

# Upper Limb Injuries in Children Presenting to a Tertiary Care Center in Rural Nepal

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## ABSTRACT

**Background:** Upper limb injuries are one of the common pediatric conditions presenting to our orthopedic department. The aim of this study is to identify the cause pattern and demographic characteristics of upper limb injuries in children so that various preventive strategies can be encouraged to reduce their morbidity.

**Methods:** A descriptive cross-sectional study was conducted at Karnali Academy of Health Sciences after ethical permission from October 2022 to March 2024. An enumerative sampling technique was used. Age, sex, address, side, upper limb anatomical location, time of hospital presentation, mode of injury, seasonal trend, prehospital management and other associated injuries were noted in individual structured proforma. All the data were entered in MS EXCEL and analyzed using version 16 of the Statistical Package for Social Sciences.

**Results:** A total of 437 children were involved in this study. Distal humerus fracture was seen in 149 (28%) patients, whereas distal radius fracture was observed in 131 (24.4 %) patients. Injury was common in children 6-9 years of age (27.5%). There were 313 (71.6%) boys and 124 (28.3%) girls. Delay of > 72 hours in presentation to hospital was noted in 88 (20%) patients. Out of 437 children, 76 (17%) received prehospital management.

**Conclusions:** Upper limb injuries were prevalent around elbow and wrist joint. Injuries were common in boys and predominant in 6-9 years of age. Fall from cliff, tree, rooftop and ladder were the major mode of injury in our rural context.

**Keywords:** Children; injuries; rural; upper limb.

## INTRODUCTION

Upper limb injuries (ULI) are one of the most common pediatric conditions presenting to our orthopedic emergency and outpatient department. In children, 12 to 36 fractures occur for every 1000 individuals annually.<sup>1</sup> About 80 % of all fractures in children occur in the upper limb.<sup>2</sup>

Our hospital is located at an elevation of 2500 to 4000 meters above sea level in the mountainous district Jumla in the Karnali province of Nepal.<sup>3</sup> Children from our community may have different modes of injury as compared to the children from urban areas.<sup>4</sup> Knowledge on prehospital management and time of presentation to hospital after ULI in children of rural communities are especially lacking in the literature. Understanding the cause pattern and settings where injury occurs can help to formulate the preventive strategies.

The aim of this study is to identify the cause pattern and demographic characteristics of upper limb injuries in children presenting to a tertiary care center of rural Nepal.

## METHODS

This is a descriptive cross-sectional study conducted at the Karnali Academy of Health Sciences (KAHS), Jumla, Karnali, Nepal. Following ethical permission (IRC KAHS Ref: 079/080/25), children were prospectively enrolled with enumerative sampling technique for a period of one and a half year from October 2022 to March 2024. Prior to their involvement in this study, informed written assent was obtained from the participants. Children below 18 years of age who presented with upper limb injuries in orthopedics emergency and outpatient clinic, referred cases from neighboring districts, poly trauma patients and children with multiple fractures

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were included in the study. Exclusion criteria were pathological fractures, cases of refracture and patient aged more than 18 years. Individual structured patient proforma were filled in with information about age, sex, address, side, upper limb anatomical location, time of hospital presentation, mechanism of injury, seasonal trend, prehospital management, and other associated injuries. No extra financial burden was given to the participants. All the data were entered in MS EXCEL and cross-verified by three council registered orthopedic surgeons. The data was transferred and analyzed using version 16 of the Statistical Package for Social Sciences. Descriptive statistics like number, percentage, mean, standard deviation (SD) and range was used to describe the variables. Table, pie chart and bar diagram was used to represent the data.

## RESULTS

Altogether 437 children were involved in this study. Injury was prevalent around elbow and wrist joint. Most of the fractures involved the humerus, radius and ulna. Distal humerus fracture was seen in 149 (28%) patients. Fracture of the distal radius was observed in 131 (24.4 %) patients. Fractures of both the forearm bones were found in 86 (19.6%) children. Anatomical distribution of upper limb injuries is tabulated in table 1. Injury most commonly occurred in children 6-9 years of age (27.5%). Age distribution of the analyzed group is mentioned in Figure 1. There were 313 (71.6%) boys and 124 (28.3%) girls. Right extremity was involved in 202 (46.2%) and left extremity in 233 (53.3%). The mode of injury is depicted in Table 2. The seasonal pattern of injury is shown in Figure 2.

The geographical distribution of patients is presented in Figure 3. Delay of > 72 hours in presentation to hospital after ULI was noted in 88 (20%) patients. The time of presentation to hospital after ULI is mentioned in table 3. Out of 437 children, 76 (17%) of them received prehospital management.

**Table 1. Anatomical distribution of upper limb injuries.**

| Anatomical Site | No  |
|-----------------|-----|
| Clavicle        | 31  |
| Humerus         | 177 |
| Elbow Joint     | 4   |
| Radius          | 174 |
| Ulna            | 122 |
| Radius And Ulna | 86  |

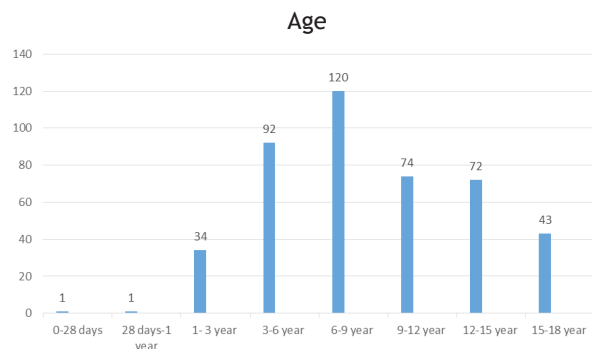
|             |    |
|-------------|----|
| Metacarpals | 11 |
| Phalanx     | 17 |

**Table 2. Mode of injury.**

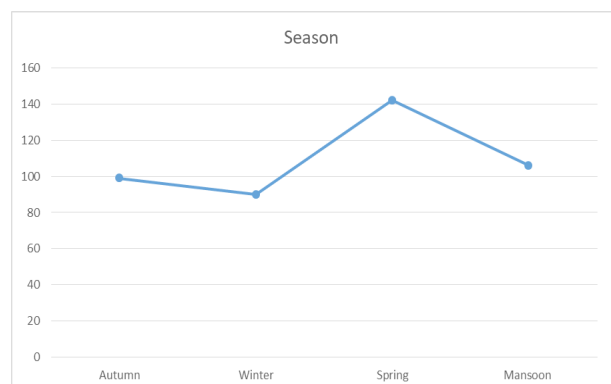
| Mode of Injury       | No  |
|----------------------|-----|
| Fall On Level Ground | 212 |
| Fall From Height     | 180 |
| Playing              | 23  |
| Physical Assault     | 1   |
| Bicycle              | 4   |
| RTA                  | 2   |
| Others               | 15  |

**Table 3. Time of presentation to hospital.**

| Time of presentation | No  |
|----------------------|-----|
| <24 hours            | 261 |
| 24-48 hours          | 55  |
| 48-72 hours          | 33  |
| >72 hours            | 88  |



**Figure 1. Age distribution.**



**Figure 2. Seasonal variation of ULI.**

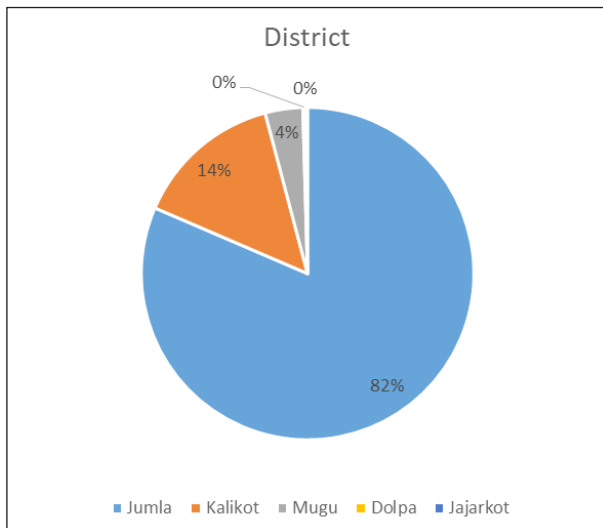


Figure 3. Geographical distribution.

## DISCUSSION

Children display a distinct set of injury pattern as compared to adults. Engaging in risky behaviors and activities often leads to significant injuries, long term disabilities or even mortality.<sup>5</sup> Understanding and recognizing the epidemiological trends of upper extremity injuries in children is essential for trauma systems, allocation of resources and planning for management.<sup>6,7</sup>

ULI is much more common than the lower limb injury in children.<sup>2</sup> In our study, humerus was the most frequently injured long bone followed by radius and ulna. Overall the injury was localized over the elbow region. The distal humerus emerged as the most commonly injured site in the upper limb, accounting for 149 (28%) of cases. This vulnerability may be attributed to anatomical and biomechanical factors: the supracondylar region, being a transition point between cancellous and cortical bone is structurally weaker and the 30° anterior angulation between the humeral shaft and condyles increases stress during trauma.<sup>8</sup> In the distal humerus there are three fossae. Olecranon fossa posteriorly coronoid fossa and radial fossa anteriorly. The presence of these fossae create a thin wafer of bone which makes distal humerus inherently weak. Children often fall with outstretched hands, transmitting force directly to this susceptible region and leading to frequent fractures at the distal humerus. In China, H. Yang et al<sup>9</sup> reviewed traumatic upper limb fractures in children and adolescents, where the most common fracture sites were humerus and radius. Fracture of the distal radius was observed in 131 (24.4%) patients. Children usually fall with elbow

in extension and wrist in dorsiflexion where the force is transmitted to distal radius. Fractures occur at the biomechanically weakest anatomic location of bone.<sup>10</sup> Distal radius cortex is relatively thin, porous and metabolically active. Children are more likely to sustain fracture near the growing end of radius where the bone is weakened by normal biological activity.<sup>11</sup> A study on musculoskeletal injuries in children and adolescents by Kiepora S et al<sup>12</sup> found fractures of distal radius in majority (38.5%) of the children.

Delayed presentation is a common scenario in remote tertiary care center of Karnali that requires further discussion (20% patients arriving at the hospital after 72 hours of injury). Unlike the western literature where delay is due to late diagnosis and management of other associated injuries in referring hospital. To speculate, the cause of delay in our context could be uneven geographical topography, lack of proper transportation,<sup>13</sup> proximity to health facility,<sup>14</sup> negligence to take medical advice, lack of health awareness, financial constraints<sup>15</sup> and initial management by traditional bonesetters and faith healers. Absence of road connectivity to all the remote village and shortage of ambulance compels patients to be carried in bamboo basket or stretcher for several days to reach the hospital.

We observed that 76 patients (17%) underwent prehospital management. It was primary intervention received either from local medical center or traditional bonesetters and faith healers. Though medical attention seeking behavior is increasing in Karnali there are still large portion of people who visit traditional bonesetters and faith healers for medical treatment. Traditional bonesetters and faith healers use “Kapro” to treat traumatic musculoskeletal injuries. This “Kapro” is a homemade local splint made up of bamboo stick and rope. Patients seek advice from traditional bonesetters and faith healers due to cultural belief and their ease of availability.<sup>16</sup> Lack of awareness, poverty and unavailability of nearby health facility could have promoted faith healers and traditional bone setters in remote areas of lower-middle-income country like ours.

<sup>15, 17</sup>

This study shows fall as the principal cause of ULI in children presenting to our rural tertiary care center. Contributing factors for fall include uneven terrain, unpaved school routes, involvement in farming tasks, and unsafe playing environments such as unguarded terraces and rooftops. In rural community of Karnali, it is a common practice to climb trees to gather fodder for cattle which heightens the risk of injury. Children

occasionally climb cliff to cut grass for household purpose in mountain districts like Jumla, Kalikot, and Mugu.<sup>18</sup> In addition, they have compulsion to walk in the uneven trails of hills and mountain for their day to day agricultural livelihood making them vulnerable to sustain fall injury.<sup>13</sup> Rooftops in the remote villages are usually open and lack protective bars or stair railings.<sup>19</sup> Wooden ladders present in houses and terrace are devoid of side bars in most of the rural community of Karnali province which explains the higher incidence of fall injury.

Upper limb injuries were most prevalent among children aged 6 to 9 years. It is likely due to their active participation in sports and recreational play combined with a natural curiosity and adventurous behavior. School going children are more prone to upper extremity injury as they are involved in school sports and outdoor activities. Intrusive behavior and lack of judgment further expose this particular age group to injury. On the contrary, a study conducted by X. Qui et al.<sup>8</sup> in China had shown that peak age of occurrence of upper extremity injuries was common at the age of 3-6 years. Boys were disproportionately affected, comprising 72% of cases, with a male-to-female ratio of 2.5:1. Boys have higher level of exposure to risky activities and boys entertain more freedom as compared to girls.<sup>5</sup> This disparity is likely influenced by sociocultural norms in rural community of Karnali, where patriarchal mentality prevails and girls often face restrictions, including limited access to education.<sup>13</sup> Left side was commonly involved (53%) as compared to right side. Many of the children are right-handed and the left limb acts as a protective limb making it more susceptible to injury during fall.<sup>5</sup> Musculoskeletal maturation is also less in nondominant limb, hence it is vulnerable to injury.<sup>20</sup> Notably, only one percent of the injured children in our study had associated injuries beyond the upper limb injuries. This lower rate likely reflects the less severe nature of the typical trauma mechanism in our cohort—mainly simple falls on level ground. In contrast, higher rates of associated injuries in other countries are often due to road traffic accidents, which are more severe and complex.<sup>21</sup>

This was a single centered study conducted at KAHS Jumla and only the referred children with ULI from other neighboring mountainous districts were included in this study. Therefore, our study likely underestimates the true burden of ULI in children of whole Karnali province. Many children with ULI who were managed outside and did not visit our center could have altered the final result of this study. Lastly, we could only identify the

trend and patterns of ULI, we were unable to determine the reason for these trends and associations.

## CONCLUSIONS

Upper limb injuries were prevalent around elbow and wrist joint. Injuries were common in boys and predominant in 6-9 years of age. Fall from cliff, tree, rooftop and ladder were the major mode of injury in our rural context. Delay in presentation to hospital and initial management of injury by traditional bonesetters is still prevailing in rural community of Karnali.

Various preventive strategies, law enforcements and effort from all stakeholders should be encouraged to reduce morbidity of ULI in children. Strengthening the health referral system, health awareness and improving the transportation facility may minimize the socioeconomic burden of ULI in children. Based on our findings we recommend the stakeholders to consider various activities like i) improve structural design of rooftops and ladders in rural community of Karnali ii) promote research on preventable injuries iii) allocate adequate resources for risk factor identification and preventive strategies for fall iv) campaign for awareness in the rural community regarding preventable injuries v) counsel faith healers and traditional bone setters on their perception towards injured patients vi) Provision of at least two ambulances in each rural municipality vii) Improve the road connectivity and provision of free transportation for trauma patients viii) strengthen the existing health referral system ix) access to specialized health service in rural parts of country.

## CONFLICT OF INTEREST

Authors declare there are no any conflicts of Interest.

## REFERENCES

1. Lempesis V, Rosengren BE, Nilsson JÅ, Landin L, Tiderius CJ, Karlsson MK. Time trends in pediatric fracture incidence in Sweden during the period 1950-2006. *Acta Orthop.* 2017 Aug;88(4):440-445. doi: 10.1080/17453674.2017.1334284. [PubMed]
2. Sinikumpu JJ, Pokka T, Serlo W. The changing pattern of pediatric both-bone forearm shaft fractures among 86,000 children from 1997 to 2009. *Eur J Pediatr Surg.* 2013 Aug;23(4):289-96. doi: 10.1055/s-0032-1333116. [PubMed]
3. Central Bureau of Statistics. National Population and Housing Census;2021. Available from: <https://>

- censusnepal.cbs.gov.np/results [Full Text]
4. Wong EG, Gupta S, Deckelbaum DL, Razek T, Kushner AL. Prioritizing injury care: a review of trauma capacity in low and middle-income countries. *J Surg Res*. 2015 Jan;193(1):217-22. doi: 10.1016/j.jss.2014.08.055. [PubMed]
  5. Hussain S, Dar T, Beigh AQ, Dhar S, Ahad H, Hussain I, et al. Pattern and epidemiology of pediatric musculoskeletal injuries in Kashmir valley, a retrospective single-center study of 1467 patients. *J Pediatr Orthop B*. 2015 May;24(3):230-7. [PubMed]
  6. Haddon W Jr. Energy damage and the 10 countermeasure strategies. 1973. *Inj Prev*. 1995 Mar;1(1):40-4. doi: 10.1136/ip.1.1.40. [PubMed]
  7. Stylianos S, Eichelberger MR. Pediatric trauma. Prevention strategies. *Pediatr Clin NorthAm*. 1993Dec;40(6):1359-68. [PubMed]
  8. Qiu X, Deng H, Zhao Z, Zeng S, Zeng Y, Wang X, et al. Futang Research Center of Pediatric Development (FRCPD). Upper limb pediatric fractures in 22 tertiary children's hospitals, China: a multicenter epidemiological investigation and economic factor analysis of 32,832 hospitalized children. *J Orthop Surg Res*. 2022 Jun 3;17(1):300. doi: 10.1186/s13018-022-03159-5. [PubMed]
  9. Yang H, Wang H, Cao C, Lu H, Zhao Y, Zeng G, et al. Incidence patterns of traumatic upper limb fractures in children and adolescents: Data from medical university-affiliated hospitals in Chongqing, China. *Medicine (Baltimore)*. 2019Sep;98(38):e17299. [PubMed]
  10. Farr JN, Tomás R, Chen Z, Lisse JR, Lohman TG, Going SB. Lower trabecular volumetric BMD at metaphyseal regions of weight-bearing bones is associated with prior fracture in young girls. *J Bone Miner Res*. 2011 Feb;26(2):380-7. [PubMed]
  11. Monga P, Raghupathy A, Courtman NH. Factors affecting remanipulation in paediatric forearm fractures. *J Pediatr Orthop B*. 2010 Mar;19(2):181-7. doi: 10.1097/BPB.0b013e3283314646. [PubMed]
  12. Kiepora S, Dutka J, Wieczorek-Grohman M. Increasing cost of Trauma Hospitalizations in the Pediatric Population. Cost Analysis of Treatment of Musculoskeletal Injuries in Children and Adolescents. *Ortop Traumatol Rehabil*. 2024 Aug 31;26(4):131-141. doi: 10.5604/01.3001.0054.8376. [PubMed]
  13. Weatherburn K, Parmar D, Pant PR, Parajuli M, Murdoch J. What safety can we talk about when all we see is difficulty? The impact of geographic and cultural determinants of unintentional injury in rural and mountainous Mugu, Nepal. *Front Public Health*. 2025 Jun 12;13:1599047. [PubMed]
  14. Gupta S, Gupta SK, Devkota S, Ranjit A, Swaroop M, Kushner AL, et al. Fall Injuries in Nepal: A Countrywide Population-based Survey. *Ann Glob Health*. 2015 Jul-Aug;81(4):487-94. [PubMed]
  15. Kiragu AW, Dunlop SJ, Mwarumba N, Gidado S, Adesina A, Mwachiro M, et al. Pediatric Trauma Care in Low Resource Settings: Challenges, Opportunities, and Solutions. *Front Pediatr*. 2018 Jun 4;6:155. doi: 10.3389/fped.2018.00155. [PubMed]
  16. Onyemaechi NO, Menson WNA, Goodman X, Slinkard S, Onwujekwe OE, Enweani UN, et al. Complications of traditional bonesetting in contemporary fracture care in low- and middle-income countries: A systematic review. *Trop Med Int Health*. 2021 Nov;26(11):1367-1377. [PubMed]
  17. Thanni LO. Factors influencing patronage of traditional bone setters. *West Afr J Med*. 2000 Jul-Sep;19(3):220-4. [PubMed]
  18. Rokaya PK, Karki DB, Rawal M, Limbu D, Menyangbo S, Devkota H. Pattern of Pediatric Supracondylar Fracture Operated at A Rural Teaching Hospital of Nepal: A Descriptive Cross-sectional Study. *JNMA J Nepal Med Assoc*. 2020 Mar;58(223):153-157. [PubMed]
  19. Joshi E, Bhatta S, Deave T, Mytton J, Adhikari D, Manandhar SR, et al. Perceptions of injury risk in the home and workplace in Nepal: a qualitative study. *BMJ Open*. 2021 Mar 25;11(3):e044273. doi: 10.1136/bmjopen-2020-044273. [PubMed]
  20. Jing SS. Hand Dominance: Nature, Nurture, and Relevance for Hand Surgeons. *J Hand Microsurg*. 2020 Jun 22;14(1):111-112. German. doi: 10.1055/s-0040-1713557. [PubMed]
  21. Rubin G, Peleg K, Givon A; Israel Trauma Group; Rozen N. Upper extremity fractures among hospitalized pediatric road traffic accident victims. *Am J Emerg Med*. 2015 May;33(5):667-70. [PubMed]