the analysis was primarily descriptive and exploratory in nature.

Ethical Considerations

Ethical approval was obtained from the Medical Ethics Committee of Albaha University (REC/SUR/BU-FM/2024/27). Due to the retrospective nature of the study, the requirement for informed consent was waived. All data were anonymized prior to analysis to ensure confidentiality.

To further protect data privacy, de-identification procedures were applied, including the removal of personal identifiers. Access to the data was restricted through authorization controls, and secure storage protocols were implemented, including encryption, password protection, and data backup systems. Data minimization principles were followed to include only variables necessary for the study.

RESULTS

This study was conducted among 886 patients, mainly male (68.8 %), with a mean age of 32.94 (Standard deviation of 22.42).

Table 1: Demographic factors of the participants

Variables, N=886		Count	Column %
Gender	Male	610	68.8%
	Female	276	31.2%
Age	Mean	32.94	
	Standard deviation	22.42	

The prevalence of different fractures across different anatomical locations was reported in Figure 1. The most common fractures reported in this study were in the forearm and elbow region, representing 19.5 % of the total cases, followed by fractures at the humerus (18.7 %) and foot (17.8 %). In addition, fractures of the tibia, fibula, femur, and hip and spine regions accounted for approximately 11-13% of the cases, while fractures of the hand and wrist were presented in 10.1% of the cases.

Further analysis was conducted to assess the prevalence of specific types of fractures within each anatomical region, as presented in Table 2. In the hand and wrist region, fractures of the phalanx and metacarpal bone were present in 3.8% and 2.0 % of the patients, respectively.

In the forearm and elbow region, fracture of the radius was common (9.6 %), as was general forearm fracture (7.1 %).

In addition, the relationship between gender and fracture type was presented in Table 3, with slight differences between the two genders but without significant differences ($P= 0.680$). Among male participants, the most common fractures were humerus fractures, forearm and elbow fractures, and foot fractures, as presented in 18.7 %, 18.4 %, and 17.9 %, respectively. In females, the most prevalent fractures were elbow, humerus, and foot fractures, representing 22.1 %, 18.8 %, and 17.8 %, respectively, with comparable patterns considering other anatomical regions between genders.

On the other hand, age is found to significantly impact the fracture site ($P=0.001$), as presented in Table 4. In the age groups of 1-10 years and 10-20 years, humerus fractures (31.0 % and 22.9 %) and forearm and elbow fractures (26.2 % and 19.4 %) were the most common. However, in the age group 20-30 years, foot fracture started to have a significant percent of 19.5 % and increased in the age group 30-50 years with 22.7 % and becoming the most prevalent type with reduced percent of humerus and forearm and elbow fracture of 14.4 % and 13.0 %. The same pattern was observed in the age group of 50-70 years old, where foot fractures remain prevalent, with 18.0 % and 21.3 % in the age group 70-90 years old and 21.3 % in those over 90 years old.

Table 2: Prevalence of different types of fractures

		Count	Column %
Hand and wrist Fractures	Fracture of wrist and hand level	25	2.8%
	Fracture of thumb	5	0.6%
	Fracture of scaphoid bone of hand	7	0.8%
	Fracture of phalanx	34	3.8%
	Fracture of metacarpal bone	19	2.1%
Forearm and Elbow Fractures	Radius (dorsal angulation, lower end, upper end, head, dislocation)	85	9.6%
	Ulna (dorsal angulation, lower end, upper end, head, dislocation)	10	1.1%
	Radius and ulna (dorsal angulation, lower end, upper end, head, dislocation)	13	1.5%
	Fracture of forearm	63	7.1%
	Elbow	2	0.2%
Humerus Fractures	Fracture of upper end of humerus	11	1.2%
	Fracture of shaft of humerus	31	3.5%
	Fracture of lower end of humerus	23	2.6%
	Fracture of head of humerus	12	1.4%
	Fracture humerus (unspecific)	89	10.0%
Clavicle and Scapula Fractures	Fracture of clavicle	37	4.2%
	Fracture of scapula	3	0.3%
Tibia and Fibula Fractures	Fracture of tibia of lower end of tibia	46	5.2%
	Fracture of fibula shaft of tibia	6	0.7%
	Fracture of tibia shaft of tibia	36	4.1%
	Fracture of tibia upper end	9	1.0%
	Tibia fractures general	4	0.5%
Femur Fractures	Fracture of femur (unspecific)	85	9.6%
	Fracture of femur intertrochanteric section of femur	8	0.9%
	Fracture of femur base of neck of femur	6	0.7%
	Fracture of femur shaft of femur	13	1.5%
	Fracture of femur trochanteric section of femur	3	0.3%
Foot Fractures	Fracture of foot	45	5.1%
	Fracture of foot cuboid	3	0.3%
	Fracture of ankle	35	3.9%
	Fracture of talus	4	0.5%
	Fracture of calcaneus	16	1.8%
	Fracture of metatarsal bone	24	2.7%
	Fracture of malleolus medial malleolus	4	0.5%
	Fracture of malleolus lateral malleolus	16	1.8%
	Fracture of malleolus bimalleolar fracture	1	0.1%
	Fracture of big toe	10	1.1%
Hip and Spine Fractures	Fracture of acetabulum	14	1.6%
	Fracture of lumbar and pelvic spine	6	0.7%
	Fracture of coccyx	2	0.2%
	Fracture of ilium	1	0.1%

	Fracture of pubis	1	0.1%
	Fracture of sacrum	10	1.1%
	Fracture of pelvis	10	1.1%

Table 3: The relation between gender and type of fracture

Fracture		Gender				P-value
		Male		Female		
		Count	Column %	Count	Column %	
Fracture	Hand and wrist Fractures	59	9.7%	30	10.9%	0.680
	Forearm and Elbow Fractures	112	18.4%	61	22.1%	
	Humerus Fractures	114	18.7%	52	18.8%	
	Clavicle and Scapula Fractures	30	4.9%	10	3.6%	
	Tibia and Fibula Fractures	70	11.5%	31	11.2%	
	Femur Fractures	81	13.3%	34	12.3%	
	Foot Fractures	109	17.9%	49	17.8%	
	Hip and Spine Fractures	35	5.7%	9	3.3%	

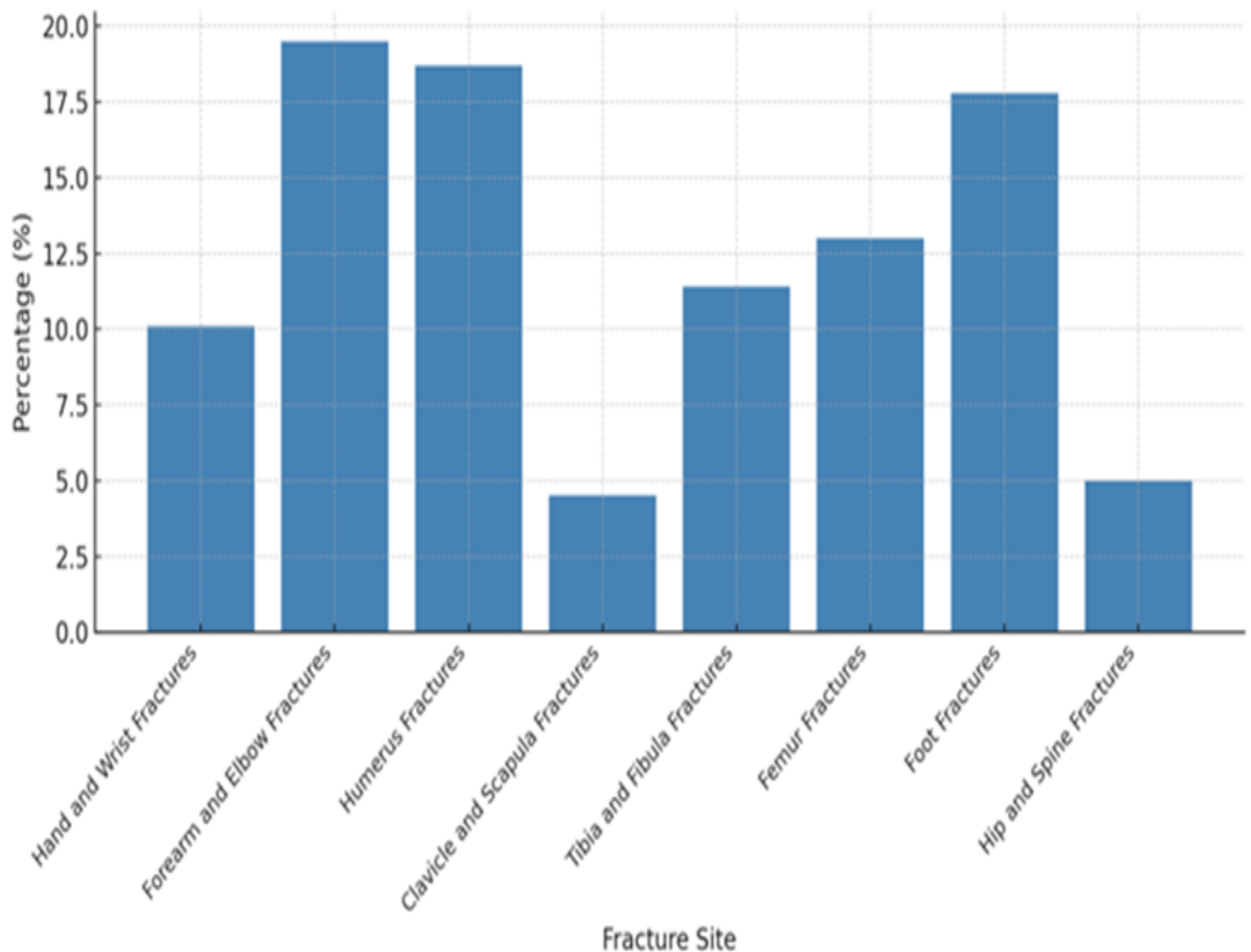


Figure 1. Prevalence of fracture according to their site.

Table 4: The relation between age and type of fracture

		Age														P-value
		1-10		10-20		20-30		30-50		50-70		70-90		> 90		
		N	Column %	N	Column %	N	Column %	N	Column %	N	Column %	N	Column %	N	Column %	
Fracture	Hand and wrist Fractures	11	7.6%	14	7.0%	9	7.3%	23	10.6%	20	14.4%	13	21.3%	0	0.0%	0.001*
	Forearm and Elbow Fractures	38	26.2%	39	19.4%	28	22.8%	28	13.0%	30	21.6%	10	16.4%	0	0.0%	
	Humerus Fractures	45	31.0%	46	22.9%	15	12.2%	31	14.4%	22	15.8%	7	11.5%	0	0.0%	
	Clavicle and Scapula Fractures	4	2.8%	11	5.5%	5	4.1%	10	4.6%	6	4.3%	4	6.6%	0	0.0%	
	Tibia and Fibula Fractures	15	10.3%	24	11.9%	14	11.4%	29	13.4%	13	9.4%	5	8.2%	1	50.0%	
	Femur Fractures	6	4.1%	28	13.9%	23	18.7%	34	15.7%	17	12.2%	7	11.5%	0	0.0%	
	Foot Fractures	18	12.4%	28	13.9%	24	19.5%	49	22.7%	25	18.0%	13	21.3%	1	50.0%	
	Hip and Spine Fractures	8	5.5%	11	5.5%	5	4.1%	12	5.6%	6	4.3%	2	3.3%	0	0.0%	

Discussion

Our study investigated how demographic factors are linked to fractures and identified some interesting trends in their prevalence and distribution. A significant finding was the strong association between age distribution and fracture prevalence (p-value = 0.001), reflecting variations in bone fragility and injury susceptibility with age.

In children aged 1–10 years, humerus fractures were the most common, representing 31.0% of cases. These fractures often result from falls or sports injuries and are usually treated conservatively (MadjarSimic et al., 2012; Lee et al., 2011). For those aged 10–20 years, humerus fractures remained prevalent at 22.9%, along with forearm and elbow fractures at 19.4%. The high rate of humerus fractures in adolescents and young adults is often due to sports activities or vehicle accidents, highlighting the need for preventive measures and safety protocols (Pencle & Varacallo, 2019)

In the 20–30 age group, forearm and elbow fractures (22.8%) and foot fractures (19.5%) were

prominent. Young adults are often involved in physically demanding activities, which increases their risk of upper and lower extremity injuries (van Netten et al., 2016). Among those aged 30–50 years, foot fractures were more common (22.7%), while forearm and elbow fractures (13.0%) and humerus fractures (14.4%) also remained significant. Middle-aged adults may experience fractures due to a mix of occupational hazards, sports activities, and changes in bone density (Wright et al., 2014).

In the 50–70 age group, forearm and elbow fractures (21.6%) and foot fractures (18.0%) were frequent, alongside humerus fractures (15.8%) and hand/wrist fractures (14.4%). Older adults in this range face increased risk from falls and fragility fractures due to age-related changes and other health conditions (Burge et al., 2007). For individuals aged 70–90 years, hand and wrist fractures (21.3%) and foot fractures (21.3%) were notably prevalent, with forearm and elbow fractures (16.4%) and humerus fractures (11.5%) also common. The rise in fracture incidence with age is often due to osteoporosis and decreased

bone strength, emphasizing the need for effective fall prevention and osteoporosis management (Klotzbuecher et al., 2000). Among those over 90 years old, fractures of the hand/wrist (21.3%) and foot (21.3%) were still high, though the sample size was smaller. Managing fractures in this age group requires a comprehensive approach considering overall health, functional capacity, and quality of life (Bliuc et al., 2015).

While the majority of our study population was male (68.8%), the difference in fracture rates between genders was not statistically significant ($p = 0.680$). This gender distribution is consistent with previous research indicating that men are generally more susceptible to fractures, likely due to higher levels of physical activity and risk-taking behavior (Court-Brown & Caesar, 2006; Axénhus et al., 2024). However, fracture patterns varied slightly between genders. For males, humerus fractures (18.7%) were the most common, followed by forearm and elbow fractures (18.4%) and foot fractures (17.9%). For females, forearm and elbow fractures (22.1%) were most prevalent, with humerus fractures (18.8%) and foot fractures (17.8%) also notable. These similar patterns between genders suggest the need for targeted fracture prevention and management strategies (Burge et al., 2007).

Limitations

This study has several limitations. First, its retrospective design may introduce information bias due to reliance on medical records. Second, the single-center setting limits generalizability to other regions. Third, potential confounding variables such as mechanism of injury, comorbidities, and socioeconomic factors were not assessed. Finally, the absence of multivariable analysis limits the ability to control for interacting factors.

In summary, our study sheds light on the epidemiology of fractures, highlighting their prevalence and distribution across different anatomical regions, ages, and genders. The variations observed underscore the complex interactions between demographic factors, lifestyle, and anatomical vulnerabilities in fracture risk. Understanding these factors is crucial for developing targeted interventions to reduce the impact of fractures and enhance patient outcomes.

Conclusion

Fracture patterns in this population vary significantly with age but not with gender. These findings emphasize the importance of age-specific preventive strategies and highlight the need for further multicenter studies incorporating additional risk factors.

Author Contributions

All authors contributed to the conception and design of the review, literature search, study selection, data charting, and interpretation of findings. All authors drafted or critically revised the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

Ethical Approval and Patient Consent

This study was conducted in accordance with the Declaration of Helsinki and approved by the Local Committee for Research Ethics at Jazan University, Saudi Arabia (Approval No. HAPO-10-Z-001). All participants provided written informed consent prior to participation.

Data Availability Statement

The full study protocol is available from the corresponding author upon reasonable request.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not for profit sectors.

Conflicts of Interest

The author declares no conflicts of interest related to financial or non-financial in this study.

Declaration of generative AI and AI-assisted technologies

The authors used generative AI tools solely to improve language clarity and correct grammatical issues during manuscript preparation. All content was carefully reviewed and revised by the authors, who take full responsibility for the accuracy, integrity, and originality of the final published work.

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