A Review of Epidemiological Distribution of Different Types of Fractures in Paediatric Age

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Disclosures can be found in Additional Information at the end of the article

Abstract

Introduction
Treating paediatric patient fractures comprises a large part of any orthopaedic trauma service. The majority of fractures take place during sports and recreational activities. In this study, we examined the incidence of fractures and their distribution according to patient age.

Methods
We collected retrospective data from all the paediatric age group patients (under age 18) referred to our orthopaedic service from August 2015 to July 2016. We collected data for 1022 patients during one calendar year.

Results
We noted 1022 paediatric fracture presentations in one calendar year, with a 48.63% incidence in male patients and 51.36% in female patients. The age with the highest incidence was 16 years in boys and 11 years in girls. Upper limb fractures were more common than lower limb fractures in most of the subgroups.

Conclusions
These insights into paediatric fracture distribution provide an opportunity to evaluate the resources in hospitals allocated to emergency and orthopaedic departments regarding their capacity to treat fractures in paediatric patients.

Introduction
Paediatric injuries comprise a large subset of emergency and orthopaedic outpatient presentations. The high number of paediatric injuries and fractures can be attributed to the enthusiasm typically seen in paediatric patients as they discover and experience new things while remaining unaware of the consequences. Bone properties of patients in this age group will also influence the incidence and pattern of fracture. Paediatric fractures constitute approximately 25% of all paediatric age group injuries [1]. The majority of fractures in paediatric patients are not life-threatening and are treatable [2]. Although there are many
systemic and metabolic diseases that can cause or contribute to the fractures, the majority of these fractures are secondary to trauma [3]. The aim of our study is to look at the incidence of fractures in paediatric patients, the prevalence of the different types of fractures, their gender distribution, and their relationship to certain activities or sports.

**Materials And Methods**

Our study is based on a retrospective collection of data of paediatric patients who presented with fractures to the orthopaedic outpatient services of University Hospital Kerry, as well as patients admitted for inpatient treatment. Patients under 18 years of age who presented to the University Hospital Kerry from August 2015 to July 2016 with fractures were included in the study. The epidemiological data was collected from the hospital and departmental medical records. All X-rays were reviewed to ensure that non-fracture or soft-tissue injuries were excluded. The data was collected on Microsoft Excel sheets and analysed using the Statistical Package for the Social Sciences (SPSS (version 19.0) IBM, New York, USA).

**Results**

The total population of County Kerry (located in Southwest Ireland) is 147,554. The paediatric population (those under 18 years of age) is 34,940, comprising 24.013% of the total population. A total of 1022 paediatric patients presented with fractures to the orthopaedic outpatient department, making the incidence rate 29.23 fractures/1000/year. The detailed results of the epidemiological distribution of fractures are shown in Table 1.
| Fracture                        | Frequency | Percent | Age (year) | Sex (Male:Female) |
|--------------------------------|-----------|---------|------------|-------------------|
| Clavicle                       | 53        | 5.2     | 9.21       | 74:26             |
| Proximal humerus               | 18        | 1.8     | 11.56      | 44:56             |
| Distal humerus/Supracondylar   | 142       | 13.9    | 6.89       | 51:49             |
| Radius/Ulna diaphysis          | 36        | 3.5     | 9.42       | 50:50             |
| Radius metaphysis              | 58        | 5.7     | 8.41       | 41:59             |
| Distal radius /Buckle          | 278       | 27.2    | 8.48       | 54:46             |
| Scaphoids                      | 35        | 3.4     | 13.37      | 40:60             |
| Metacarpals                    | 51        | 5.0     | 14.02      | 47:53             |
| Phalanx fingers                | 85        | 8.3     | 12.85      | 39:61             |
| Tibia diaphysis                | 13        | 1.3     | 8.00       | 46:54             |
| Distal tibia                   | 9         | 0.9     | 5.00       | 67:33             |
| Femur diaphysis                | 19        | 1.9     | 14.42      | 42:58             |
| Proximal tibia                 | 25        | 2.4     | 8.56       | 88:12             |
| Patella                        | 7         | 0.7     | 13.29      | 29:71             |
| Ankle                          | 94        | 9.2     | 12.36      | 40:60             |
| Toe phalanx                    | 16        | 1.6     | 12.88      | 44:56             |
| Metatarsals                    | 26        | 2.5     | 11.23      | 54:46             |
| Pubic rami                     | 3         | 0.3     | 16.00      | 0:100             |
| Olecranon                      | 11        | 1.1     | 7.27       | 18:82             |
| Hook of hamate                 | 7         | 0.7     | 14.00      | 57:43             |
| Ulnar styloid                  | 18        | 1.8     | 12.00      | 100:0             |
| Radial head                    | 18        | 1.8     | 8.33       | 33:67             |

**TABLE 1: Common fractures and their epidemiological distribution according to age, sex, and frequency of different types of fractures**

The most common fracture was distal radial/buckle fractures (27.2%), followed by distal humerus /supracondylar fracture (15.9%), ankle fractures (9.2%), phalanx fractures (8.3%), and radial/ulnar metaphysis fractures (5.7%). Figure 1 presents the nine most common fractures and their ratios.
The mean age of paediatric patients presenting with distal radial fracture was 8.48 years with a male/female (M/F) ratio of 54:46. The mean age of paediatric patients presenting with distal humerus fracture was 6.89 years with an M/F ratio of 51:49. The mean age of patients with ankle fractures was 12.36 years with an M/F ratio of 40:60. The mean age of patients with a phalanx fracture was 12.85 years with an M/F ratio of 59:61. Finally, the mean age of patients with a radial/ulnar metaphysis fracture was 8.41 years with an M/F ratio of 41:59. Table 2 presents fracture data according to age, M/F ratio, limb distribution, and common fractures.
| Age group (years) | Male (%):Female (%) | Upper:Lower Limb (%) | Five Most Common Fractures (%) |
|------------------|---------------------|----------------------|-------------------------------|
| 0-2              | 33:67               | 100:0                | Distal radius /buckle fracture 29.17 |
|                  |                     |                      | Distal humerus/supracondylar 25 |
|                  |                     |                      | Clavicle 25                   |
|                  |                     |                      | Ankle 12.5                    |
| 3-6              | 50:50               | 81:19                | Distal humerus/supracondylar 32.35 |
|                  |                     |                      | Distal radius /buckle fracture 32.35 |
|                  |                     |                      | Radius metaphysis 9.66        |
|                  |                     |                      | Clavicle 7.56                 |
|                  |                     |                      | Proximal tibia 6.3            |
|                  |                     |                      | Distal radius/buckle fracture 37.28 |
|                  |                     |                      | Distal humerus/supracondylar 11.61 |
| 7-12             | 45:55               | 74:26                | Ankle 8.93                    |
|                  |                     |                      | Phalanx fingers 8.705         |
|                  |                     |                      | Radius/ulna diaphysis 8.036   |
|                  |                     |                      | Ankle 14.74                  |
|                  |                     |                      | Phalanx fingers 14.74         |
|                  |                     |                      | Metacarpals 13.78             |
|                  |                     |                      | Distal radius /buckle fracture 8.65 |
|                  |                     |                      | Scaphoids 8.33                |
| 13-17            | 54:46               | 66:34                | Ankle 14.74                  |
|                  |                     |                      | Phalanx fingers 14.74         |
|                  |                     |                      | Metacarpals 13.78             |
|                  |                     |                      | Distal radius /buckle fracture 8.65 |
|                  |                     |                      | Scaphoids 8.33                |

**TABLE 2: Paediatric subgroups according to age with sex ratio, limb distribution, and common fracture distribution**

Up to the age of two years, the most common fractures were distal radial buckle fractures (29.17%), followed by distal humerus/supracondylar fractures in 25% of patients in this age group. Between the ages of three and six years, the most common fractures presented were distal humerus/supracondylar fractures (32.35%), distal radial/buckle fractures (32.35%), and radial/ulnar metaphysis fractures (9.66%). Between age seven and age 12, the most common fractures were distal radial/buckle fractures (37.28%), followed by supracondylar fractures (11.61%) and ankle fractures (8.93%). In patients aged 13 to 17, the most common fractures were ankle fractures (14.74%), phalanx fractures (14.74%), followed by metacarpal fractures (15.78%). Table 3 presents the fracture epidemiology according to activities.
| Activity or Mechanism     | Mean Age (years) | Male (%): Female (%) | Upper: Lower Limb (%) | Most Common Fractures (%) |
|---------------------------|------------------|----------------------|-----------------------|---------------------------|
| Blunt trauma              | 11.417           | 40:60                | 54:46                 | Metacarpals 25             |
|                           |                  |                      |                       | Phalanx fingers 12.0       |
|                           |                  |                      |                       | Toe phalanx 12.0           |
|                           |                  |                      |                       | Clavicle 33.3              |
| Cycling                   | 9.889            | 22:78                | 83:17                 | Proximal humerus 33.3      |
|                           |                  |                      |                       | Phalanx fingers 16.6       |
|                           |                  |                      |                       | Metatarsals 16.6           |
|                           |                  |                      |                       | Clavicle 21.0              |
|                           |                  |                      |                       | Distal hum/supracondylar 20|
| Fall from bed/chair       | 5.737            | 49:51                | 74:26                 | Proximal tibia 13.6        |
|                           |                  |                      |                       | Distal radius/buckle fracture 10.5|
|                           |                  |                      |                       | Scaphoids 6.32             |
| Fall on outstretched hand | 7.864            | 66:34                | 98:2                  | Distal radius/buckle fracture 72.4|
|                           |                  |                      |                       | Radius metaphysis 9.5      |
|                           |                  |                      |                       | Scaphoids 7.24             |
|                           |                  |                      |                       | Distal radius/buckle fracture 17.2|
| Gaelic Soccer             | 14               | 23:77                | 84:16                 | Clavicle 13.5              |
|                           |                  |                      |                       | Phalanx fingers 13.5       |
|                           |                  |                      |                       | Radius metaphysis 12.3     |
|                           |                  |                      |                       | Phalanx fingers 34.4       |
|                           |                  |                      |                       | Metacarpals 27.5           |
| Hockey                    | 13.034           | 76:24                | 90:10                 | Olecranon 10.3             |
|                           |                  |                      |                       | Ankle 10.3                 |
|                           |                  |                      |                       | Phalanx fingers 20         |
|                           |                  |                      |                       | Distal radius/buckle fracture 20|
|                           |                  |                      |                       | Proximal humerus 20        |
|                           |                  |                      |                       | Metacarpals 10             |
A commonly reported cause of injury was blunt trauma, occurring in 54% of the fractures of the upper limb and 46% of the fractures of the lower limb. The most common fractures due to blunt trauma were metacarpal fractures (25%), finger phalanx and foot phalanx fractures (12% each), followed by ankle fractures (11.11%). Another common mechanism was falling on an outstretched hand, and the associated fractures were distal radial fractures (72.4%), radial metaphysis fractures (9.5%), scaphoid fractures (7.24%), and radial head fractures (2.71%). Fractures associated with trampolines, monkey bars, and bouncing castles were common in younger children. The most common fracture pattern seen in these activities was distal humerus supracondylar fractures (80.8%), distal radial buckle fractures (9.6%), followed by ankle and phalanx fractures (4.8% each). The fracture pattern seen resulting from Gaelic football injuries were distal radial buckle fractures (17.28%), clavicle fractures (13.58%), finger phalanx fractures (13.58%), radial ulnar fractures (12.55%), and distal humerus supracondylar, metacarpals, and tibia fractures (7.41% each). Fractures associated with hurling (a popular outdoor stick and ball field sport) were finger phalanx, distal radius, and proximal humerus fractures (20% each), followed by metacarpal and scaphoid fractures (10% each).

In the female population, camogie (a sport similar to hurling) and hockey are very popular activities. The most common fracture seen in camogie players were the ankle, phalanx, and radial ulnar shaft fractures (33.3% each). For hockey players, finger phalanx fractures were most common (34.48%), followed by metacarpal fractures (27.59%), ankle (10.34%), and olecranon fractures (10.34%). Fractures associated with soccer were distal radial buckle fractures (35.43%), ankle fractures (21.7%), and radial ulnar metaphysis fractures (10.29%).

The other common activities/mechanisms reported included cycling, road and traffic accidents.
(RTA), and falls from beds or chairs. See Table 3 for common fractures during those activities. The distribution of fractures in male/female population and the fracture distribution according to age is shown in Figure 2.

![Fracture distribution](image)

**FIGURE 2: Distribution of fractures in the male/female population and fracture distribution according to age**

**Discussion**

Fractures commonly occur in paediatric and elderly patients because of relatively weaker points of physis and metaphysis, and in elderly patients because of deteriorated bone quality [4]. The incidence rate of fractures in the paediatric population has ranged from 12.8/1000 as reported by Kopjar, et al. in Norway [2] to 36.1/1000 as described by Lyons, et al. [5] in Wales. The incidence rate in our study was 29.2/1000, near the higher end of the range. Many variables can affect the incidence, including the size of the paediatric population and the social emphasis on encouraging physical activity. The distribution of fractures between the upper and lower limbs has a certain pattern depending on the age. Early in life, children’s activities utilise upper limbs rather than lower limbs, but as they start walking and running, the incidence of lower limb fractures increases.

According to our findings, the distribution of upper and lower limb fractures show specific trends that are quite representative of the nature of the sports related to those fractures. The distribution of fractures among male and females is shifted more towards males in our study, which may be due to the difference in activity levels. In the literature, distal radial fractures are the most common fractures in all paediatric age groups, which aligns with our findings [6]. The incidence and pattern of the fractures differ by location due to lifestyle differences such as rural vs. urban, area topography, and social and economic parameters.

**Conclusions**

This study provides an accurate assessment of the fractures in paediatric patients distributed by type, age, gender, and activity. This information can help allocate resources for dealing with these injuries in emergency and outpatient departments. These findings may also help healthcare professionals educate parents, guardians, school staff, paramedic staff, hospital staff, and the public in general, on common injuries in children and their relations to certain
activities, in efforts to help minimise those injuries.

Additional Information

Disclosures

**Human subjects:** Consent was obtained by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Rennie L, Court-Brown CM, Mok JYQ, et al.: The epidemiology of fractures in children. Injury. 2007, 38:913–22. 10.1016/j.injury.2007.01.036
2. Kopjar B, Wickizer T: Fractures among children: incidence and impact on daily activities. Inj Prev. 1998, 4:194–7. 10.1136/ip.4.3.194
3. Valerio G, Gallè F, Mancusi C, et al.: Pattern of fractures across pediatric age groups: analysis of individual and lifestyle factors. BMC Public Health. 2010, 10:656. 10.1186/1471-2458-10-656
4. Hedström EM, Svensson O, Bergström U, et al.: Epidemiology of fractures in children and adolescents. Acta Orthop. 2010, 81:148–53. 10.3109/17453671003628780
5. Lyons R, Delahunty A, Kraus D, et al.: Children’s fractures: a population based study. Inj Prev. 1999, 5:129–32. 10.1136/ip.5.2.129
6. Cooper C, Dennison EM, Leufkens HG, et al.: Epidemiology of childhood fractures in Britain: a study using the general practice research database. J Bone Miner Res. 2004, 1:1976–81. 10.1359/JBMR.040902