

# Patterns, Treatment Modalities and Outcomes of Extremity Fractures in Children Presenting at Moi Teaching and Referral Hospital, Eldoret Kenya

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DOI: 10.29322/IJSRP.15.03.2025.p15916

<https://dx.doi.org/10.29322/IJSRP.15.03.2025.p15916>

Paper Received Date: 09<sup>th</sup> February 2025

Paper Acceptance Date: 11<sup>th</sup> March 2025

Paper Publication Date: 18<sup>th</sup> March 2025

**Abstract- Background:** Fractures in children mostly from unintentional injuries represent a major public health concern, and 90% occur in low- medium income countries. The prevalence of extremity fractures in children is increasing; these fractures primarily affect the distal radius/ulnar, the distal humerus, and the epiphyseal bones. This underscores the need for high-quality musculoskeletal treatment in sub-Saharan Africa. Although there is growing evidence of greater operational treatment, the majority of these fractures are managed nonoperatively. There is more emphasis locally on technical outcomes as indicator of successful intervention at the expense of functional outcomes using Pediatric Quality of Life (PedsQL). There is paucity of published data locally on this subject and patient reported outcomes in children, highlighting a research opportunity locally at Moi Teaching and Referral Hospital (MTRH), Eldoret. The study will enable guide treatment, educate parents and set expectations about quality of life and return to activities after treatment.

**Objective:** To describe the patterns, treatment modalities and outcomes of extremity fractures in pediatric patients at Moi Teaching and Referral Hospital?

**Methods:** A descriptive prospective study design was conducted at MTRH on children aged 2-14 years with extremity fractures between May 2023 and April 2024. Consecutive sampling was done until a sample size of 478 was achieved. Data was collected via interviewer administered structured questionnaire. Health related quality of life was determined through filling in the PedsQL measurement tool at 6 and 12 weeks. Continuous variables such as age were analyzed using means, median and their corresponding standard deviation and interquartile ranges. Categorical variables such as gender were summarized as proportions or percentages. A  $p$ - value < 0.05 was considered statistically significant.

**Results:** The age range was 2-14 years with a median of 6 (IQR: 4, 10) years. Males were majority (59.8%). However, for children aged 8-12 years, females were a majority 74(51.1%). Majority of fractures occurred at home, with distal radius 191 (30%) being the commonest injured part. Falls 248 (56%) was commonest mechanism of injury. Majority of fractures were treated non-operatively with casting (63.3%). Lower PedsQL scores were reported at 6 weeks, improving by 12 weeks. Lower limb scores

(26.1) were worse than upper limb (40.6) at 6 weeks, and similarly at 12 weeks (86.8 versus 89.3). Girls had lower PedsQL scores than boys.

**Conclusion:** Majority of fractures occurred at age 8-12 years at home, with upper limb mostly affected and the commonest mechanism was a fall. Most of the fractures were managed non operatively. Lower extremity fractures had poor PedsQL scores compared to the upper ( $p < 0.05$ ), with girls generally having poorer health related outcomes than boys (with  $p < 0.05$ ).

**Recommendations:** Safety education should be given to minimize falls. More options of surgical implants should be made available. There is need for more research to address low PedsQL score for injured girls and lower limb fractures to be given more attention in terms of rehabilitation.

**Index Terms-** Activity limitation, extremity fracture, functional outcome, patterns and treatment outcomes

## I. INTRODUCTION

Fractures are extremely common finding in children, representing a major public health problem across the region (Valerio et al., 2010). Fractures are a significant cause of morbidity in children, with the highest burden seen in low- and middle-income countries. As a result of increased funding and technology the global burden of disease has shifted from communicable diseases like HIV, Tuberculosis to non-communicable diseases and injuries, especially from road accidents (Yusuf et al., 2019). Multiple studies suggest that extremity injuries are on the rise in children highlighting the need for quality musculoskeletal care in sub-Saharan Africa (Galukande et al., 2016; Kisitu Dan, 2014; Naddumba, 2016).

MTRH sees significant cases and related burdens weekly and locally, limited published and non-published data exists on pediatric extremity fracture prevalence and patient-reported outcomes. More focus on technical outcomes as indicator of successful intervention at the expense of functional outcomes. A study done in Nairobi (Ng'ang'a, E and Mutiso, 2017), on

children's fracture patterns lack patient-reported outcomes, highlighting a research opportunity at MTRH.

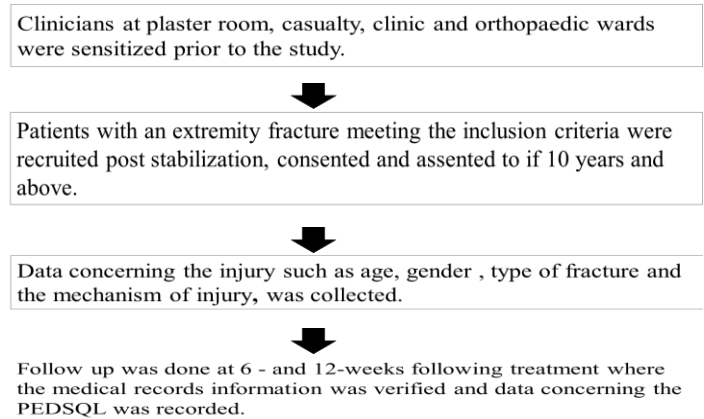
Studies suggest that most fractures occur in the radius/ulnar, followed by distal humerus fractures and this varies according to different regions. This incidence varies due to the fact that the childhood age definition according to WHO is between 0-19 years and in some other countries its between 0-16 years. Hence some variations in the statistics are expected with geographic and demographic variations due to different age definitions (Bilge et al., 2022). Childhood fractures commonly occur on the playground, during sports and growth spurts, which impacts life and hence this has prompted needed epidemiological prevention studies (Joeris et al., 2014).

There is emerging evidence of increased surgical management due to various reasons but ultimately a majority of children's fractures are treated non-surgically and others are treated operatively (Odatuwa-Omagbemi et al., 2023). The main reasons for increased surgical include but not limited to this are: continuous innovations in the medical field, parents and patients being aware of recent advances in treatment modalities and hence demanding what they deem to be the best, to the training programs for orthopedic residents and fellows that have become more focused on operative management at the expense of non- operative treatment.

A study of patient reported outcomes (functional outcomes) will enable us the healthcare providers educate parents and set expectations about quality of life and possible return to activities post fracture. Treatment outcomes will also enable us healthcare providers put more emphasis in areas reporting poor functional outcomes, in terms of more attention and rehabilitation. This is meant to bridge the gaps/ unmet needs identified in specific objectives of the study. Studies have suggested that functional outcomes are more meaningful indicator of effectiveness of an intervention than clinical outcomes(bony union & alignment) and hence the use of a tool that measures this is more beneficial (Horsch et al., 2022).

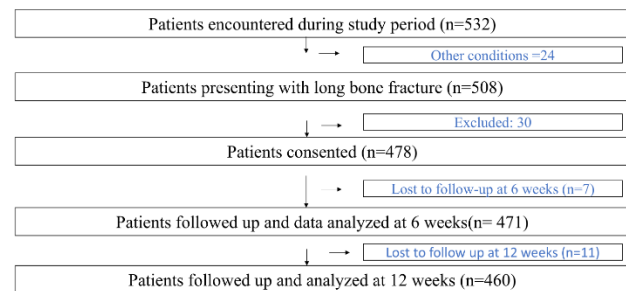
PedsQL is a multidimensional measurement model for assessing the health-related quality of life (functional outcome). It consists of physical, mental and social health general score characteristics specified by W.H.O (Varni et al., 2003).Past studies demonstrated that low mean PedsQL scores were seen in injured children who later improve over 12-24 months with lower scores being reported in lower extremities and among girls (Dipnall et al., 2022). It has been noted that lower extremity fractures cause significant initial decline in children's health related quality of life well-being, which cause lasting effects (Ding et al., 2006).

Children encountered with an extremity fracture who met the inclusion criteria were recruited after initial investigation and stabilization and data was collected according to flow chart below:



**FIGURE 1: Study procedure**

## RECRUITMENT SCHEMA



**FIGURE 2: Schema**

## II. METHODS

:

**Settings:** The study was conducted at MTRH pediatric orthopedic ward, pediatric orthopedic clinic and plaster room with institutional approvals and licenses

**Design:** A descriptive prospective study design was employed, involving 460 children aged between 2-14 years of age with an extremity fracture between May 2023 to April 2024 based on the eligibility criteria.

III. RESULTS: SOCIODEMOGRAPHIC AND  
CLINICAL CHARACTERISTICS

Demographic clinical characteristics

Total  
N=460

Age (years)  
Median (IQR) 6.0 (4.0-10.0)  
Range 2 – 14

Sex  
Male 275 (59.8%)  
Female 185 (40.2%)

County  
Uasin Gishu 403 (87.6%)  
Nandi 23 (5.0%)  
Elgeyo Marakwet 17 (3.7%)  
Others 17 (3.7%)

Parent/Guardian Relation  
Mother 327 (71.1%)  
Father 92 (20.0%)  
Others 41 (8.9%)

Place Of Injury  
Home 341 (74.1%)  
School 71 (15.4%)  
Public playground 19 (4.1%)  
Road 17 (3.7%)  
Others 12 (2.6%)

Sport  
No 294 (77.8%)  
Yes 84 (22.2%)

Specify Sport  
Football 80 (95.2%)  
Volleyball 4 (4.8%)

RTA  
No 362 (92.8%)  
Yes 28 (7.2%)

Specify RTA  
Pedestrian 15 (57.7%)  
Bicycle 4 (15.4%)  
Pillion 6 (15.4%)  
Passenger 2 (7.7%)  
Tractor accident 1 (3.8%)

Fall/Child's play  
No 116 (25.2%)  
Yes 344 (74.8%)

Specify height  
Same height 96 (27.8%)  
<1m 119 (34.5%)  
1-5m 93 (27.0%)  
>5m 37 (10.7%)

Others specify  
During physiotherapy 1 (25.0%)  
Hit by sheep 1 (25.0%)  
Chaff cutter 2 (50.0%)

FIGURE 3: Demographic clinical characteristics

TABLE 1: Patterns of the extremity fractures by age group

|                        | 2-4 years  | 5-7 years   | 8-12 years  | >12 years  | p-value |
|------------------------|------------|-------------|-------------|------------|---------|
|                        | N=124      | N=144       | N=145       | N=47       |         |
| Limb category          |            |             |             |            | 0.009   |
| Upper Limb             | 90 (23.8%) | 124 (32.8%) | 126 (33.3%) | 38 (10.1%) |         |
| Lower Limb             | 34 (41.5%) | 20 (24.4%)  | 19 (23.2%)  | 9 (11.0%)  |         |
| Limb                   |            |             |             |            | 0.007   |
| Humerus                | 43 (23.0%) | 64 (34.2%)  | 67 (35.8%)  | 13 (7.0%)  |         |
| Radius/Ulna            | 47 (24.6%) | 60 (31.4%)  | 59 (30.9%)  | 25 (13.1%) |         |
| Femur                  | 20 (39.2%) | 11 (21.6%)  | 11 (21.6%)  | 9 (17.6%)  |         |
| Tibia/Fibula           | 14 (45.2%) | 9 (29.0%)   | 8 (25.8%)   | 0 (0.0%)   |         |
| Segment                |            |             |             |            | <0.001  |
| Proximal end           | 3 (12.5%)  | 3 (12.5%)   | 14 (58.3%)  | 4 (16.7%)  |         |
| Diaphyseal             | 45 (28.8%) | 39 (25.0%)  | 45 (28.8%)  | 27 (17.3%) |         |
| Distal end             | 76 (27.1%) | 102 (36.4%) | 86 (30.7%)  | 16 (5.7%)  |         |
| AO class               |            |             |             |            | <0.001  |
| Proximal humerus       | 1 (6.7%)   | 1 (6.7%)    | 10 (66.7%)  | 3 (20.0%)  |         |
| Diaphyseal humerus     | 4 (17.4%)  | 6 (26.1%)   | 9 (39.1%)   | 4 (17.4%)  |         |
| Distal humerus         | 38 (25.5%) | 57 (38.3%)  | 48 (32.2%)  | 6 (4.0%)   |         |
| Proximal radius/ulna   | 2 (28.6%)  | 1 (14.3%)   | 4 (57.1%)   | 0 (0.0%)   |         |
| Diaphyseal radius/ulna | 15 (24.2%) | 14 (22.6%)  | 18 (29.0%)  | 15 (24.2%) |         |
| Distal radius/ulna     | 30 (24.6%) | 45 (36.9%)  | 37 (30.3%)  | 10 (8.2%)  |         |
| Proximal Femur         | 0 (0.0%)   | 1 (50.0%)   | 0 (0.0%)    | 1 (50.0%)  |         |

FIGURE 4: Place of injury

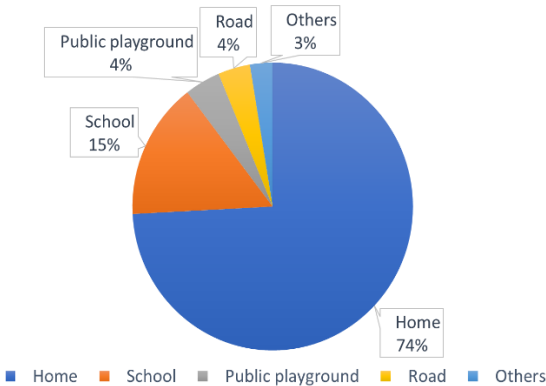


FIGURE 5: ANATOMIC DISTRIBUTION OF FRACTURES

FIGURE 7: DEFINITIVE TREATMENT

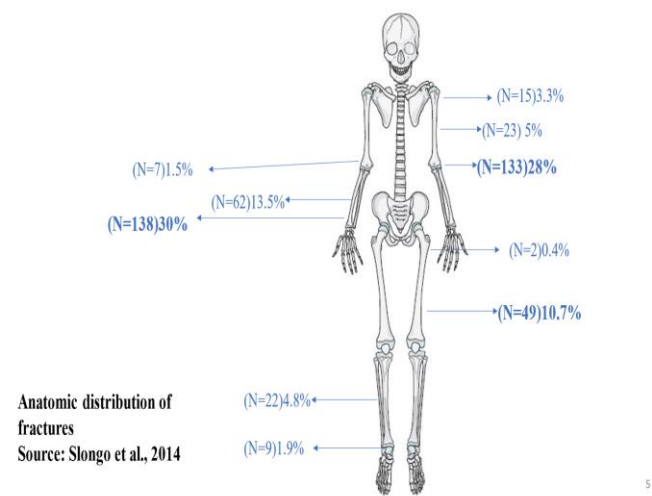
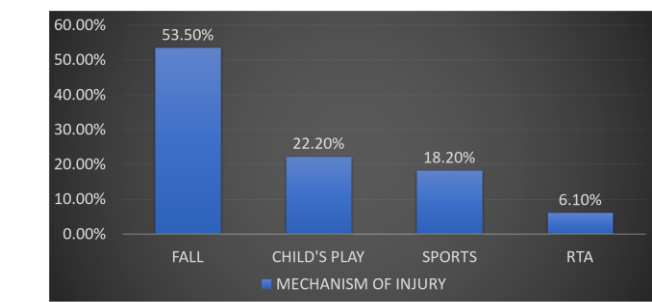


FIGURE 6: MECHANISM OF INJURY



Most of the injuries were caused by a fall from a height, followed by child’s play, then sports and finally RTA’s

Falls-248

Child’s play-96

Sport- 84

RTA-28

Others (hit by cow-2: chaff cutter-2)- 0.8%

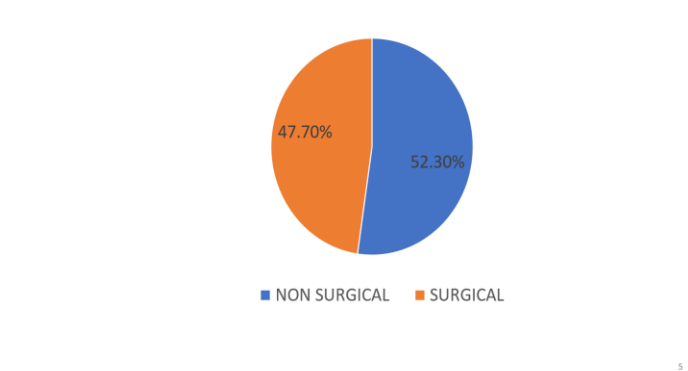
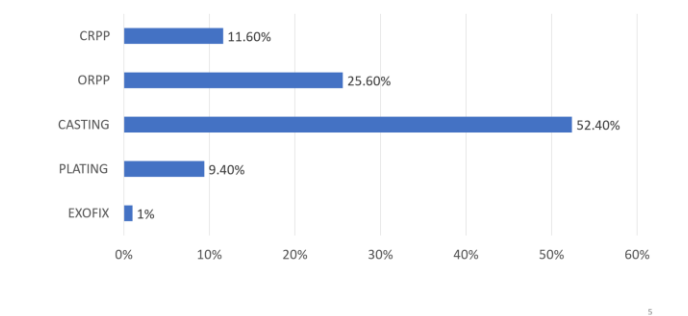


FIGURE 8: DEFINITIVE TREATMENT



TREATMENT OUTCOMES

TABLE 2: AVERAGE PEDSQL SCORES

| FUNCTIONAL SCORES          | 6 WEEKS | 12 WEEKS |
|----------------------------|---------|----------|
| AVERAGE PHYSICAL SCORE     | 38      | 79.3     |
| AVERAGE PSYCHOSOCIAL SCORE | 71      | 91.9     |
| AVERAGE TOTAL MEAN SCORE   | 62.7    | 88.9     |

**TABLE 3: PEDSQL SCORES BY FRACTURE REGION**

| FUNCTIONAL SCORES              | 6 WEEKS    |            |         | 12 WEEKS   |            |         |
|--------------------------------|------------|------------|---------|------------|------------|---------|
|                                | Upper Limb | Lower Limb | P-value | Upper Limb | Lower Limb | P-value |
| PedsQL Physical function score | 40.6       | 26.1       | <0.001  | 80.8       | 72.1       | <0.001  |
| PedsQL Psychosocial function   | 71.8       | 67.3       | 0.064   | 92         | 91         | 0.86    |
| PedsQL total mean score        | 64.3       | 55.4       | <0.001  | 89.3       | 86.8       | 0.023   |

**TABLE 4: PEDSQL versus GENDER**

| FUNCTIONAL SCORES              | 6 WEEKS |      |         | 12 WEEKS |      |         |
|--------------------------------|---------|------|---------|----------|------|---------|
|                                | FEMALE  | MALE | P-value | FEMALE   | MALE | P-value |
| PedsQL Physical function score | 36.8    | 38.7 | 0.02    | 78.8     | 80   | 0.65    |
| PedsQL Psychosocial function   | 69.4    | 73.4 | 0.03    | 91.4     | 92.7 | 0.15    |
| PedsQL total mean score        | 61.7    | 64.1 | 0.11    | 88.2     | 89.8 | 0.07    |

#### IV. DISCUSSION:

##### SOCIO-DEMOGRAPHIC CHARACTERISTICS

The median age was 6 years with an IQR of 4-10 years, which concurred with other studies that had a similar age on childhood fractures in Shenzen (Qiu et al., 2022) and Kenya (Ng'ang'a, E and Mutiso, V 2017). This age is associated with children who have just started school and for those who are unable are found playing on the streets, playing in an environment that's is not suitable for them, coupled with a lack of health education regarding the prevention strategies that should be employed.

It however contrasted with an Italian study had a median age of 8.8 years (Valerio et al., 2010), which suggested that children there at that age live more sedentary lifestyles with unhealthy behaviors like increased consumption of energy dense snack foods or carbonated beverage, which combined with increased sports participation increased the risk of fractures at that age.

It was found that males were a majority forming 59.8% of the children encountered and this concurred with results in other studies done at Aga Khan University Hospital, Nairobi (Ndung'u et al., 2019), KNH (Ng'ang'a, E and Mutiso, V 2017) and Italy (Valerio et al., 2010). This could be attributed to the fact that

males are more adventurous, intense and more likely to engage in high risk play and sports as compared to girls. The trend was the same across all age groups apart from the 8-12 years age group, where females were more. This coincides with the peak height velocity encountered at that age which is associated with decreased bone density.

A majority of fractures were as a result of a fall (53%), which concurs with other studies in Turkey (Bilge et al., 2022), Italy (Valerio et al., 2010), KNH (Ng'ang'a, E and Mutiso, V 2017) and Switzerland (Joeris et al., 2014). Falls are as a result of the increase in motor ability as children grow and increased involvement in physical activity which increases the risk of fractures from falls as they build confidence. Unlike adults, children do not possess matured cognitive and perceptuo-motor abilities to avoid accidental injuries. As such their physical strength outweighs judgment, and protective reflexes are not fully developed making them a high-risk group for fractures. This study however contrasts with a study done in Nigeria (Nwadinigwe et al., 2006) and Mumbai (Tandon et al., 2007) that reported higher incidences due to RTAs as pedestrians. This could also be attributed to local childcare practices where it was found that in Enugu, Nigeria most children are found hawking, while in Mumbai most children use motorcyclists as pylon passengers, risking exposure to road traffic accidents. Increased road traffic accidents could also be attributed to a lack of traffic control policies, and enforcement of road signs, including lack of zebra crossing points, separate tracks for children riding bikes, lack of sidewalks or separate lanes for those walking on the roads, and other such safety measures not being adhered to.

##### ANATOMICAL DISTRIBUTION OF FRACTURES

The study found that a majority of the children suffered an upper extremity fracture (82.2%) and this concurred with similar other studies in New York, Turkey and Yaonde (Bilge et al., 2022); Guifo et al., 2017 & Lee et al., 2021). This is attributed to risk taking behavior, yet to be developed coordination and protective response makes them prone to more upper limb injuries than lower extremity injuries. This however contrasted with a study done in Nairobi, that had the lower limb as the majority compared to the upper limb (Ng'ang'a, E and Mutiso, V 2017). The study done at Kenyatta National Hospital received a disproportionate amount of lower limb fractures that required admission which formed a majority of the patients they admitted.

It was also discovered that the distal radius was the most fractured bone, forming 30% of the cases followed by the distal humerus at 28% of the cases. This concurred with other studies done in Turkey (Bilge et al., 2022) and Cameroun (Guifo et al., 2017). This is attributed to the fact that children are discovering new heights and speeds, which predisposes them to these kinds of fractures. This was however in contrast to the study done at Kenyatta National hospital (Ng'ang'a, E and Mutiso, V 2017) which found that most of the fracture encountered were of the lower limb. This can be explained by the fact they receive most fractures that require admission and those are lower limb fractures. It was also found that their study had a duration of three months, which probably wasn't representative of the population.



## DEFINITIVE TREATMENT

Despite emerging evidence of increase in operative management, a majority of children (63%) were treated non-surgically. This concurred with studies done in Turkey (Ömeroğlu et al., 2020) and Nigeria (Nwadinigwe et al., 2006). The study however contrasts with another done in Lagos (Odatuwa-Omagbemi et al., 2023) and another done in Shenzhen (Qiu et al., 2022). The study in Shenzhen was a retrospective study that looked at all bone fractures in the body which probably resulted in an increase in operative management. While in Lagos a majority of patients were attended to initially by TBS, with most fractures later complicating and are then referred and hence they ended up being managed surgically.

## FUNCTIONAL OUTCOME

In this study it was noted that the PedsQL score at 6 weeks was low and improved when scored later at 12 weeks. This was similar to a study done in San Francisco (Sabatini et al., 2014) and Melbourne (Dipnall et al., 2022) although with higher scores. It Concurs with their findings, though their figures had higher scores and this could be attributed to the longer follow up period of time (2 years), which allowed time to fully heal.

Girls it was reported had lower PedsQL physical and psychosocial scores compared to boys and this concurred with the study in Melbourne (Dipnall et al., 2022) and was attributed to the fact that girls have a poor perception of their well status and well-being than boys.

## FUNCTIONAL OUTCOME SCORES vs FRACTURE REGION

Lower extremity fractures had lower scores compared to those with upper limb fractures, which concurred with a study by (Ding et al., 2006). This is due to inherent functional differences of the lower limb in comparison to the upper limb. Heavier load and constant use make recovery and rehabilitation more challenging for the lower limbs and hence poorer outcomes. The duration and intensity of rehabilitation needed for lower limb recovery are greater and hence early outcomes are poor as they take time before fully healing.

## STUDY LIMITATION AND MITIGATION STRATEGY

I lost some patients to follow up and this was mitigated in sample size calculation where I anticipated a 20% loss to follow up to cover up for that.

## V. CONCLUSION

The majority of patients were between 8 and 12 years old, with most being male, and the majority of injuries occurred at home via falls.

Most fractures were managed non-operatively with casting, while lower extremity fractures had poorer PedsQL scores than upper limb fractures, with girls generally experiencing worse

health-related outcomes than boys.

## RECOMMENDATIONS:

Safety education should be given by health care givers to minimize falls.

PedsQL is a tool that should be used by orthopaedic surgeons to measure functional outcomes.

More research is needed to address low PedsQL for injured girls.

More attention should be given to lower limb rehabilitation as they demonstrated lower PedsQL compared to the upper limb.

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## ACKNOWLEDGMENT

The Candidate wishes to thank the supervisors for their guidance and support in formulating and preparing the proposal and eventual thesis development.

The assistance of the Department of Orthopedics and Trauma (Moi Teaching and Referral Hospital) and the Department of Orthopedics and Rehabilitation (Moi University). Gratitude to the family members and colleagues for their guidance.

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