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# Prevalence of Pediatric Femur Shaft fracture and its Associated factors at Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia

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BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT ORTHOPEDIC SURGERY

PREVALENCE OF PEDIATRIC FEMUR SHAFT FRACTURE AND ITS  
ASSOCIATED FACTORS AT TIBEBE GHION SPECIALIZED HOSPITAL,  
BAHIR DAR, ETHIOPIA

BY: BINIAM ZEMEDU (ORTHOPEDICS RESIDENT)

A RESEARCH THESIS TO BE SUBMITTED TO BAHIRDAR UNIVERSITY,  
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BAHIR DAR, ETHIOPIA

## **ABSTRACT**

**Background:** Pediatric femoral shaft fractures are one of the most common pediatric orthopedic fractures and are the most common reason for pediatric hospitalization due to orthopedic injury. In Ethiopia, femur fractures are a common and significant injury in children. But the information about the prevalence and mechanisms of femur fractures among children is scarce.

**Objective:** To assess the prevalence of pediatric femoral shaft fractures and its associated factors at Tibebe Ghion Specialized Hospital, Bahirdar, Ethiopia.

**Methods:** Institutional based cross-sectional study was conducted on Records of 298 pediatric patients with extremity fractures who visited the Orthopedic Emergency Department of Tibebe Ghion Specialized Hospital from January 2019 to August 2020. Data collection was done by using a pre-tested checklist comprising sociodemographic and characteristics of femur shaft fractures data. Data analysis was done by using SPSS Windows Version 23. Chi-square test ( $\chi^2$ ) was used to identify factors associated with femur shaft fracture. A P-value < 0.05 was considered statistically significant. The results of the analysis were presented in texts, tables, and figures.

**Result:** Amongst the 298 patients, 74(24.8%) sustained femur shaft fractures which is the largest type of fracture. 43.2% of these injuries occurred in the adolescent age group and 50% of them happened due to falls while 33.8% were from road traffic accidents. 64.9% of femur shaft fractures involved the mid-shaft region of the femur and 41.9% of these injuries were simple transverse in the pattern while 27% were comminuted. The age of the patient showed a significant association (p-value 0.029) with the rate of occurrence of femur shaft fractures in children.

**Conclusion:** The magnitude of femur shaft fracture amongst children with extremity fractures in the study area was significantly high. The majority of these injuries occurred in the adolescent age group. Falls and road-traffic accidents were the main causes of these fractures. Patient age was found to be associated with the rate of occurrence of femur shaft fracture in children. Attention should be given to children with pediatric femur fractures and all the necessary implants and materials should be available for treating these injuries.

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## **ACRONYMS**

BDU	Bahir Dar University
GC	Gregorian Calendar
WHO	World Health Organization
CDC	Center for Disease Control
BDU	Bahir Dar University
TGSH	Tibebe Ghion Specialized Hospital
TASH	Tikur Anbesa Specialized Hospital
SPSS	Statistical Package for Social Sciences
PI	Principal Investigator
RTI	Road Traffic Injuries
MRN	Medical Record Number
AAU	Addis Ababa University
MD	Medical Doctor
MPH	Master of Public Health
MVC	Motor Vehicle Crush
NAT	Nonaccidental Trauma
RTA	Road Traffic Accident
ARHB	Amhara Regional Health Bureau
ESOT	Ethiopian Society of Orthopedic Surgeons
CMHS	College of Medical and Health Sciences

# 1 INTRODUCTION

## 1.1 Background

Fracture is a loss in the structural continuity of a bone. It results from injury, repetitive stress, or abnormal weakening of the bone (“pathological” fracture). Most fractures are caused by sudden and excessive force, which may be direct or indirect(1). Fracture prevalence varies in different parts of the world and the spectrum of fractures presenting to different hospitals may differ considerably(2). It is the most common pattern of orthopedic injuries, which affects all age groups. It is also frequently associated with other injuries(2, 3).

Fractures of the femur usually are classified according to location as subtrochanteric, shaft (proximal, middle, and distal thirds), supracondylar, and distal femoral physal. Additionally, femoral fractures are classified by being open or closed, comminuted or noncomminuted, and by fracture pattern (transverse, spiral, or oblique). Fractures occur most commonly in the middle third of the shaft as a closed, noncomminuted, transverse fracture (2-4).

Pediatric femoral shaft fractures are one of the foremost common pediatric orthopedic fractures and are the most common reason for pediatric hospitalization due to orthopedic injury. When subtrochanteric and supracondylar fractures are included, the femoral shaft represents about 1.6% -2% of all bony injuries in children(4, 5).

Children comprise a higher proportion of the total population in developing countries. Childhood fractures constitute a major part of public health problems. The prevalence and causes of femur fractures depend on different factors(5, 6).

The incidence of femoral fractures is on the rise, almost like the increase in nearly all pediatric injuries. Increased participation in organized sports and extracurricular activities is driving this trend. Femoral fractures represent the most common reason for hospitalization for traumatic pediatric orthopedic injuries which accounts for 21.7% of admissions in the US-based nationwide study during 1997. Femoral fractures are costly as well; the length of stay and hospital charges lead to that of the other extremity injury as noted within the same study.

Although these are the most commonly isolated injuries, femoral fractures can be associated with additional injuries (2, 3, 7).

The cause of femoral fractures in children varies with age and the distribution appears to be bimodal with peaks during the toddler years and then again in early adolescence. Boys have higher rates of fracture than girls at all ages (2.6:1) (2-4). The primary mechanisms of fracture are age-dependent and include falls in preschool children, motor vehicle-pedestrian accidents and falls from trees particularly in parts of Africa and Asia in children 4-12 years, and motor vehicle accidents in adolescents and older children(2-4, 7-9).

However, one should keep the suspicion of child abuse in mind while dealing with these fractures in young children as it has been observed that up to 80% of femur shaft fractures occurring in children before walking age are due to abuse(10). Pathologic femur fractures are relatively rare in children but may occur because of generalized osteopenia (OI), neoplasm (mostly benign lesions), and infections(11). Stress fractures of the femoral shaft, although uncommon, are increasingly being noticed in adolescent athletes participating in soccer, basketball, athletics, *etc.*, and account for 4% of all stress fractures in children(12).

A seasonal bimodal variation was observed, in a 21<sup>st</sup> -century Swedish incidence study, with a peak in March and in August(13).

Fracture incidence is the best indicator of injury occurrence in surveillance systems. There is little report about femoral fracture epidemiology in all age groups but even less in young infants. Anticipatory guidance can reduce injuries(14).

Understanding the prevalence, causes and associated factors of femur fractures in children is crucial to inform researchers, practitioners, responsible authorities, and families in the context.

## **1.2 Statement of the problem**

Pediatric femoral shaft fractures constitute about 2% of all fractures in children, yet they are a significant burden on healthcare systems and families as they are the most common fractures requiring hospitalization in children. These injuries often require prolonged immobilization or surgery(2-4, 7).

Femoral shaft fractures rank third among long bone fractures of the pediatric age group when it comes to incidence, but these fractures are the most common injuries requiring hospital admissions and are associated with a prolonged hospital stay, prolonged immobilization, and impose a significant burden on the healthcare system as well as caregivers (3, 4).

Femoral diaphyseal fractures in children often need hospital admission because the modality of treatment of these injuries is either prolonged immobilization or operative management; this reason makes pediatric femoral shaft fractures to bring a significant cost to families and health care systems as well as a burden to physicians. Other common long bone fractures of children, like the forearm and tibia, can mostly be treated nonoperatively without hospital admission(3-5). These costs include the additional home care required for a patient, the costs of rehabilitation and missed school for the patient, child care costs if both parents work, and time off of work required by one or both parents to care for the pediatric patient(3, 5).

The etiology of femoral shaft fractures varies with the age of the child. The most common cause of these fractures is fall and motor vehicle accidents in the age group below 10 years and above 10 years of age, respectively(4).

After the first year of life, injury is the most frequent cause of death and disability in children and young people. Fractures of the femoral shaft are a common consequence of trauma requiring inpatient care in children(5, 15).

Mortality from a femur fracture has been estimated at 1 per 600 patients but is most often due to associated injuries sustained as a result of high energy trauma(5, 6).

Pediatric femoral diaphyseal fractures are one among other childhood injuries that could result in late sequelae, leg length discrepancy and rotational deformities are the commonest ones, affecting the child's life thereafter(5).

In Ethiopia, femur fractures are a common and significant injury in children. Witnessing disabled children following these injuries is not uncommon. But the information about the prevalence and mechanisms of femur fractures among children is scarce.

### **1.3 Significance of the study**

Pediatric femoral shaft fractures are one of the foremost common pediatric orthopedic fractures. Although the incidence of femur fractures in children is on the rise, evidence as regards the prevalence and its associated factors are rare in Ethiopia.

This study is aimed at determining the prevalence of femoral shaft fractures in children, identifying the causes and associated factors of pediatric femoral shaft fractures. Gaining insight on the prevalence of pediatric femur fractures and its associated factors will be of significant value for practitioners, researchers, and responsible authorities in understanding the magnitude and to make evidence-based decision to focus, especially, on the prevention aspect, to allocate resource and budget for hospital equipment to facilitate the management of pediatric femoral shaft fractures. The result of the current study may also enable health care professionals to predict these fractures and site of injury.

Bahir Dar University will be benefited from this study and we can take it as a benchmark for undertaking preventive measures. Being the first study in Tibebe Ghion Specialized Hospital, the data will be used as a stepping stone for future interventional studies.

Finally, this study will also provide baseline information to other researchers in conducting further detailed investigations on related issues.

## **2 LITERATURE REVIEW**

### **2.1 Pediatric Femur Fracture**

Injuries are one of the leading causes of death, morbidity, and disability among children around the world. (15) Each year, 1 in 5 children who live in the United States will be treated for injuries that are a major cause of medical costs for children ages 5 to 21 years, and that accounts for 20% of hospital admissions. (6)

Fracture is an outcome of 10% to 27% of all childhood injuries, contributing significantly to the mortality, morbidity, and costs of care. There is an increasing secular trend within the incidence of fractures among children. (6, 16) The cause of this increase is still unclear; however, an increase in sports-related fractures has been observed and may be primarily responsible for the trends. (17) It is also possible that better surveillance data contribute to the trend.

Pediatric diaphyseal fractures account for 1.4% to 1.7% of all fractures in the pediatric population. They are more prevalent among males, with a ratio of 2.6:1. The distribution of the incidence is bimodal: the first peak between two and four years of age and the second during adolescence. There is also a seasonal distribution, with greater incidence during the summer months. (5, 18)

### **2.2 The Magnitude of Pediatric Femur Fracture**

A descriptive population-based study on Childhood Femur Fractures, Associated Injuries, and Socio-demographic Risk Factors in America showed that femur shaft fractures are more common in boys (69.7 %) than girls (30.3 %). The median age of children with femur fractures was 8 years. The femoral mid-shaft (62.5%), followed by the proximal (12.5%) and distal (11.7%) femur, was the most frequent location of the fracture. Nearly 1 in 8 (13.3%) fractures involved the femoral shaft fracture in combination with a proximal or distal fracture. And the annual incidence rate of all types of femur fractures was 26.0 per 100 000. Femur fractures were found to be 25% more common during late winter and late summer/early fall. The incidence of femur shaft fractures showed peaks in infants and toddlers (29.4 %) as well as in older teenagers (19.3 %). The most common cause of femur fracture was fall (64.5%) among children younger than 3

years while NAT (14.5%) was the second most common cause. Fall was also the most common cause of femur fracture among young school-aged children (39.0%) followed by motor vehicle crashes (MVC; 13.5%), pedestrian (13.3%), and bicyclist (12.4%) injuries. MVC (43.3%) was the most common cause of femur fracture among adolescents. And meanwhile, Sport-related activity led to 202 (17.7%) femur fractures. The prevalence of associated injuries was 28.6%, and girls had a higher prevalence of associated injury than boys: 32.0% vs 27.2%. (19)

A retrospective cohort study of 2716 patients from two Swiss tertiary pediatric hospitals on, an epidemiological evaluation of pediatric long bone fractures, Switzerland showed that more boys sustained a femur shaft fracture (72%) than girls, and fall was the leading cause of fractures followed by leisure activities. The study also revealed that Femoral fractures were more frequently observed in the infant group(13%) compared to around 3% to 6% for the other age groups. (20)

A retrospective cross-sectional study of femoral shaft fractures in children and adolescents, Brazil showed that males (67.7%) are more affected than females (32.4%), and the mean age was 6.3 years. A Road traffic accident was the most common contributor to the cases of 53.6%. In this study, 49.3% of patients fractured the right side, 49.3% on the left side, and 1.4% of the cases fractured both sides. In 60% of the cases, fracture involved the middle third, 23.9% in the proximal, and 15.5% in the distal third. The study showed that 93% of the femur fractures were simple transverse fractures, 4.2% comminuted, and 2.8% segmental fractures. Isolated femur fractured occurred in 64.8% of the cases whereas associated injuries were identified in 35.2% of the patients. (21)

A retrospective cross-sectional study on the epidemiological study of children diaphyseal femur fractures in Brazil showed that femur shaft fracture is more common in boys (58.3%) than girls(41.7%). Road traffic injuries are incriminated for 54.2% of femur shaft fractures while falls are the cause for 29.2% of the fractures. The right side is involved in 52.1 %, left side in 43.8%, and bilateral in 4.2%. The majority of femur fractures are closed (89.6%) while the rest are open (10.4%). The study showed that the majority (58.3%) of femur shaft fractures occurred in the mid-shaft region; 25% occurred in the proximal and 16.7% occurred in the distal region of the femur. Associated injuries were observed in 22.9% of cases while isolated femur fractures

occurred 77.1% of patients. Simple fracture lines were observed in 89.6% of cases; 4.2% were wedge type and 6.3% were complex fracture patterns. (22)

A retrospective review of a multicentre trauma registry data on childhood injuries (0-15 years of age) in Oman revealed that transport injuries (54.5 %) were the most common causes of injury; exposure to inanimate external force (23.5%) and fall injuries (13.6%) followed as a leading cause of childhood injuries. 66.8 % of the children were males while 33.2% were females. (23)

A retrospective review of the epidemiology of femur shaft fractures in children in South Africa revealed the mean incidence of femoral shaft fractures was 21.9% of all patients with orthopedic fractures and 1.4% were bilateral. The study showed a male: female ratio of 2.2:1. The commonest mechanism was a fall (39%) while Motor vehicle accidents (MVA's) were responsible for 33.7% of fractures, of which 88% were pedestrians (PVAs). 6.6% of femur fractures were due to Non-accidental injury (NAI), of which 70% were in <1-year-old children. Pathological fractures occurred in 5.1% of patients and Sports-related injuries were responsible for 4.6% of femur fractures. 57% of femur fractures involved the middle shaft while 26% occurred in the proximal and 17% involved the distal femur region. (24)

A descriptive cross-sectional study on patterns of extremities trauma in children and their management in the emergency department in Suez Canal University Hospital, Ismailia, Egypt showed that males (66.67%) were more injured than their female (33.33%) counterparts. A statistically significant difference was found between sex and age of patients ( $p < 0.001$ ) as males were at a higher risk of injuries than females in every age group, with progressively increasing incidence with age. The study showed that falling was the most common mechanism of injuries and constituted about 64% of all cases followed by road traffic accidents which accounted for 18.89% of all cases. Femur fractures constituted only 0.37% of cases. (25)

A cross-sectional study on the pattern of long bone fractures in a pediatric population at Kenyatta national hospital, Kenya showed that males formed the majority (59%) of patients with long bone fractures. The study revealed that the upper limb was involved in 53% of the cases while the lower limb constituted 47% of the cases, and the femur had the majority of the fractures at 33%. (26)

A retrospective study of the pattern of femoral fractures and associated injuries in a Nigerian tertiary trauma center showed that males (63.7%) constituted the majority of cases when compared to females (36.3%). The study showed that the majority of the cases 62.8% occurred due to road traffic accidents (RTAs), and the mid-shaft was the most common site to fracture with 26.5% of the cases. In this study, the incidence of open femoral fractures was 8.4%. (27)

A retrospective study of femoral fractures in children treated in a regional trauma center in Nigeria revealed that the highest incidence (32.8%) of femur fractures occurred in children between the ages of 1 and 5 years. The male to female ratio (M: F) was 1.8:1 while the mean age of the patients was 8.9 years. The study showed that Road traffic crash (RTC) was the highest contributor to the cases as the cause of injury (66.6%), particularly motor vehicle crashes (39.8%). Most of the fractures were closed fractures (91.1%), while open fractures were (8.9%). When assessing the geometry of fractures, the study revealed that most (84.7%) of the fractures were transverse and short oblique fractures, whereas comminuted fractures were 6.7%. The right side (56.7%) was more involved than the left side (43.3%). (8)

A prospective cohort study of the therapeutic patterns, challenges, and outcomes of pediatric femoral fractures in a Cameroonian Tertiary Center showed that males are more affected than females with a sex ratio of 1.6 and the mean age was 4.2 with a median of 3 years. Falls (38%) were the highest contributor followed by road traffic accidents (31%). The study also showed that 86.7 % of the cases were isolated femur fractures while 13.3% of patients had associated injuries. All of the fractures were closed, and the mid-shaft region of the femur was involved in 76.6% of the cases. (28)

A retrospective study conducted in TASH (Tikur Anbesa Specialized Hospital), Addis Ababa, Ethiopia on childhood(0-13 years of age) limb fracture showed that boys (78.2 %) are more affected than girls(21.8). the most affected age group is between 6-13 years of age. The most common mechanism of injury was a fall, which accounted for 72.6 % followed by RTA (road traffic accidents). The majority of fractures were closed (90.8%) while the rest (9.2%) are open fractures. Upper limb fractures were more common comprising 66.2% where lower limb fractures constitute 33.2 %. Femur shaft fractures constituted 16.6 % of all fractures and are the commonest in the lower extremity fractures. (29)

A facility-based cross-sectional descriptive study of factors associated with fracture and its outcome at Wolaita Sodo University Teaching and Referral Hospital, Wolaita Sodo, Southern Ethiopia showed that upper limb and lower limb are commonly injured anatomic sites accounting (46.4%) and (37.5%) respectively. Bilateral injuries to the limbs were observed in 2.9% of patients. 48.9% of limb fractures were radial and/or ulnar and 23% of them were tibia and/or fibular while femur fractures occurred in 10.3 % of the cases. The study showed that 20.7% of the extremity fractures occurred in the pediatric age group between 0 and 14 years of age, and RTA (35.4%) was the commonest cause of fracture followed by fall down accidents (28.6%). (30)

### **2.3 Factors associated with Femur Fracture**

A population-based study on childhood femur fractures, associated injuries, and sociodemographic risk factors in America revealed that the risk of femur fractures is generally higher among children who live in areas with lower socioeconomic indicators. This study also showed that Predictors of femur fractures change with age. (19)

A retrospective study on Fractures of the femoral shaft in children. Incidence, mechanisms, and sociodemographic risk factors in America showed that age, gender, and race were significantly associated with the rate and mechanisms of femur shaft fractures in children. The study also revealed that adverse socioeconomic conditions were significantly associated with higher rates of fracture. (31)

A Swedish case-control study on sociodemographic factors influences the risk for femur shaft fractures in children showed that the risk of femur shaft fracture increased for children with younger parents or those living in low-income households. Having a parent with a university education reduced the risk. It also revealed that for gender and age group, the association between parents' age was evident only for older boys (7–14 years of age) (OR = 1.40; 95% CI 1.04–1.45), and the association between living in low-income households and fracture rate was only seen in older girls (7–14 years) (OR = 1.50; 95% CI 1.01–2.22). (32)

A descriptive cross-sectional study on the patterns of extremities trauma in children and their management in the emergency department in Suez Canal University Hospital, Ismailia, Egypt

showed a statistically significant difference between sex and age of patients ( $p < 0.001$ ) as males were at a higher risk of injuries than females in every age group, with progressively increasing incidence with age. The study also showed that a statistically significant association was found between low energy trauma and sex in school children and adolescents ( $p = 0.007$  and  $p = 0.016$ , respectively) in whom mild trauma was more frequent in males, while no difference existed in pre-school children. (25)

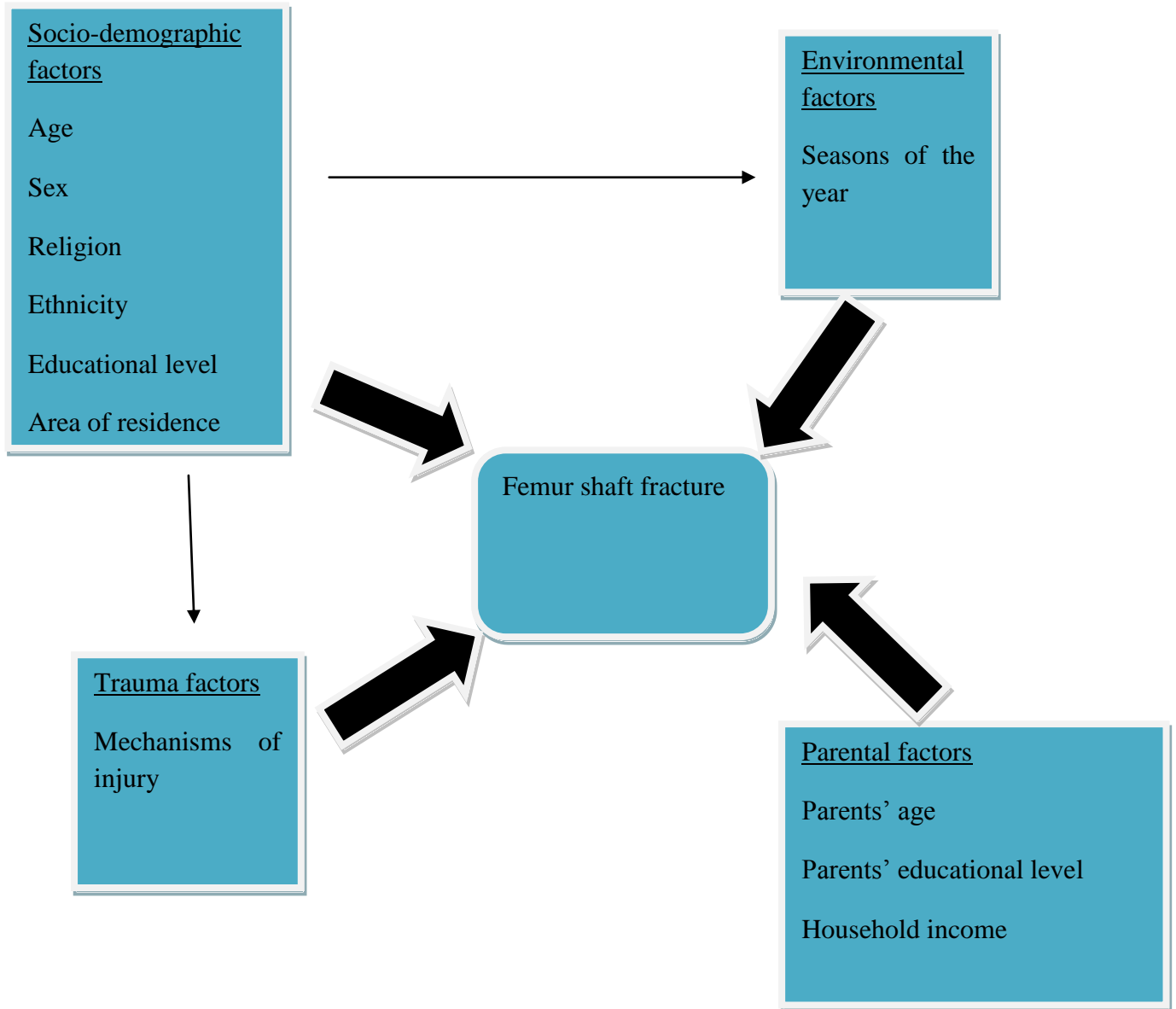


Figure 1: Conceptual framework showing the relationship between femur shaft fracture and associated factors

## **3 OBJECTIVES**

### **3.1 General objectives**

The purpose of this research was to assess the prevalence of pediatric femoral shaft fractures and its associated factors at Tibebe Ghion Specialized Hospital, Bahirdar, Ethiopia.

### **3.2 Specific objectives**

- To determine the prevalence of femur shaft fractures in children
- To determine the factors associated with femur shaft fractures in children

## **4 METHODS AND MATERIALS**

### **4.1 Study area**

The study was conducted in TGSH, Bahir Dar, Ethiopia. TGSH, located in Bahir Dar, is one of the largest specialized referral hospitals in the Amhara region and the country at large. It is a general public hospital and one of the university hospitals in the country. The hospital is a new referral teaching hospital in the Amhara region, and it is established by Bahirdar University in 2018 G.C.

TGSH is the largest hospital in northwest Ethiopia. We witness an increasing number of children with femur shaft fractures. We have also seen a lot of disable children following femur shaft fractures. Although children with femur shaft fractures are admitted and treated in TGSH, less is known about the prevalence and its associated factors of pediatric femur fractures in the study area.

Currently, it runs residency programs in seven specialties. The hospital provides a tertiary level health care service and it is administered by BDU. The hospital has more than 500 beds, all over 65 beds are dedicated to Orthopedic Surgery cases.

## **4.2 Study period**

The study was conducted by reviewing records of pediatric patients with extremity fractures who presented to the Orthopedics Emergency Department of TGSB from January 2019 to August 2020.

## **4.3 Study design**

Institution based cross-sectional study design was employed.

## **4.4 Population**

### **4.4.1 Source population**

The source population was all pediatric patients with extremity fractures who visited Orthopedics Emergency Department in TGSB from January 2019 to August 2020.

### **4.4.2 Study population**

The study population was all sampled pediatric patients with extremity fracture who presented to the Orthopedics Emergency Department in TGSB, and that fulfill the inclusion criteria.

## **4.5 Inclusion and exclusion criteria**

### **4.5.1 Inclusion criteria**

- All pediatric patients with extremity fractures who visited Orthopedics Emergency Department in TGSB from January 2019 to August 2020 was included in the study.

### **4.5.2 Exclusion criteria**

- Pediatric patients with femur shaft fracture resulting from birth-related injuries and pathologic fractures.
- Pediatric extremity fracture patients' chart that has incomplete data.

## 4.6 Sample size determination and sampling technique

### 4.6.1 Sampling size determination

There was no data, as per the knowledge of the Investigator, on the prevalence of femur shaft fractures in the pediatric age group in Ethiopia. Therefore, a 50% prevalence of pediatric femur shaft fracture was taken to obtain a maximum sample size.

The minimum number of samples required for this study was determined by using a single population proportion formula.

$$n = \frac{(z_{\alpha/2})^2 \cdot pq}{d^2}, p=q=0.5$$

Where: n= minimum sample size required for the study

Z= standard normal distribution (Z=1.96), CI of 95% = 0.05

P= prevalence of pediatric femur shaft fractures was unknown; Hence; p=50 % (0.5) was used

d=Absolute precision or tolerable margin of error= 5 % (0.05)

$$\text{Sample size : } n = \frac{Z^2 p(1-p)}{d^2} = \frac{1.96^2 \times 0.5(0.5)}{(0.05)^2} = 384$$

The total source population during the study period was 298. The correction formula depicted below was applied.

$$nf = n / \left(1 + \frac{n}{N}\right) = 298 / \left(1 + \frac{298}{10000}\right) = 289$$

Although the final sample size was 289, all the source populations were included in the study.

### 4.6.2 Sampling technique

All the children whose data are complete will be enrolled for the study.

## **4.7 Data collection tool and procedures**

Pretested checklist or formats prepared in English, adapted from similar pieces of literature(29, 33, 34) was used as a data collection instrument to extract the data from the charts. The checklist had both open and close-ended questions, and it was comprised of sociodemographic and femur shaft fracture characteristics data. During data collection, one medical record officer and two nurse diploma holders were involved. Using the medical record number (MRN) of patients, data collectors traced and collected data from the charts using a checklist.

Supervision of the data collection process was made by the principal investigator. The supervisor then crosschecked for completeness and consistency of collected data daily.

## **4.8 Study variables**

### **4.8.1 Dependent variable**

Pediatric femur shaft fracture

### **4.8.2 Independent variables**

Age

Sex

Religion

Ethnicity

Educational level

Area of residence

Parents' age

Parents' educational level

Household income

Causes of femur shaft fracture

Seasons of the year

## **4.9 Definition of terms and operational definitions**

**Pediatrics:** The age group between 0 and 18.

**Extremity fractures:** fractures/dislocations involving both the upper and lower extremities including the shoulder and pelvic girdles.

**Femur shaft fractures:** Fracture of the femur involving the proximal, middle, and distal thirds excluding fractures of the subtrochanteric, supracondylar, and distal physeal area.

**Prevalence of femur shaft fracture:** The proportion of children with femoral shaft fracture among the total children with extremity fracture who visited TGSB from January 2019 to August 2020.

In this study, the numerator is pediatric patients with femoral shaft fractures and the denominator is all children with extremity fracture.

## **4.10 Data quality control**

Data collection formats were properly designed and data collectors were trained well and supervised by the investigator. Tool pre-testing was done to ensure that data collectors were clear with the content and techniques of gathering the data. Every datasheet was checked and evaluated by the investigator after collection for its completeness.

## **4.11 Data processing and analysis**

The data were coded, entered into, and analyzed using SPSS Windows Version 23 for analysis. Descriptive statistics like frequency and percentage were computed for categorical data and presented by the use of tables, bar graphs, and pie charts. Chi-square test ( $\chi^2$ ) was applied to see if there was any association between the different categorical variables related to femur shaft fracture. The statically significant association was declared at p-values <0.05.

## **4.12 Ethical consideration**

Ethical clearance was obtained from the IRB/DRERC (Department of Research Ethics Review Committee) of BDU. Then this ethical clearance and cooperation letter was sent to TGSB Outpatient Department Director to obtain consent to perform data collection. Confidentiality of patient information was maintained by taking the data anonymously. The data extracted from medical registration charts was only used for the study and every data was kept confidential by securing personal information in passwords.

## **4.13 Dissemination of the study**

The finding of the study will be presented and submitted to BDU, CMHS, school of medicine, department of Orthopedic Surgery as one of the partial fulfillment of specialty certificates. The finding of the study will be shared with ARHB, ESOT, and other concerned bodies. For broader dissemination, the manuscript will be submitted to one of the peer-reviewed journals for publication.

## 5 RESULTS

### 5.1 Socio-demographic Characteristics

A total of 298 patients were included in the analysis. Of the total patients, the majority of them were males 209(70.1%) and 89(29.9%) were females. Adolescents (11 to <18 years) account for majority 139(46.6%) of the study participants. About 63(21.1%) of the participants were from Bahar Dar town. The majority 87(29.2%) of patients suffered injuries during the summer time. About 79(25.9%) of the participants sustained fracture of the femur bone, and among the total patients, 74(24.8%) of them had fracture of the femur shaft.

Table 1 Socio-demographic characteristics of study participants in TGSB.(n=298)

Variables		Frequency	Percentage
Age (in years)	Infants (0-2)	7	2.3
	Preschool (2-6)	45	17.1
	School (6-11)	107	35.9
	Adolescents (11-18)	139	46.6
Sex	Male	209	70.1
	Female	89	29.9
Area of residence	Bahirdar town	63	21.1
	West Gojam	59	19.8
	East Gojam	52	17.4
	South Gondar	59	19.8
	Awi	27	9.1
	Metekel	20	6.7
	North Wollo	18	6.0
Season	Autumn	65	21.8
	Winter	72	24.2
	Spring	74	24.8
	Summer	87	29.2

Table 2 Patterns and frequency of fractures in the study participants, TGS.H.

Site of fracture/dislocation	Frequency	Percentage
Clavicle	6	1.96
Scapula	1	0.36
Humerus	74	24.26
Radius	18	5.90
Ulna	6	1.96
Radioulnar	28	9.18
Pelvis	5	1.64
Femur	79	25.90
Patella	2	0.65
Tibia	19	6.23
Fibula	1	0.33
Tibiofibular	40	13.11
Short bones (hand & foot)	12	3.93
Total	305	100

\* Some patients had multiple site fractures

Of the total patients, 74(24.8%) of them sustained femur shaft fractures. Adolescents (11 to <18) and school children constitute the majority of patients comprising 32(43.2) and 28(37.8), respectively. Males account for 48(64.9%) of these patients while females constitute 26(35.1%) of them. The majority of femur shaft fractures occurred in patients from South Gondar 20(29.7%) and East Gojam zone 15(20.3%). Most of the patients suffered from femur shaft fractures in the summer 26(35.1%) and winter 20(27.0%).

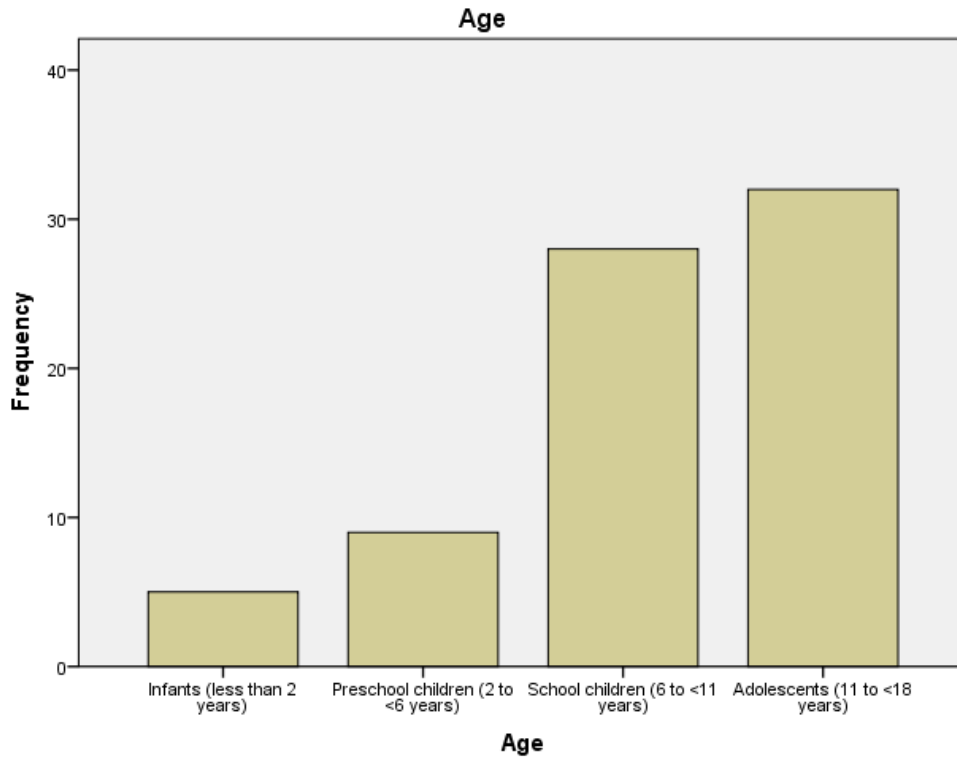


Figure 2 Age-group distribution in patients with femur shaft fracture in TGSB

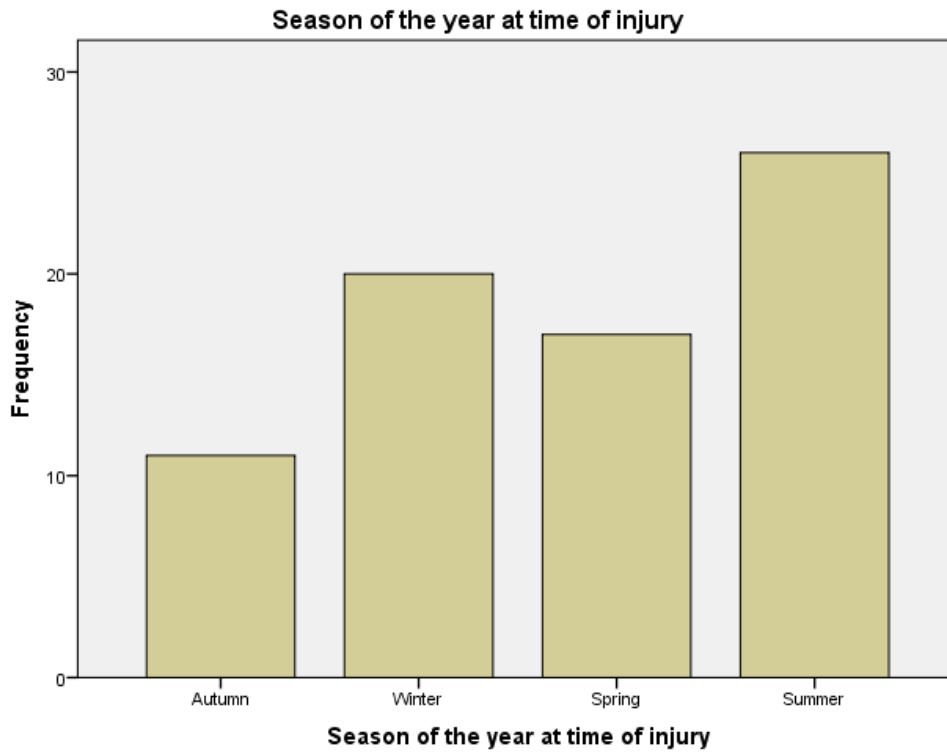


Figure 3 Femur shaft fracture distribution based on season of the year at time of injury, TGSB

## 5.2 Femur shaft fracture characteristics

Of the participants with femur shaft fractures, 48(64.9%) of them sustained injuries in the mid-shaft region of the femur bone. About 57(77.0%) of them had simple(closed) injuries to the femur shaft. The majority 46(62.2%) of femur shaft fractures involved the right side of these patients. Isolated femur shaft fractures occurred in 57(77.0%) of the study participants. Transverse type fracture patterns 31(41.9%) are the commonest observed types.

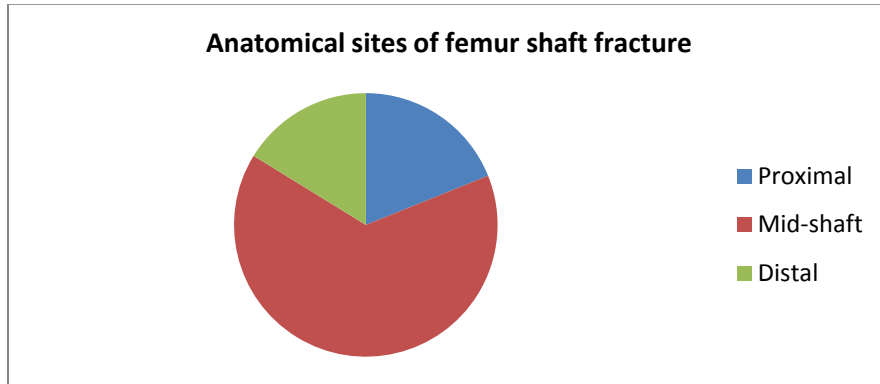


Figure 4 Femur shaft fracture distribution based on anatomical sites of fracture, TGSH

Table 3 Specific patterns of femur shaft fractures in study participants, TGSH

Variables	Frequency	Percentage
Transverse	31	41.9
Oblique	8	10.8
Spiral	15	20.3
Comminuted	20	27.0
Total	74	100

## 5.3 Causes of femur shaft fractures

Amongst the study participants with femur shaft fractures, falls 37(50.0%), and road-traffic injuries 25(33.8%) comprised the majority of the mechanisms of injuries leading these injuries in the participants. From femur shaft fractures due to road-traffic injuries, 10(40.0%) of the injuries were due to Minibus, 10(40.0%) were roll-over injuries, and 15(60%) were passengers.

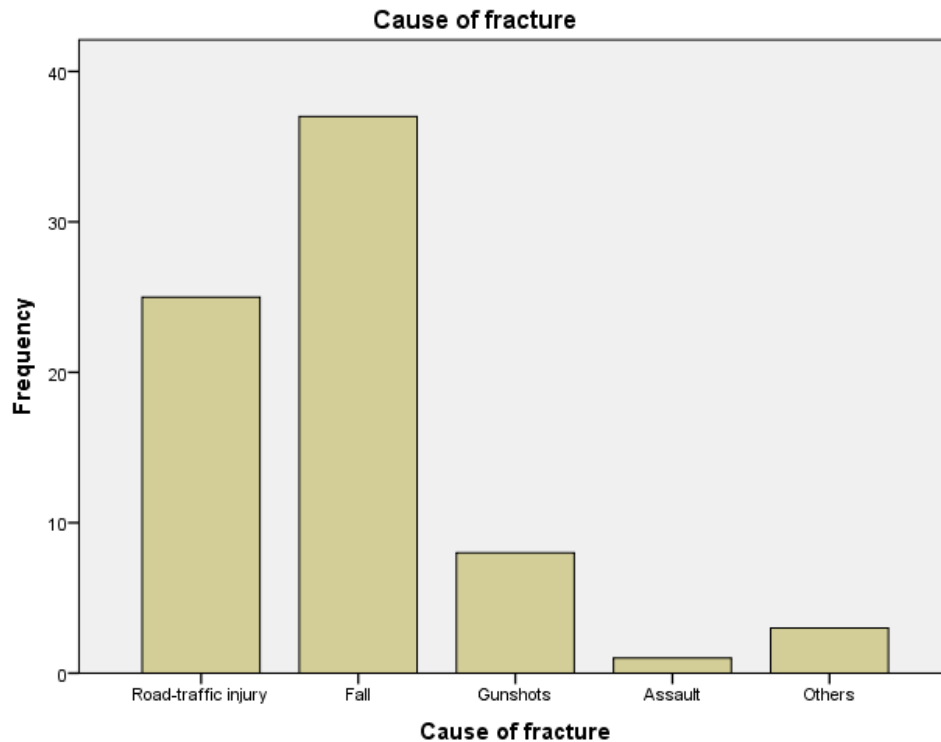


Figure 5 Femur shaft fracture distribution based on the causes of fracture in study participants, TGSH.

Table 4 Road-traffic injuries in patients with femur shaft fracture amongst study participants.

RTA injuries	Types	Frequency	Percentage
Vehicle type	Bicycle	1	4
	Motorcycle	3	12
	Bajaj	6	24
	Minibus	10	40
	Bus	3	12
	Truck (E.g. Sinotruck)	2	8
	Total	25	100
Vehicle injury type	Rollover	10	40
	Head-on collision	5	20
	Pedestrian	7	28
	Hit by a car	3	12
	Total	25	100
Victim groups	Passenger	15	60
	Pedestrian	10	40
	Total	25	100

## 5.4 Factors associated with femur shaft fractures

By running the chi-squared test we have found that some independent variables have a significant association with femur shaft fracture. Age had a significant association with femur shaft fracture. But other independent variables had no significant association with femur shaft fractures in the study participants.

Table 5 Chi-squared association between different variables and femur shaft fractures, TGSB

Variable	Category	Femur shaft fractures		Pearson chi-square	p-value
		Yes	No		
Age	Infants	5	2	9.052	0.029
	Preschool	9	36		
	School	28	79		
	Adolescents	32	107		
Sex	Male	48	161	1.305	0.253
	Female	26	63		
Season	Autumn	11	54	3.840	0.279
	Winter	20	52		
	Spring	17	57		
	Summer	26	61		

## 6 DISCUSSION

The prevalence of femur shaft fracture among pediatric patients with extremity fractures in Tibebe-Ghion Specialized Hospital was 24.8%. Our finding is comparable to studies undergone in South Africa and Kenya. (24, 26)

The magnitude of femur shaft fracture was higher among males (64.9%) than females (35.1%) which is consistent with the global evidence. This could be due to engagement of boys in activities which make them vulnerable for injuries. Moreover, femur shaft fractures in children were observed to be higher in the adolescent age group and during the summer months. This might be because of higher occurrence of falls and road-traffic injuries during the summer season. This finding is in line with other studies conducted in America. (5, 18, 19)

Regarding the anatomical sites of fracture, our study showed that the mid-shaft (64.9%) region of the femur was the most frequent location of fracture followed by the proximal (18.9%) and the distal (16.2%) femur. This finding is consistent with the global evidence. In our study, we found that femur shaft fractures occurred more frequently on the right side (62.2%) and the majority of these fractures are closed (77%) in nature. These findings are in line with studies done in TASH, Addis Ababa, Ethiopia, Nigeria, and Brazil. (22, 27, 29)

The majority of femur shaft fractures in our study were isolated fractures (77%) to the femur, and simple transverse fractures (41.9%) are the most common pattern of fractures seen in the study. These findings are comparable with studies undertaken in Cameroon, Brazil, and America. (19, 21, 28)

In our study, falling was the most common mechanism of injuries and constituted about 50% of all cases of femur shaft fracture in children followed by road traffic accidents which accounted for 33.8% of the cases. This finding is supported by studies conducted in TASH, Addis Ababa, Ethiopia, Cameroon, South Africa, Switzerland, and America. (19, 34), (24, 28, 29)

Our study showed that the age of the patient had a significant association with the rate of occurrence of femur shaft fracture in children. And our finding is consistent with studies undertaken in Egypt and America. (19, 25, 31)

## **7 LIMITATIONS**

The data we used in the study is from the charts of the patients, which limited our effort to visualize the full picture of the problem. The small sample size did not enable us to run binary logistic regression analysis, and for the same reason, the study findings cannot be generalized to the population.

## **8 CONCLUSION AND RECOMMENDATION**

### **8.1 Conclusion**

The magnitude of femur shaft fracture amongst children with extremity fracture in the study area was significantly high. The majority of this problem occurred in the adolescent age group and most of these injuries happened during the summer months. Most of the femur shaft fractures in children involved the mid-shaft region of the femur, and the majority were simple (closed) and isolated injuries to the femur. Most of these injuries had a simple transverse pattern of fracture. Falls and road-traffic accidents took the majority regarding the mechanisms of injuries leading to these injuries. The commonest type of vehicle involved in road-traffic injuries leading to femur shaft fractures was minibus followed by Bajaj. The age of patients showed a significant association with the rate of occurrence of femur shaft fracture in children.

### **8.2 Recommendation**

As per the finding of this study, the following recommendations are forwarded.

#### **To Amhara Regional Health Bureau and Ministry of Health**

- Emphasis should be given to pediatric femur shaft fracture as the magnitude of this problem amongst children with extremity fractures is significantly higher.
- Emphasis should be given to measures to minimize falling and road-traffic injuries as these are the leading causes of these injuries.

### **To Tibebe Ghion Specialized Hospital**

- Attention should be given to children with pediatric femur fractures and all the necessary implants and materials should be available for treating these injuries.
- Surgeons should be aware of the characteristics of these fractures in children to plan, choose, and be equipped with the optimal implant types in treating these patients.

### **To Health Educators and Researchers**

- Health Educators should provide continuous education to the public about the burden and the risks of femur shaft fractures in children.
- Researchers should further investigate to identify treatment outcomes and complications of femur shaft fractures in children.

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## 10 ANNEXES

### Checklist

MRN\_\_\_\_\_

Diagnosis \_\_\_\_\_

#### I. Socio-demographic characteristics

1. Age\_\_\_\_\_

2. Sex:       A. Male        B. Female

3. Religion\_\_\_\_\_

4. Ethnicity\_\_\_\_\_

5. Educational level\_\_\_\_\_

6. Area of Residence:\_\_\_\_\_

7. Parents' age:   A. paternal\_\_\_\_    B. maternal\_\_\_\_

8. Parents' educational level:    A. paternal\_\_\_\_\_    B. maternal\_\_\_\_\_

9. Household income\_\_\_\_\_

#### II. Fracture of the femur shaft

1. Anatomical site of femur shaft fracture

          A. Proximal            B. Mid-shaft                    C. Distal

2. Nature of fracture

          A. Simple (closed)    B. Compound

3. Affected side

          A. Left                B. Right

4. Isolated femur fracture

          A. Yes/Isolated

B. No/ another associated injury (Specify) \_\_\_\_\_

5. The specific pattern of fracture

- A. Transverse
- B. Oblique
- C. Spiral
- D. Comminuted
- E. Greenstick

**III. Cause of femur shaft fracture**

1. Cause of fracture

- A. Road traffic injury
- B. Fall down injury
- C. Gunshots
- D. Assault
- E. Sport-related injury
- F. Others (specify)

2. If RTA,

I. Type of vehicle

- A. Bicycle
- B. Motorcycle
- C. Bajaj
- D. Minibus
- E. Bus
- F. Automobile
- G. Truck (E.g. Sinotruck)
- H. others(specify)\_\_\_\_\_

II. Type of motor vehicle injury

- A. Rollover
- B. Head-on collision
- C. Pedestrian
- D. Hit by a car

III. Victim groups

- A. Passenger
- B. Pedestrian
- C. Other