



# Assessment of Limb Fractures in Children Below 12 Years of Age

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## Abstract

**Background:** In Iran, trauma is the second cause of mortality after cardiovascular diseases. Since children are known to belong to one of the high-risk age groups, the identification of the prevalent fractures in this age group could aid the identification of causes of fractures as well as damages observed in this group.

**Methods:** In this descriptive cross-sectional study, a total of 5187 patients under 12 years of age, with definitive diagnosis of fractures referred to the Taleghani hospital of Kermanshah, were evaluated and the information was extracted from the patients' records according to a researcher-built checklist, the validity of which was confirmed by 2 faculty members. The data was analyzed using SPSS v.16 software.

**Results:** The average age of patients was  $6.4 \pm 5.32$  and their hospitalization duration was  $1.2 \pm 0.98$  days. Herein, 3579 patients (67% of the total number of patients) were male and a significant difference was observed between the 2 genders ( $P < 0.001$ ). Furthermore, 3498 subjects (65.4%) had upper-limb fractures, 1662 subjects (31.2%) had lower-limb fractures, and 182 cases (3.4%) had non-limbic fractures. The most common cause of fracture was falling from a height (77%).

**Conclusions:** The results demonstrate that a high percentage of fractures resulted from falling from a height, in males younger than 12 years old.

**Keywords:** Fracture, Limb, Children

## 1. Background

Fractures account for 10% to 25% of all afflictions sustained by children (1, 2). The prevalence of fractures in children is substantially greater than other age groups; the likelihood of fracture in children (who are younger than 16 years of age) has been 42% in males and 27% in females (3). On average, 2.1% of children were exposed to fractures (4). The occurrence of fractures has been influenced by various factors, such as age, season, climate, environmental and cultural factors, and the city or town of residence. The rate of fractures has been equal in both genders and increases slightly until the age of 10, yet after this age, the number of bone fracture occurrences has been higher in males in comparison to females. The number of fractures after the age of 10 decreases significantly and is very low among mature cases (5, 6). The predominant age of fracture occurrence was reported to be 11 to 12 years old in females and 13 to 14 years in males, with a male to female incidence ratio of 1.5 (5). This rate increased in females after menopause,

while after the age of 80, this rate increased in males once again (5, 6).

Most children's fractures are located in the upper limbs, 20% was detected in the lower limbs, and less than 5% was observed in the axial skeleton and the body. The most common part for fractures in children is the forearm; forearm fractures constitute at least a third of all fractures (5, 7-9). Humerus fractures constitute 10% of all fractures in children and its pattern has dual peaks depending on the age of the child. Fractures in the distal humerus is common in children between 4 and 9 years of age; fractures in the proximal humerus, on the other hand, is more common in older children (10, 11). The fractures in the lower limbs of children frequently occur in the lower part of the femur and the leg (12).

An increase in the occurrence of fractures is related to changes in the activity patterns of children at that particular age (5). In addition, accidents leading to fractures are the primary cause of fractures in children, and the

most common cause is falling from a height (5, 13). Fractures caused by exercises, vehicular accidents, and bicycle accidents have been other causes of fractures in children. The deficiency of minerals in children, low strength of bones, obesity, and exercise patterns (high involvement in exercise activities lead to an increase in risk acceptance, whereas low involvement in exercise causes reduction of bone strength) has been risk factors governing fractures in the children. Children have different fracture patterns in comparison to adults. In children, for example, the cartilage matrix is softer than the mineralized bones and the ligaments of the joints are stronger in children in comparison to adults. The rate of improvement is greater in children than in adults due to greater remaking activities (13). In this study, researchers evaluated fracture status in the upper and the lower limbs of children, who were less than 12 years old referred to Taleghani hospital of Kermanshah between years 2003 and 2013.

This study aimed to achieve the following goals:

- Determination of the prevalence rate of common fractures in the upper and the lower limbs in children less than 12 years old considering gender of the patients, who were referred to the Taleghani hospital of Kermanshah between years 2003 and 2013.

- Determination of the prevalence rate of common fractures in the upper and the lower limbs in children less than 12 years considering the cause of fractures, who were referred to the Taleghani Hospital of Kermanshah between years 2003 and 2013.

## 2. Methods

In the present descriptive cross-sectional study, all hospitalized patients under 12 years of age, who had been referred to the Taleghani hospital of Kermanshah with a definitive diagnosis of fracture between years 2003 and 2013, were evaluated. The data collection tool was a researcher-built checklist whose validity had been confirmed by 2 members of the faculty. The data-collection approach was referral to patient records by the researchers and extraction of data, including demographic data of patients (age and gender), background disease, the time of hospitalization, and the cause of fracture. In this study, diseases, including diabetes as well as cardiovascular, respiratory, and neurogenic diseases were considered as background disease of the children; these subjects were excluded from the study. After assessing the records of the patients, a descriptive report of patient information was represented, and then, the frequency and the percentage of fractures in the upper, lower, and non-limbic limbs were obtained. Eventually, the difference between the studied

fractures in males and females was evaluated using the Chi-square test. The significance level in this study was considered as 0.05 and the data was analyzed using the SPSS v.16 software.

## 3. Results

In this study, 5187 patients were assessed. From all patients, 3331 subjects (67%) were males. The mean age of the patients was 6.4 years with a standard deviation of 5.32; their hospitalization duration was 1.2 days with a standard deviation of 0.98.

As demonstrated in Table 1, in this study, 3498 subjects (67.44%) had fractures in their upper limbs. In the upper limbs, the fractures were related to the forearm, wrist, fingers, shoulders, elbow, and arms with respective frequencies of 966, 945, 636, 447, 434, and 70. In addition, 1662 (32.04%) of fractures were in the lower limbs and most of these fractures were related to the leg, ankle, toes, thigh, knee, and the pelvis, with respective frequencies of 505, 418, 250, 216, 193, and 80.

**Table 1.** Frequency Distribution and the Rate of Limbic and Non-Limbic Fractures

Limbs	Frequency	Percentage
Upper	3498	67.44
Lower	1662	32.04
Non-limbic	27	0.52
Total	5187	100

In case of non-limbic fractures in the studied children, most of the fractures were related to the scalp. This was observed in 27 cases out of 5187.

In order to compare and evaluate the fracture rates in females and males for upper and lower limbs, and non-limbic areas, the Chi-square analysis was used. As seen in Table 2, it could be concluded that the rate of fractures in males and females had significant differences: In terms of the upper limbs, 2252 cases (64.38%) of fracture were related to males and 1246 cases (35.62%) were related to females. In all the fractured parts, except the fingers ( $P = 0.213$ ), a significant difference in the rate of fractures between genders was observed. In the case of the shoulders ( $P = 0.020$ ), arm ( $P = 0.027$ ), elbow ( $P < 0.001$ ), forearm ( $P = 0.002$ ), and the wrist ( $P < 0.001$ ), the rate of fracture was higher in males.

Additionally, 1079 cases (64.92%) of fractures in the lower limbs were observed in males and 583 cases (35.08% of all cases) were observed in females. In all the fractured parts, except for the toes ( $P = 1.000$ ), a significant difference in the rate of fractures was observed between different genders. In case of the pelvis ( $P < 0.001$ ), thigh ( $P = 0.007$ ),

**Table 2.** Comparison of the Rates of Limbic and Non-Limbic Fractures According to Gender: Frequency (%)

Limbs	Fractured Part	Males	Females	Total	P Value
Upper	Shoulder	324 (72.48)	123 (27.52)	447 (100)	0.020
	Arm	54 (77)	16 (23)	70 (100)	0.027
	Elbow	239 (55)	195 (45)	434 (100)	< 0.001
	Forearm	666 (69)	300 (31)	966 (100)	0.002
	Wrist	657 (69.5)	288 (30.5)	945 (100)	< 0.001
	Fingers	312 (49)	324 (51)	636 (100)	0.213
	Total	2252 (64.38)	1246 (35.62)	3498 (100)	-
	Pelvis	24 (30)	56 (70)	80 (100)	< 0.001
	Thigh	134 (62)	38 (82)	216 (100)	0.007
	Knee	102 (52.8)	91 (47.2)	193 (100)	0.034
Lower	Leg	330 (65.3)	175 (34.7)	505 (100)	0.005
	Ankle	364 (87)	54 (13)	418 (100)	< 0.001
	Toes	125 (50)	125 (50)	250 (100)	1
	Total	1079 (64.92)	583 (35.08)	1662 (100)	-
	Non-limbic	Scalp	13 (48)	14 (52)	27 (100)

knee ( $P = 0.034$ ), leg ( $P = 0.005$ ), and the ankle ( $P < 0.001$ ), the rate of fractures was higher in males. In case of scalp fractures, no significant difference was observed between males and females ( $P = 0.074$ ).

#### 4. Discussion

From a total number of patients considered in this study, 3579 subjects (67%) were males and a statistically significant difference was observed between different genders ( $P < 0.01$ ). This finding was consistent with the results obtained by Landin, who had reported that the likelihood of fractures in children was 42% in males and 27% in females (3). This was also consistent with the findings of Mayranpaa, who demonstrated that the prevalence of fractures in males was greater than females (due to their greater presence outside their home) (13), and Hedsrom et al., who had reported that the rate of fractures between males and females was 1.5 (5). The results of this study were, however, different from the results obtained by Van Staa et al., who had reported that the rate of fractures was equal in both genders (6).

The frequency of upper-limb fractures in the present study was 67.8%. This frequency was consistent with the findings of Landin, who demonstrated a low percentage of fractures in the upper limbs (3) as well as the results of Hedstrom et al., Brudvik and Hove, Cooper et al., and Lyons et al. (5, 7-9).

Among the mentioned fractures, forearm fracture, with a frequency of 27.6%, was the most common type of

upper-limb fracture. This observation was consistent with the findings of Hedstrom et al., Brudvik and Hove, Cooper et al., Lyons et al., and Rennie et al., in which the most common types of fractures in children were reported in the forearm area (5, 7-9, 11).

In this study, the most common cause of fracture was falling from a height (77%) and car accidents (9.28%) were the second-most frequent cause. This finding was consistent with the results obtained by Mayranpaa, who stated that the most important cause of fracture in this field was falling from a height, fractures caused by exercises, and vehicular accidents (13); the aforementioned observations were also supported by Hedstrom et al. (5).

#### 4.1. Conclusion

The obtained results demonstrate that the high percentage of fractures in males, who are less than 12 years of age, is primarily due to falling from a height. Families and educators should consider this issue, and it could help provide specialized care for this age group. Based on these issues, a more comprehensive study is required to assess the cultural education of children, who are under 12 years of age and spend their free time on desirable activities.

Car accidents, being the second most common cause of fractures, have a significant influence on the health of children; their regulation could be achieved through appropriate education and an enforcement of stricter riding rules.

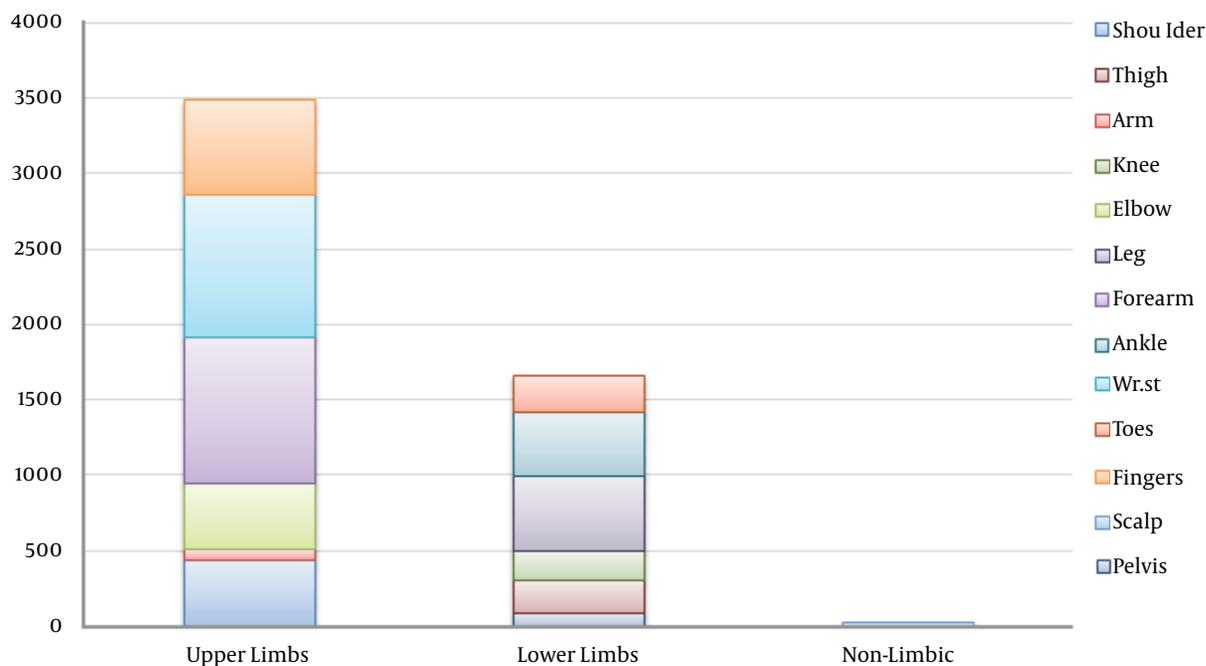


Figure 1. Frequency Distribution and the Rate of Limbic Fractures According to the Fractured Areas

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