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# Prevalence and pattern of congenital clubfoot among less than 5-year-old children in Ethiopia; cross-sectional based study

Seid Mohammed Abdu<sup>1\*</sup>, Girma Seyoum<sup>2</sup> and Birhanu Ayana<sup>3</sup>

## Abstract

**Background** Clubfoot is one of the most common congenital malformations, but it is also one of the most neglected public health problems among less than five-year-old children, mainly in middle- and low-income countries. Approximately 80% of clubfoot cases are found in low- and middle-income countries. In this study setting, no epidemiological studies have been conducted to assess clubfoot deformity. Due to this gap, the study aimed to assess prevalence, and pattern of congenital club foot among less than 5-year-old children.

**Materials and methods** An institutional-based cross-sectional study was carried out at Black Lion Specialized Hospital at the pediatric orthopedic clinic. The sample size was 261 to determine the prevalence and pattern of congenital clubfoot. Terms like frequency, percentage, and mean were used for data presentation.

**Result** A total of 36,303 pediatric patients visited Black Lion Specialized Hospital during the study period, and clubfoot prevalence was 7.2 per 1000. The largest subclassification of congenital clubfoot was idiopathic clubfoot, which accounted for 6.2 per 1000, whereas syndromic clubfoot was 0.3 per 1000, and neuropathic clubfoot was shared at 0.36 per 1000. Most of the cases in this study were bilateral clubfoot, with males having more dominance.

**Conclusion** In the area under investigation, a significant prevalence of congenital clubfoot was observed, especially among male children. The majority of cases were bilateral, with idiopathic clubfoot being the dominant form.

**Keywords** Congenital clubfoot, Club foot, Talipes Equinovarus, Prevalence, Pattern, Black lion hospital, Addis Ababa, Ethiopia, Africa

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## Introduction

Clubfoot, referred to as Congenital Talipes Equinovarus, is a complicated congenital foot deformity that, if left untreated, can make walking unpleasant and difficult for a person [1]. The affected foot in clubfoot is characterized by a shorter length and reduced calf circumference compared to a normal foot [2]. The deformity is not passively correctable upon presentation and exhibits varying degrees of rigidity [3]. The term Talipes equinovarus is derived from the combination of “Tali,” meaning ankle, “Pes,” meaning foot, “Equinus,” indicating the foot pointing downward (resembling a horse’s foot), and “Varus,” signifying deviation towards the midline [4].

Clubfoot is one of the major, but neglected, public health problems among less than five-year-old children, mainly in middle and low-income countries. Globally in 2017, evidence indicated that there were ~675,061 < 5 year old children with clubfoot among 675,100,000 < 5 year old children [5, 6]. From this global burden, Southern Asia shared the highest estimated cases of clubfoot (176,462; 26%), followed by Eastern Asia (95,085 estimated cases, 14%) and Eastern Africa (66,158 estimated cases, 10%) [5]. According to the global clubfoot initiative, per year around the world, 150,000–200,000 babies are born with clubfoot. Out of this, 80% of cases were found to be in low- and middle-income countries [7]. The incidence of clubfoot varies around the world and even within one state due to the presence of different ethnicities; for instance, in Australia, Aboriginal people have an incidence of clubfoot of 3.49 and Caucasian people have an incidence of 1.11 per 1000 live births [8]. The pooled estimate for clubfoot birth prevalence in low and middle-income countries within the Africa region is 1.11; in the Americas, 1.74; and in Southeast Asia, 1.21 [9]. Zimbabwe estimates 532 to 3,198 children born with clubfoot per year [10]. In addition, clubfoot prevalence is 1.2, 2, and 2.7 per 1000 live births in Uganda, Malawi, and Papua New Guinea, respectively [11–13].

When a child with clubfoot finally starts to walk, the deformity eventually becomes a “late presenting clubfoot or waking age clubfoot if treatment is not received. The child’s foot position causes a large bursa and callous form, causing pain and reduced mobility as soft and bony tissues are stretched further [14]. The impact of clubfoot deformity can have significant effects on an individual’s life, with females affected by clubfoot facing potential challenges in securing marriage in different countries [15]. In others, some social groups believe the abnormality to be the product of a curse [16].

In Ghana, clubfoot is twice as prevalent in males, with 65.5% of cases being bilateral, and idiopathic clubfoot constitutes 67.9% of total cases [17]. Ivory Coast experiences a significant annual incidence of clubfoot, 204 patients with bilateral clubfoot and 93 with unilateral

cases [10]. In Nigeria, out of 72 clubfoot patients, 28 had bilateral involvement, with 38 males and 34 females share [18]. In Malawi, males are dominant, with 175 cases of bilateral clubfoot and 132 cases of unilateral clubfoot [19]. In Ethiopia, there is a lack of reliable data and no conducted research, whether community-based or institutional-based. The available sources of data are limited to statistical fact-book estimations.

Generally, clubfoot is one of the most common visible congenital deformities seen in low- and middle-income countries (MIC), including Ethiopia. However in Ethiopia there is a scarcity of research and data on its prevalence and pattern. This study was aimed at determining the prevalence and pattern of clubfoot in Ethiopia. The result of this study could also be used as reference data for policymakers to make evidence-based decisions to focus on, especially to allocate resources for the purchase of hospital equipment in order to facilitate the management of club foot. The result of the current study may also enable health care professionals to predict the burden of clubfoot.

## Materials and methods

### Study design & study area

A hospital-based cross-sectional study was conducted among patients with congenital clubfeet at Black Lion Specialized Hospital, Addis Ababa, Ethiopia, in 2021. It was conducted from October 1–November 30, 2021.

The research was carried out at the Orthopedics Ward of the Pediatric Orthopedics Clinic, located in the Black Lion Specialized Hospital in Addis Ababa, Ethiopia. This department delivers comprehensive musculoskeletal clinical services, provides specialized and sub-specialized training, and engages in research activities. It is equipped with consultant orthopedic surgeons and residents undergoing training. As a prominent institution in Ethiopia, the department serves as a primary referral center for extremity cases, including referred fracture/trauma patients, emergency cases, and routine musculoskeletal conditions like clubfoot, from across the nation. The estimated population size covered by the Pediatric Orthopedic Clinic at Black Lion Specialized Hospital can vary. As a referral center, it generally serves patients from various regions, including rural areas. It primarily serves patients from Addis Ababa and its surrounding rural and urban regions in Oromia and Amhara, who are referred by local healthcare providers or through outreach programs. It serves around 1 million referral patients per year from every corner of the state, including rural parts of the country.

## Population

### Source population

All pediatric patients, age less than 5, attend the Pediatric Orthopedic Clinic in Black Lion Specialized Hospital.

### Study population

The study population was all pediatric patients who presented to the Pediatric Orthopedic Clinic in Black Lion Specialized Hospital during the study periods up to age 5, and those who fulfilled the eligibility criteria.

## Inclusion and exclusion criteria

### Inclusion criteria

Congenital club foot patients who were diagnosed and enrolled in the Orthopedics Department, Pediatrics Orthopedics Clinic at Black Lion Specialized Hospital Ages less than five years old, from January 2020 to December 2020, were included in the study.

### Exclusion criteria

Charts that had incomplete data of the variables were excluded and charts which were lost from the record office at the time of data collection were also excluded. Cases with relapsing congenital club foot and age greater than 5 years were not included.

## Sample size determination and sampling technique

### Sample size determination

To assess the prevalence of congenital clubfeet, the Medical Record Number (MRN) from January 1, 2020, to December 30, 2020, which fulfills inclusion criteria, was reviewed. It was done through a retrospective review of the charts of all patients with congenital clubfoot who were presented to Black Lion Specialized Hospital at the Pediatric Orthopedic Ward during the study period. The total number of patients attended at the time of the study period was 261; and the patient chart that fulfilled inclusion criteria (256) was reviewed for descriptive analysis.

### Sampling procedure

All patient medical record numbers (MRNs) were gathered from the health management information system (HMIS) registration book of the pediatric orthopedic clinic within the designated study period. Although MRNs for all pediatric patients were compiled, they were specifically chosen and subsequently assigned sequential numbers based on their registration in the HMIS. Descriptive analysis employed census sampling techniques. The overall prevalence of congenital clubfeet was determined by calculating the number of clubfoot cases among the total pediatric patients, aged up to five, attending the Black Lion Specialized Hospital during the study period (n/N).

**Operational definitions** Arica Clubfoot Training describes the classification of clubfeet as follows: [20].

**Primary/ idiopathic clubfoot** All babies who were found to have clubfoot without any other neuromusculoskeletal anomaly were classified as having idiopathic clubfoot.

**Neuropathic clubfoot** clubfoot associated with a neurological disorder such as meningomyelocele, meningocele.

**Syndromic clubfoot** Clubfoot presenting with other orthopedic defects such as congenital arthrogryposis multiplex, amniotic band syndrome, Down syndrome, etc.

**Late presenting clubfoot or waking age clubfoot** clubfoot that has never been treated in a child two years and over.

**Recurrent clubfoot** Clubfoot that relapses after or during treatment with the Ponseti method.

## Data collection tool and procedures

Data gathering utilized a structured checklist adapted from existing literature. The initial step involved extracting the primary patient file from the health management information system (HMIS) registration book using the first medical record numbers (MRNs). Subsequently, within the patient's chart room, relevant details such as age, gender, and other crucial variable data completeness were extracted from the main card. Following the inclusion and exclusion criteria of the study, a card containing study variables was employed. All necessary information was then collected from the main card. Four nurses holding a Bachelor of Science (BSc) degree were designated to collect data from the ward, while two senior BSc degree nurses supervised the data collectors throughout the data collection process. The principal investigator (PI) provided timely supervision during the data collection period.

## Data quality control

Data collectors and supervisors underwent a 2-day training session covering data collection techniques, materials, and the research's purpose. Daily supervision by both supervisors ensured completeness and consistency, maintaining data quality. A pretest, conducted on 5% of the total patient card sample size before actual data collection, allowed for necessary corrections. To enhance data quality, double data entry into Epi data was implemented. The validity of the questionnaire was assessed by incorporating feedback and comments from advisors and experts in the fields of orthopedics and anatomy based on the collected perspectives.

## Data analysis and interpretation

The data was checked after each data collection for its completeness. The data was entered through the Epi data manager, the latest version 4.6.0.0, and then exported to SPSS Version 25 analysis. For categorical data, descriptive statistics like frequency and percentage were computed and presented through the use of tables, bar graphs, and pie charts. Continuous variables were summarized using means, median, mode, and standard deviation.

## Result

### Club foot prevalence & descriptive result

During the study period, a total of 36,303 patients who were less than five years old attended Black Lion Specialized Hospital. Out of 36,303 patients, a total of 261 clubfoot cases were founded. From 261 chart records for congenital clubfoot, only 256 were selected for data collection, the remaining 5 (1.9%) were not selected for data collection due to either having no records or the charts not fulfilling the inclusion criteria. All these clubfoot patients were referred to the hospital primarily due to clubfoot. The remaining non-clubfoot pediatric patients attended the hospital for other orthopedic cases.

Out of the total number of child patients in Black Lion Hospital (36303), the number of patients with clubfoot was 261; this represented 7.2 per 1000. The largest sub classification of congenital club foot was idiopathic clubfoot which accounted 225 cases, it was 6.2 per 1000, whereas syndromic 11 cases, 0.3 per 1000 and neuropathic clubfoot was shared in the remaining categories 13 cases, with 0.36 per 1000.

The number of Pediatrics Orthopedics patients attended the hospital during study period were 3583, and from this, 261 were club foot cases, which accounted for 7.3% of Pediatrics Orthopedics patients. Idiopathic clubfoot was predominance 6.27%, followed by neuropathic

clubfoot 0.36% and least one was syndromic clubfoot 0.3% out of 3583 Pediatrics Orthopedics patients (Fig. 1). From 256 selected sample cases, only 10/256 (3.9%) of them visited the hospital after the age of two, which is categorized under late presenting clubfoot or waking age clubfoot.

In this study, males accounted for 198 (77.3%) and females for 58 (22.7%), resulting in a male-to-female ratio of 3.4:1.0. The patient ages ranged from 1 to 5 years, with mean and standard deviations of 147 days (4.9 months) and  $\pm 655.3$  days (21.84 months), respectively. The median and the mode of age were 17.5 and 3 days, respectively. Most of the patients, 178 (66.9%), were between the ages of 1 and 30 days. Nearly three-fourths of study participants came from Addis Ababa, 195 (76.2%), followed by Oromiya and Amhara, which accounted for 48 (18.8%) and 7 (2.7%), respectively. The other study participants, 6 (2.3%), came from elsewhere or other regions of Ethiopia. SD of 4107.5 and  $\pm 2290$ , respectively. The median and mode of weights were 3500 for the median and 3000 for the mode. The birthplace of 250 (97.7%) patients was a health institution. The other 6 (2.3%) were born either at home or during transportation (Table 1).

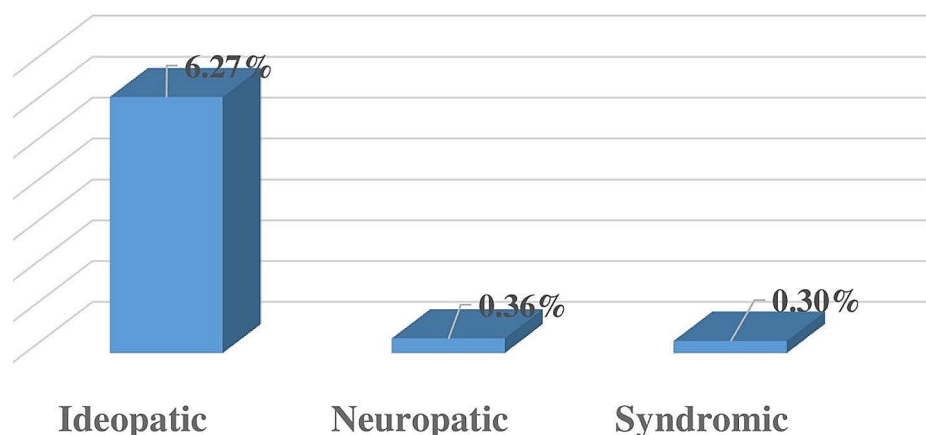
### Patterns of clubfoot among studied patients

Out of 256 children, 398 total legs were involved by clubfoot, and the distribution of unilateral and bilateral ailments was, 114 (44.5%) unilateral versus 142 (55.5%) bilateral (Fig. 2).

Out of 114 unilateral clubfoot cases, left and right presentations were 19.5% ( $n=50$ ) and 25% ( $n=64$ ), respectively (Fig. 3).

### Obstetric history of the clubfoot patients

Patients born before the 37th week of gestation age in number 31 (12.1%), which is called preterm, 10 (3.9%)



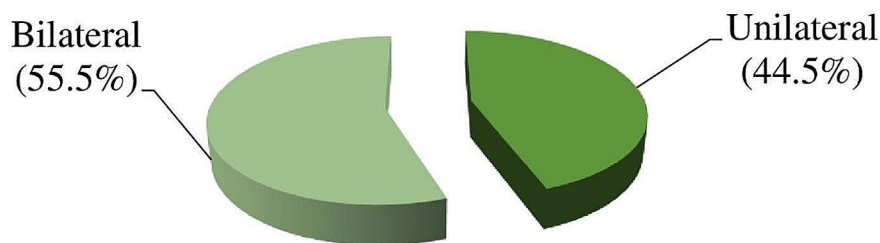
**Fig. 1** Classification of congenital clubfoot patients attended Black Lion Specialized Hospital at Pediatric orthopedic clinic

**Table 1** Socio-demographic characteristics of club foot patient who visited orthopedics department in Black Lion specialized hospital

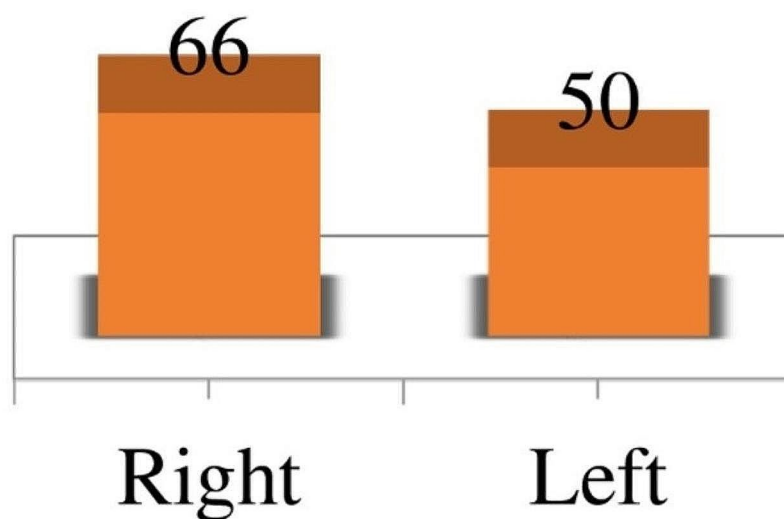
Birth place of the congenital club foot		
Characteristics	Frequency	Percentage
Home	6	2.3
Health institution	250	97.7
The club foot cases came from		
Addis Ababa	195	76.2
Oromiya	48	18.8
Amhara	7	2.7
Other	6	2.3
Sex of congenital club foot		
Male	198	77.3
Female	58	22.7
Age of the patient in month		
1–10	227	91.5
11–20	7	2.9
21–30	6	2.4
31–40	4	1.6

were postterm (born after the 42nd week of gestation), and the rest of 215 (84%) were born at term (Fig. 4). One hundred and thirty-two (51.6%) children were the first child of the family, and 77 (30.1%) were the second child; the remaining 47 (18.4%) were the third child of the family. Thirty-one (31) of the cases (12.2%) were born by caesarean section, and the rest, 225 (87.5%), were delivered vaginally.

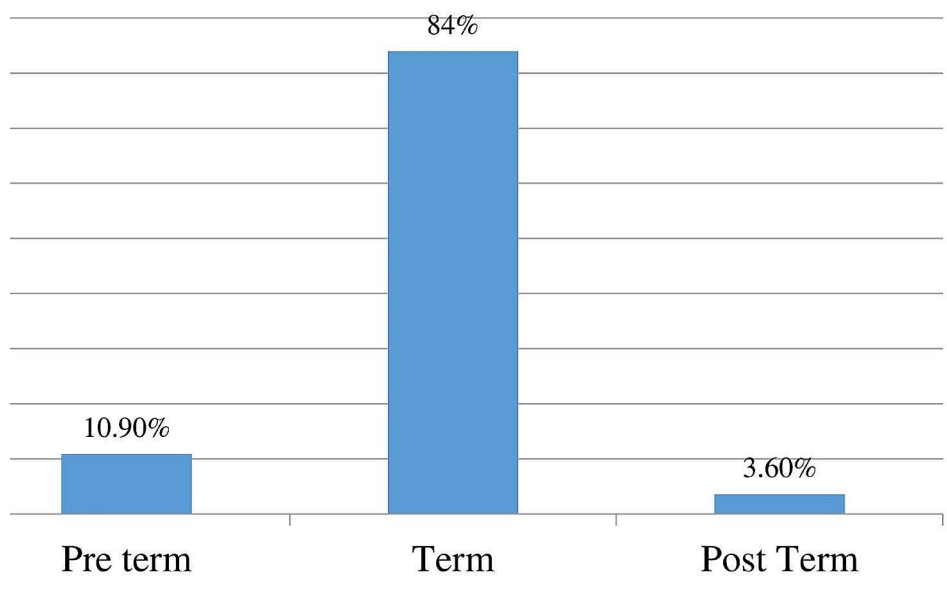
Out of 256 children with clubfoot, only 10 (4.1%) were from multiple births. All 10 were involved in twin pregnancies, and the remaining 246 (95.9%) children were born as singletons (Fig. 5). When we see the ANC follow-up of a child mother during pregnancy, 246 (96.1%) have followed up, and ultrasounds have been conducted for all who had ANC follow-up for screening purposes, but only seven (2.7%) of them have informed us about an anomaly of the club foot. Out of 256 club foot cases, most of them noticed the anomaly during the neonatal period (154, 60.2%), immediately after birth (87, 34%), and the



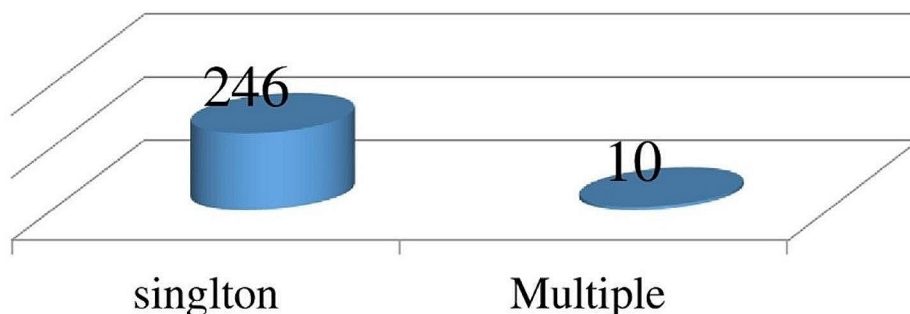
**Fig. 2** Presentation of club foot ailment, in Black Lion specialized hospital at pediatric orthopedic clinic



**Fig. 3** Unilateral Club Foot ailment, in Black Lion Specialized Hospital at Pediatric orthopedic clinic



**Fig. 4** Show the pattern club foot patient gestational week during pregnancy that attended Black Lion Specialized Hospital at Pediatric orthopedic clinic



**Fig. 5** Show the club foot patient, pregnancy status, in Black Lion Specialized Hospital at Pediatric orthopedic clinic

rest (15, 5.9%) were identified during pregnancy and after the neonatal period (Fig. 6).

**Discussion**

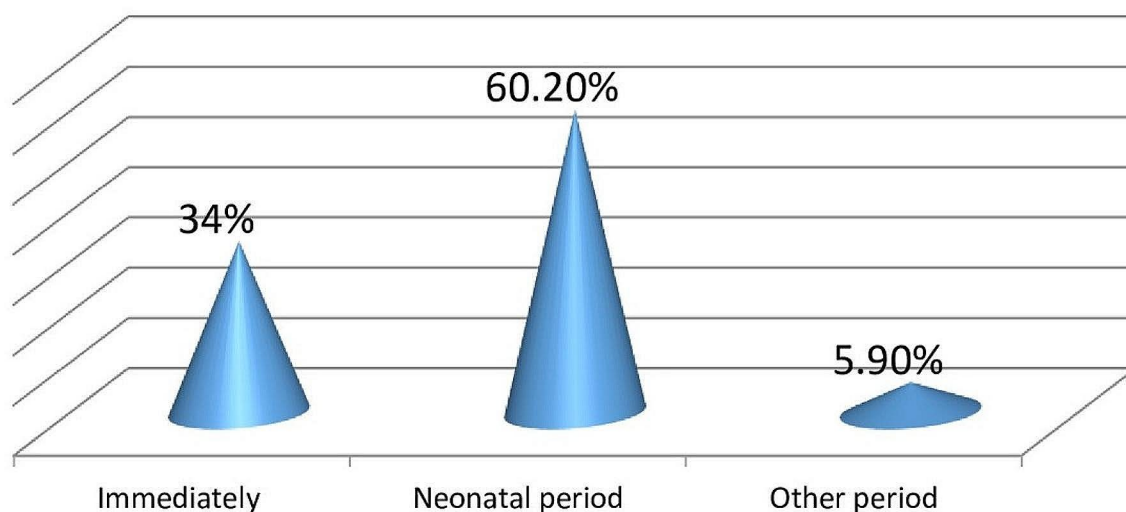
Clubfoot is a significant public health issue in the developing world, including Ethiopia, due to its potential long-term impact on foot deformity if left untreated. The findings of this study revealed a high prevalence of congenital clubfoot in the study area (7.2 per 1000), with a higher occurrence among male children. Most cases were bilateral, and idiopathic clubfoot predominated.

According to this study, the prevalence of clubfoot was found to be 7.2 per 1000 patients of age less than five. This was in line with the study conducted in the Hawaiians and Maoris [2] where it was 7 per 1000. However, the prevalence in the current study was higher than those reported by other studies conducted in the Australian Aborigine & Caucasia [8], Ghana [17], Uganda [11], and Malawi [12]. The prevalence was 3.49, 1.11, 1, 1.2, and 2 per 1000, respectively. The possible explanation for the

difference might be the sample size, study design, study area, and study population used in the studies. In comparison to this study, a small sample size was used in a study conducted in Malawi [12]. In a descriptive study conducted in Uganda [11], data were obtained from the postnatal centers of eight regional hospitals, whereas in this descriptive study, data were obtained from the club foot treatment center of a single hospital. This study was done with an institutional-based study design; however, in Ghana [17], it was population-based.

The bilateral club foot alignment of this study was slightly greater (55.5%). It was consistent with several studies. According to studies conducted in Ivory Coast [21], Romania [22], Vietnam [23] and Sweden [24], bilateral club feet accounted for 56.3%, 52%, 53%, and 52%, respectively. A higher prevalence of bilateral alignments was also observed in studies conducted in Ghana [17] and Malawi [12], in which the prevalence was 73% and 65.1%, respectively. On the contrary, a higher prevalence of unilateral club foot was observed in studies conducted





**Fig. 6** Show the clubfoot patients, time of first notice of malformation, in Black Lion Specialized Hospital at Pediatric Orthopedic Clinic

in Afghanistan [25] & Israel [26], it was 56% and 53.2% respectively. The possible explanation for this difference might be related to differences in study population, age, means of diagnosis and the small sample size used compared to this study. Pediatric patients of age up to five were included in this study and diagnosed by looking at the shape and position of their foot clinically, while fetus patients were studied in Israel and diagnosed by a sonographer, and this could be explained by the fact that the misdiagnosis of ultrasound is high, especially for bilateral clubfoots [27, 28]. A small sample size was used in Afghanistan [25, 29] compared to this study.

The finding of this study also revealed that, from unilateral alignment, the most affected side was the right 25%. This is supported by a study conducted in Afghanistan [25, 29] and Ivory Coast [21], which comprised 20.45% and 25.7%, respectively. The male-to-female burden of this study recorded that males accounted for 198 (77.3%) and females accounted for 58 (22.7%), resulting in a male-to-female ratio of 3.4:1.0. It was consistent with several studies conducted in several countries, including Nigeria, and Pakistan [18, 30].

Generally, since it was a retrospective study with poor documentation of patient information and the data management system in the study area, it was difficult to increase the scope of this study, and the study was done in one hospital, and the data were collected over a year retrospectively, so the findings may not fully reflect the true picture of clubfoot prevalence and pattern.

## Conclusion

The prevalence of congenital clubfoot was high in this study area and more prevalent in male children, and most cases are bilateral, with idiopathic clubfoot dominance. Therefore it's important to prepare training for health

professionals who work in the field to widen their understanding of club foot burden and patterns of congenital club foot. The importance of diligence and prompt medical intervention can greatly help reduce the incidence of clubfoot and disability. Finally, further study shall be conducted in a community-based study design to show the burden of anomalies in the relationship between the club foot and its pattern.

## Abbreviations

CTEV	Congenital talipes equinovarus
MRN	Medical record number
HMS	Health management information system

## Author contributions

"SM" conceived the study and drafted the methodology. "SM, & GS" conducted literature search and drafted the manuscript. "SM, GS & BA" performed the data analysis, and prepared the figures of the manuscript and combined and edited the drafts and supervised the manuscript. All authors subsequently revised the manuscript. All authors read and approved the final version of the manuscript.

## Funding

No funding was obtained for this study.

## Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethical approval and consent to participate

The study was conducted following the principles of the Declaration of Helsinki. Ethical approval was obtained from the Departmental Research Ethical Review Committee of Addis Ababa University in the Anatomy Department (DRERC) (Meeting No.: DRERC/08/21). Additionally, an informed consent waiver was provided by the same committee due to the retrospective nature of the study, which made it impractical to obtain consent from all patients' guardians. The ethical clearance and cooperation letter was sent to the Black Lion Specialized Hospital Outpatient Department Directorate to obtain permission to collect the data. The confidentiality of patient information was maintained throughout the process by collecting data

anonymously. After data collection, the raw data was secured and was not accessed by anyone except the principal investigator.

#### Conflict of interest

The authors declare that they have no conflict of interest.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

Received: 8 March 2024 / Accepted: 25 July 2024

Published online: 30 July 2024

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