

ORIGINAL ARTICLE

# Patterns and management of upper and lower limb fractures in pediatric patients presenting to the pediatric emergency department at a Tertiary Care Hospital: a retrospective study in Riyadh, Saudi Arabia

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## ABSTRACT

**Background:** Pediatric fractures constitute a significant public health concern globally, with varying implications on healthcare systems and affected individuals. While global trends have been well-documented, research in Saudi Arabia, particularly within a tertiary care setting, continues to contribute significantly to the understanding of this issue.

**Methods:** This retrospective chart review, conducted over 4 years from 2019 to 2023, analyzed pediatric fracture cases at a major hospital in Riyadh, Saudi Arabia. The study included 286 children aged 14 years or younger presenting with new fractures. Data on demographics, fracture types, anatomical locations, and treatment modalities were extracted from electronic health records and analyzed using IBM Statistical Package for Social Sciences Statistics Version 25.

**Results:** The study found a higher incidence of fractures in males, particularly increasing after age 8, with radial, metatarsal, and humeral fractures being the most common. Radial fractures, especially distal radial fractures, were predominant, and the majority were treated with casts and backslabs. Metatarsal fractures were more prevalent in males, predominantly treated with backslabs, while humeral fractures were more common in females, mainly treated with backslabs and slings.

**Conclusion:** This study provides essential insights into pediatric fracture patterns in a Saudi Arabian tertiary care setting, echoing global trends and underscoring the need for conservative treatment approaches. Future research should expand on long-term outcomes, broader demographic factors, and the impact of comorbidities to enhance pediatric fracture management and healthcare strategies.

**Keywords:** Pediatric fracture, pediatric emergency, fracture patterns, fracture management.

## Introduction

The Global Burden of Disease study of 2019 indicates that in Saudi Arabia, transport injuries and unintentional injuries are the primary causes of death in children aged 5-14 years old [1]. Sound evidence on trends by cause at the national level is essential. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD). For children under 5 years old, unintentional injury is the leading cause of death, when excluding maternal and neonatal factors [1]. Sound evidence on trends by cause at the national level is essential. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD). This highlights a significant public health issue, paralleling global concerns about pediatric injuries.

Supporting this, data from the United States reveals that orthopedic surgeries for fractures and musculoskeletal injuries are the second most common type of pediatric

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inpatient surgery [2]. The financial implications of these treatments are substantial, ranging from approximately \$7,000 in the emergency department to nearly \$24,000 for operative treatment, underlining the significant impact of pediatric fractures on healthcare costs [3]. This correlation suggests that similar to the US, managing fractures and related injuries is likely a critical aspect of pediatric healthcare in Saudi Arabia and an important area for public health focus.

Beyond the fundamental medical expenses, the impact on the child extends to missed school days and limited activities, with durations varying from 14 days for fractures in the upper extremities to as long as 26 days for lower extremity fractures [4]. In addition, parents or guardians incur indirect costs, including lost workdays, transportation expenses, and various other related outlays [4].

The lifetime risk of sustaining a fracture for children aged 0-16 years varies significantly between genders: boys face a risk of 42%-64%, while girls have a lower risk of 27%-40%. Annual fracture rates in childhood are reported to range from 12.0 to 36.1 per 1,000 children. In a detailed Swedish study, the incidence was higher in boys at 257 per 10,000, compared to 165 per 10,000 in girls, leading to a combined incidence rate of 212 per 10,000 [5]. Contrastingly, a Greek study estimated a lower annual incidence rate of 12 fractures per 1,000 children [6].

While global and regional data highlight the significance of pediatric fractures, specific research in Saudi Arabia has made strides in advancing our understanding of this issue. For instance, a study conducted at a university hospital in Riyadh focused exclusively on hand fractures in children, revealing the proximal phalanx of the fifth digit as the most commonly fractured bone [7]. In addition, another study, which explored all-terrain vehicle accidents, encompassed various pediatric traumas, albeit not exclusively focused on fractures [8]. These studies, while providing valuable insights, underscore the ongoing efforts to comprehensively investigate the broader spectrum of pediatric fractures in Saudi Arabia, contributing to the refinement of our understanding in this area.

This study, at a tertiary care center in Riyadh, assessed the patterns of fractures in children under 14, encompassing the most common fracture types, their anatomical locations, associated comorbidities, demographic features, and predominant treatment modalities.

## Methods

This retrospective chart review study was conducted at King Fahad Medical City, a tertiary hospital in Riyadh, Saudi Arabia. The study spanned a four-year period from 2019 to 2023. The study included children aged 14 years or younger who were presented to the emergency department with new fractures. Cases were identified and included based on age criteria and the presentation of a new fracture.

Data were collected retrospectively from the hospital's electronic health records. The collected data encompassed demographic characteristics of the patients, details of any comorbidities, fracture types, and their anatomical locations, as well as the treatment modalities administered.

The data analysis was performed using IBM Statistical Package for Social Sciences Version 25. Descriptive statistics were utilized to analyze the data, including the use of frequencies and percentages. This approach was chosen to effectively summarize the patterns and characteristics of pediatric fractures and their treatments.

Ethical approval (No: 23-140) for this study was obtained from the relevant institutional review board at King Fahad Medical City. Given the retrospective nature of the study and the use of de-identified data from medical records, patient consent was not required. Patient confidentiality was strictly maintained throughout the study.

## Results

The study initially included a dataset of 310 patients. Of these, 24 were removed from the study due to the absence of fractures in their radiological assessments. Consequently, the analysis was conducted on 286 patients, among whom 36 presented with more than one fracture. This situation resulted in the evaluation of a total of 337 distinct fractures.

Within this cohort, males constituted a majority with 190 cases (66.4%), while females accounted for 96 cases (33.6%). The age distribution of the patients ranged from 1 to 15 years, with the majority (40.5%) in the 11-15-year age group, followed by 32.1% in the 6-10-year category. Notably, 36 patients (12.5%) were presented with multiple fractures. Patient characteristics are detailed in Table 1. Age-gender distribution is presented in Figure 1.

The study identified various comorbidities, including attention deficit hyperactivity disorder ( $n = 2$ ), diabetes mellitus type 1 ( $n = 2$ ), Joubert syndrome ( $n = 1$ ), and singular instances of osteogenesis imperfecta type 1, Rett syndrome, acute myeloid leukemia, and Angelman

**Table 1.** Patient characteristics ( $n = 286$ ).

Patients' characteristics	
Characteristics	Frequency (%)
Gender	
Male	190 (66.4)
Female	96 (33.6)
Age group	
<1 year	0 (0)
1-5 years old	78 (27.2)
6-10 years old	92 (32.1)
11-15 years old	116 (40.5)
Patients with multiple fractures	36 (12.5)

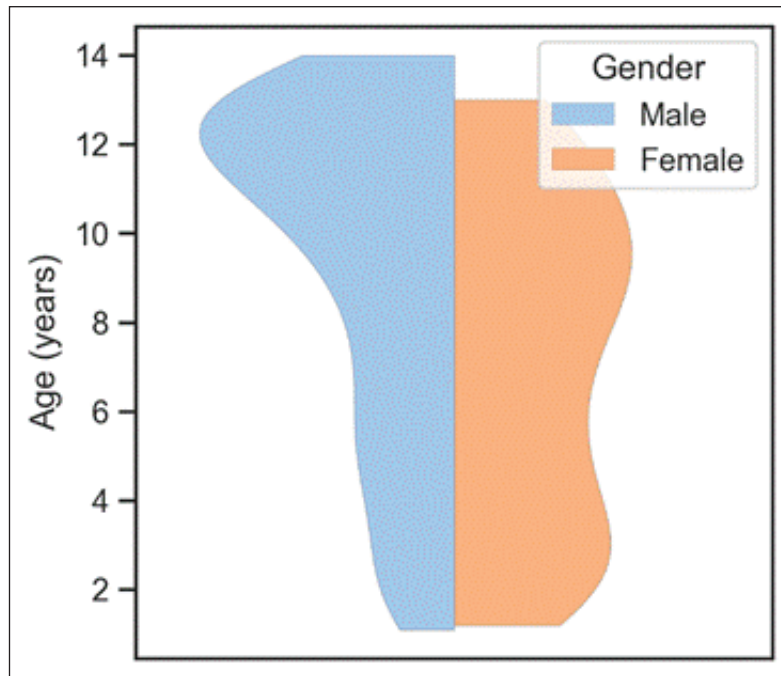


Figure 1. Age-gender distribution.

Table 2. Comorbidities among participants.

Disease	Frequency
Attention deficit hyperactivity disorder	2
Diabetes mellitus type 1	2
Joubert syndrome	1
Osteogenesis imperfecta type 1	1
Rett syndrome	1
Acute myeloid leukemia	1
Enteropathy	1
Esotropia	1
Congenital heart disease	1
Cornelia de Lange syndrome	1
Cohen syndrome	1
Seizure disorder	1
Glucose-6-phosphate dehydrogenase deficiency	1
Spastic quadriplegia	1
Psoriasis	1
Asthma	1
Angelman syndrome	1
Segawa syndrome	1
Ehler syndrome	1
Brain tumor	1
Congenital blindness	1
Familial intrahepatic cholestasis	1

syndrome. A detailed summary of these findings can be referenced in Table 2.

Upper limb fractures were most common, accounting for 199 cases (63.3%), followed by lower limb fractures with 153 cases (35.7%). The study observed only one instance

Table 3. Distribution of fractured bones in pediatric patients.

Bone	Frequency (%)
Radius	106 (37)
Humerus	42 (15)
Metatarsal	31 (11)
Clavicle	24 (8)
Phalanx (Foot)	24 (8)
Tibia	22 (8)
Fibula	15 (5)
Ulna	6 (2)
Femur	5 (2)
Navicular	3 (1)
Calcaneus	2 (1)
Coronoid	2 (1)
Olecranon	2 (1)
Glenoid	1 (<1)
Pubic	1 (<1)

of a pelvic fracture, with no reported fractures in the back and chest regions.

In terms of specific bones, the radius was the most frequently fractured bone, represented in 106 cases (37%), followed by the humerus in 42 cases (15%), and the metatarsal bones in 31 cases (11%). The distribution of fractured bones in pediatric patients is presented in Table 3.

The radius was the most commonly fractured bone across all age groups, with its incidence increasing with age. The breakdown of commonly fractured bones across age groups is presented in Table 4.

When examining gender-specific trends, the radius also emerged as the most frequently fractured bone in both

**Table 4.** Fractured bones by age groups.

Age group	Bone	Frequency (%)
1–5 years old		
	Radius	24 (21)
	Humerus	20 (17)
	Clavicle	13 (11)
6–10 years old		
	Radius	31 (34)
	Metatarsal	22 (24)
	Humerus	14 (15)
11–15 years old		
	Radius	37 (47)
	Metatarsal	31 (39)
	Phalanx (Foot)	13 (16)

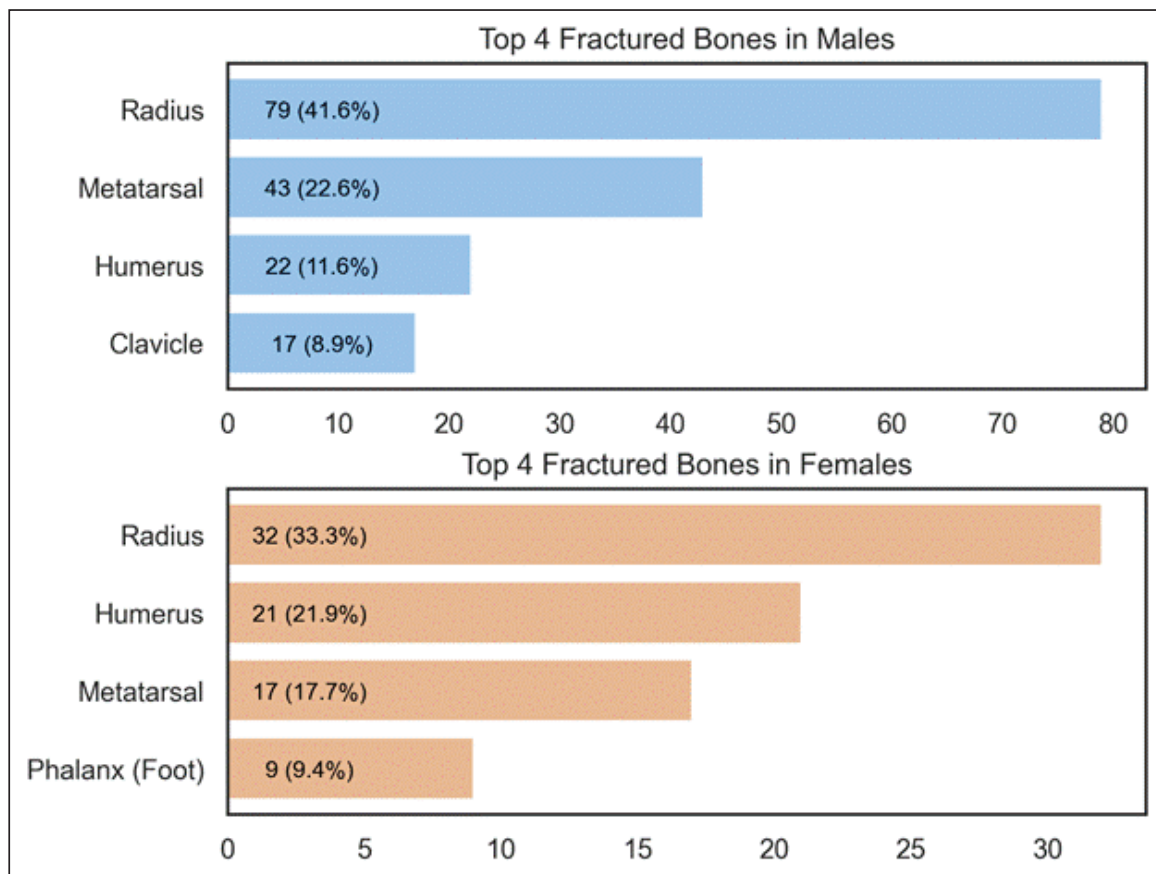
males (42%) and females (33%). Females showed a higher prevalence of humerus (22%) and metatarsal (18%) fractures, while males similarly, but inversely, displayed a significant incidence of metatarsal (23%) and humerus (12%) fractures. Figure 2 illustrates the distribution of the most frequently fractured bones, categorized by gender.

In this study, radial fractures were predominant, comprising 32.9% ( $n = 111$ ) of all fractures, consistently across age groups and genders. Distal radial fractures were particularly frequent, accounting for 26.4% of all fractures and 82% of radial fractures. Within radial fracture subtypes, the majority were unspecified (59%), followed by buckle fractures at 25%. The treatment

of radial fractures predominantly involved the use of casts (49%) and backslabs (26%). Procedures such as open reduction and closed reduction with fixation were relatively rare, each accounting for less than 2% of the treatment approaches.

Metatarsal fractures were identified as the second most common type of fracture in this study, representing 17.8% ( $n = 60$ ) of all cases. These fractures were notably more prevalent in males, comprising 22.6% of their fractures, whereas in females, they were the third most frequent, following humerus fractures. Specifically, the fourth, third, and fifth metatarsal bones were the primary sites of these fractures, accounting for 30%, 25%, and 23%, respectively. In the dataset, 43% of metatarsal fractures were unspecified due to a lack of detailed subtype information. Among the specified types, distal metatarsal fractures were observed in 18% of cases, and base fractures near the ankle in 13%, with other locations such as proximal, metaphysis, and midshaft being less common. Neck fractures were the least common at 2%. The predominant treatment for metatarsal fractures was backslabs, utilized in 72% of cases.

Humeral fractures represented the third most frequent type of fracture in this study, making up 12.7% of all cases ( $n = 43$ ). Notably, these fractures were more prevalent in females, constituting 22% of fractures in this group, compared to 11.6% in males.



**Figure 2.** The most frequently fractured bones stratified by gender.

Supracondylar fractures were the predominant type of humeral fracture, constituting 42% of such cases. Proximal humeral fractures followed at 30%, and lateral condyle fractures comprised 16%. Other fracture sites on the humerus, like the distal end, surgical neck, shaft, and medial epicondyle, each accounted for 5% or fewer of total humeral fractures. Most humeral fractures lacked detailed data regarding types and subtypes beyond anatomical location. The most common treatment for these fractures was backslab, applied in 53% of cases, with slings and casts being the next most used treatments, at 21% and 16%, respectively. Less frequently employed treatment methods, including various reduction techniques, were used in only 5% or fewer cases.

Treatment modalities are summarized in Table 5. Across the various types of fractures analyzed in this study, backslabs and casts emerged as the most prevalent treatment modalities, being used in 43% (144 cases) and 32% (107 cases) of all fractures, respectively.

## Discussion

This study conducted at King Fahad Medical City offers a comprehensive analysis of pediatric fractures within a tertiary care setting in Riyadh, Saudi Arabia. Our present study indicates a higher incidence of fractures in males compared to females, with a notable increase in fracture cases among males after the age of 8. This pattern is consistent with results from other research and could be attributed to greater involvement in sports and variations in activity and risk-taking behaviors in males [9,10]. The study also highlights the predominance of radial, metatarsal, and humeral fractures among pediatric patients, a finding that aligns with global fracture trends observed in children [5,9,11-13].

The high incidence of radial fractures, especially distal radial fractures, observed in this study reflects patterns noted in pediatric orthopedic research, where the radius is often vulnerable due to activities such as sports and falls [14-17].

**Table 5.** Summary of treatment modalities.

Treatment modalities for all fractures		
Treatment	Frequency	Percentage
Backslab	144	43
Cast	107	32
Closed reduction + cast	38	11
Sling	29	9
Open reduction with internal fixation	7	2
Conservative	2	1
Open reduction + k-wires	2	1
Closed reduction + external fixation	2	1
Closed reduction + internal fixation	2	1
Open reduction + internal fixation	1	<1
Closed reduction and percutaneous pinning	1	<1
Closed reduction + sling	1	<1
Missing	1	<1
Treatment modalities for distal radial fractures		
Treatment	Frequency	Percentage
Cast	45	49
Backslab	24	26
Closed reduction + cast	19	21
Open reduction with internal fixation	2	2
Closed reduction + external fixation	1	1
Treatment modalities for distal humeral fractures		
Treatment	Frequency	Percentage
Backslab	23	53
Sling	9	21
Cast	7	16
Open reduction + K-wires	2	5
Closed reduction and percutaneous pinning	1	2
Open reduction with internal fixation	1	2

Metatarsal fractures, identified as the second most frequent type of fracture, were more common in males. This could suggest a correlation between increased physical activity and sports participation, leading to a higher risk of such injuries [17].

Our study offers valuable insights into pediatric fractures, providing physicians with essential information for more informed decision-making in managing fractures in children. These findings will aid healthcare professionals in delivering optimal care to pediatric patients with fractures. The study underscores the need for additional research, particularly regarding the long-term outcomes and effectiveness of different treatment modalities for pediatric fractures in Saudi Arabia. Such research could significantly contribute to the optimization of fracture management and patient care.

Future research should focus on several key areas to improve the understanding and management of pediatric fractures. Research across multiple centers would enhance the diversity of data and improve the generalizability of findings. Emphasis on long-term outcomes, encompassing both physical and psychological aspects, is crucial for a thorough understanding of post-fracture recovery. Investigating the role of rehabilitation and physical therapy can deepen knowledge about optimal recovery strategies. Further research into the impact of comorbidities on fracture incidence and outcomes is also necessary, given the limited data in our study. In addition, examining the influence of socioeconomic and environmental factors can inform targeted prevention and education initiatives. Finally, developing and evaluating injury prevention measures, particularly for high-risk groups identified in the study, is imperative for enhancing pediatric fracture care.

This study has several limitations. First, being a retrospective chart review from a single tertiary care center, the findings may not be generalizable to other settings or the broader pediatric population in Saudi Arabia. Second, the high percentage of unspecified fractures in the dataset indicates a limitation in the available data, potentially affecting the precision of our findings. In addition, comorbidities were not extensively recorded in the patient files, precluding any definitive conclusions about their impact on fracture patterns and outcomes. This lack of comprehensive comorbidity data is a significant limitation, as it could influence the understanding of fracture risks and management strategies. Third, the study did not evaluate long-term outcomes of these fractures, which restricts our understanding of the effectiveness of different treatment modalities.

## Conclusion

This research provides key insights into pediatric fracture patterns, indicating a higher prevalence of fractures in males and pinpointing radial, metatarsal, and humeral fractures as the most common. Aligning with worldwide trends in pediatric injuries, the findings emphasize the importance of conservative treatment methods. The study's limitations highlight the need for future research, particularly in areas such as long-term outcomes and

comprehensive data analysis. Enhanced understanding from such studies will be crucial for improving pediatric fracture management and healthcare approaches.

## Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

## Funding

None.

## Consent to participate

Not applicable.

## Consent for publication

Not applicable.

## Ethical approval

The study received ethical approval from the IRB of King Fahad Medical City in Riyadh, Saudi Arabia, via reference IRP Log number 23-140, dated 27/03/2023.

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