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FREQUENCY AND PATTERN OF INJURIES AMONG CHILDREN: A HOSPITAL BASED CROSS-SECTIONAL STUDY IN PAKISTAN

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Abstract

Background: *Childhood injuries remain a major public health issue, particularly in low- and middle-income countries (LMICs). In Pakistan, updated hospital-based evidence is scarce, limiting effective injury prevention and trauma service planning. This study aimed to describe patterns of childhood injuries and identify factors associated with hospital disposition.*

Methods: *A descriptive cross-sectional study was conducted among 533 injured children presenting to the Paediatrics Emergency Department of a tertiary care hospital in Karachi, Pakistan (May 2020–April 2021). Data on demographics, mechanism and place of injury, body site affected, clinical features at presentation, and final disposition were collected using a structured electronic case report form. Descriptive statistics summarized injury patterns, and binary logistic regression identified factors independently associated with admission or referral.*

Results: *The mean age of participants was 6.3 ± 3.7 years, and 68.7% were male. Nearly half of injuries occurred at home (48.9%). Falls were the most common mechanism (28.4%), followed by road traffic accidents (22.2%). In multivariable analysis, moderate pain (aOR 1.9, 95% CI 1.3–2.8) and severe pain (aOR 8.0, 95% CI 4.5–14.0) were strongly associated with admission or referral. Complications (aOR 2.2, 95% CI 1.4–3.4), burn injuries (aOR 6.5, 95% CI 2.1–20.2), and presence of inflammation or swelling (aOR 1.4, 95% CI 1.0–2.1) were also independently associated with admission.*

Conclusion: *Childhood injuries in this tertiary care setting were common among young boys and frequently occurred at home, with falls being the leading mechanism. However, hospital admission was primarily determined by clinical severity pain intensity, complications, burns, and swelling rather than demographic factors or location of injury. These findings underscore the need for preventive interventions in domestic environments and highlight the importance of early clinical assessment in pediatric emergency care.*

Introduction

Childhood injuries are a growing public health concern worldwide, with significant implications for morbidity and mortality among children. Injuries occur when the human body is exposed to mechanical, thermal, chemical, electrical, or radiation energy at levels that exceed physiological tolerance, resulting in tissue damage [1]. As children grow older, injuries progressively replace infectious diseases as a leading cause of illness and death [2]. Globally, injury ranks second for disability, eleventh for premature death, and fifth for total healthy years lost per 1000 persons, according to burden of disease research [3].

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In low- and middle-income countries (LMICs), injuries account for approximately 13% of deaths among children under 15 years, a proportion nearly 3.5 times higher than reported in high-income countries [1]. This disparity reflects differences in environmental safety, supervision, health system capacity, and injury prevention policies [8]. Karachi, one of the most densely populated cities in Pakistan, presents multiple injury risks for children [4]. Rapid urban growth, increasing traffic congestion, poor housing infrastructure, and the absence of child-focused safety measures contribute to the rising burden of childhood injuries [5].

The majority of childhood injuries result from unintentional causes such as falls, burns, road traffic incidents, poisoning, and drowning, while a smaller proportion is related to abuse or neglect [1,6,11]. Despite their prevalence, hospital-based childhood injury data in Pakistan remain limited [6,9]. Most available evidence from Karachi is over a decade old and may not reflect current trends [7]. Reliance on outdated data hinders effective injury prevention and trauma care planning. Updated hospital-based evidence is essential for clinicians' caseload forecasting, hospital administrators' resource allocation, and targeted injury-prevention initiatives. Moreover, home safety programs, child-focused urban design, and road traffic injury reduction strategies require knowledge about local injury patterns [8,12].

Globally, the epidemiology of childhood injuries demonstrates considerable variation across regions. In South Asia, road traffic injuries and burns are disproportionately higher compared to other LMICs, reflecting both infrastructural challenges and limited enforcement of safety regulations [6,13]. Studies from India, Bangladesh, and Pakistan highlight that overcrowded living conditions, unsafe cooking practices, and lack of protective legislation significantly elevate risks for children [8,10]. These findings underscore the importance of contextualized research in Pakistan, where similar socio-economic and environmental determinants prevail.

Hospital-based studies also reveal that injury outcomes are strongly influenced by delays in seeking care and limited trauma management capacity [6,9]. In Pakistan, many families rely on informal care or delay hospital visits due to financial constraints, resulting in worsened injury severity at presentation [4]. Furthermore, pediatric trauma units remain underdeveloped, with inadequate staffing and limited access to specialized equipment [10]. This gap in emergency preparedness highlights the urgent need for evidence-based advocacy to strengthen pediatric trauma systems.

Preventive interventions have proven effective in reducing childhood injury burden in LMICs. Community-based safety education, enforcement of traffic laws, and home hazard reduction programs have demonstrated measurable impact in reducing injury incidence [8,13]. However, the success of such interventions depends on accurate, locally relevant data. By documenting the frequency and patterns of injuries among children in Karachi, this study provides critical evidence to guide policymakers, clinicians, and public health practitioners in designing targeted prevention strategies that address Pakistan's unique urban risks [9,12].

Method

Study design and setting

A descriptive hospital-based cross-sectional study was conducted in the Paediatrics Emergency Department of Indus Hospital and Health Network, Karachi, Pakistan, from 1 May 2020 to 30 April 2021. Hospital-based cross-sectional designs are widely used in LMICs to capture real-time injury patterns and outcomes [6,9].

Study population and eligibility criteria

Children aged 1 to 14 years presenting to the Paediatrics Emergency Department with injuries were considered eligible. Injuries included falls, road traffic accidents, foreign body ingestion, burns, animal bites, poisoning, assault, self-harm, and near drowning, consistent with WHO and LMIC injury surveillance frameworks [8,13]. Patients with congenital orthopedic anomalies, malignancy, muscular dystrophy, myopathies, osteogenesis imperfecta, and fatal drowning were

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excluded to avoid confounding from chronic or non-traumatic conditions [10].

Sample size and sampling technique

The sample size was calculated using the OpenEpi calculator. With a 95% confidence level, 5% margin of error, and anticipated frequency of 50%, the required sample size was 384. However, a total sample of 533 was achieved, which increased the precision of the results. A non-probability convenience sampling technique was used, consistent with prior pediatric trauma studies in Pakistan [9,12]. All eligible patients presenting during the study period were approached consecutively.

Data collection procedure

Data were collected in real time using a structured electronic case report form (e-CRF) developed on REDCap and accessed through a password-protected electronic tablet. REDCap is a validated platform for secure clinical data capture in LMIC settings [8]. The e-CRF included predefined fields covering socio-demographic variables (age and gender), injury characteristics (mechanism, place, nature, and body site involved), and clinical presentation at arrival (pain severity, bleeding, inflammation or swelling, and complications). Final disposition was recorded under three categories: discharged, admitted or referred, and left against medical advice (LAMA). Only the principal investigator and IRB-approved personnel had access to the data collection platform.

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Data Analysis

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Ethical Considerations

The Institutional Review Board (IRB) of Interactive Research and Development (IRD) approved the research (IRD_IRB_2020_03_010). Ethical principles of voluntary participation, confidentiality, and child assent were strictly followed, consistent with international pediatric injury research guidelines [11].

Results

A total of 533 injured children were included in the study. The mean age of participants was 6.3 years (SD 3.7). Among the study population, 367 (68.7%) were male and 167 (31.3%) were female. The overall baseline characteristics of the study population are presented in Table 1. Nearly half of all injuries occurred at home (48.9%), followed by roads (22.3%) and neighborhood settings (13.1%). Falls from height were the most common mechanism of injury (28.4%), followed by road traffic accidents (22.2%). Injuries involving multiple body sites were frequent (38.3%), while upper extremities (20.9%) and head injuries (14.8%) were the most common single-site presentations. Moderate pain severity was the

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predominant clinical feature (52.8%), and inflammation or swelling was present in 69.1% of cases. In terms of disposition, 52.7% were discharged, 44.7% admitted or referred, and 2.5% left against medical advice.

Table 1. Baseline Characteristics of Injured Children (n = 533)

Characteristic	Mean (SD) / n (%)
Age (years)	6.3 (3.7)
Gender	
Male	367 (68.7%)
Female	167 (31.3%)
Place of Injury	
At home	261 (48.9%)
Road	119 (22.3%)
Neighborhood	70 (13.1%)
Other specified	59 (11.0%)
Outside home / public place	25 (4.7%)
Mechanism of Injury	
Fall from height	152 (28.4%)
Road traffic accident	119 (22.2%)
Other (miscellaneous)	78 (14.6%)
Burns	41 (7.7%)
Animal attack	26 (4.9%)
Falling of heavy object	19 (3.6%)
Foreign body aspiration	7 (1.3%)
Assault	1 (0.2%)
Body Site Injured	
Upper extremities	112 (20.9%)
Head	79 (14.8%)
Lower limb	62 (11.6%)
Face	22 (4.1%)
Trunk	7 (1.3%)
Multiple body sites	205 (38.3%)
Bleeding	
No	290 (55.7%)
Yes	231 (44.3%)
Complications	
No	325 (63.6%)
Yes	186 (36.4%)
Pain Severity at Arrival	
Mild	148 (28.0%)
Moderate	279 (52.8%)
Severe	101 (19.1%)
Inflammation / Swelling	
Yes	362 (69.1%)
No	162 (30.9%)
Final Disposition	

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Discharged	270 (52.7%)
Admitted or referred out	229 (44.7%)
Left against medical advice (LAMA)	13 (2.5%)

Figure 1 illustrates the distribution of injury locations. Nearly half of all injuries occurred at home, underscoring the importance of domestic safety interventions. Road-related injuries accounted for more than one-fifth of cases, highlighting the burden of traffic hazards in urban Karachi. Neighborhood and public-place injuries were less frequent but still notable, reflecting risks in community and recreational environments.

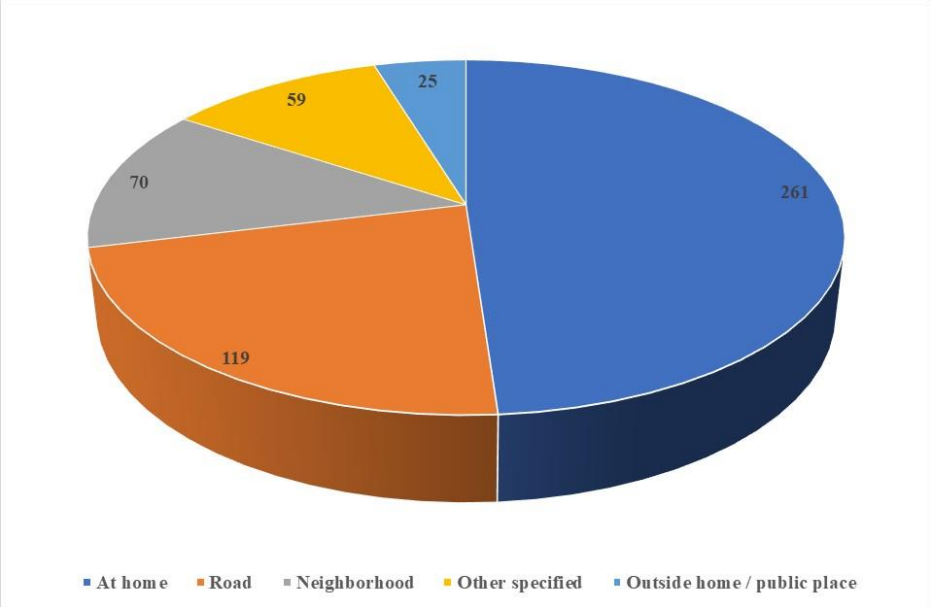


Figure 1 Place of Injury among Pediatric Emergency Presentations

Figure 2 presents the distribution of injury mechanisms. Falls from height were the leading cause, followed closely by road traffic accidents. Burns and animal attacks contributed smaller but clinically significant proportions. Assault and foreign body aspiration were rare, yet they highlight the diversity of injury types encountered in pediatric emergency care.

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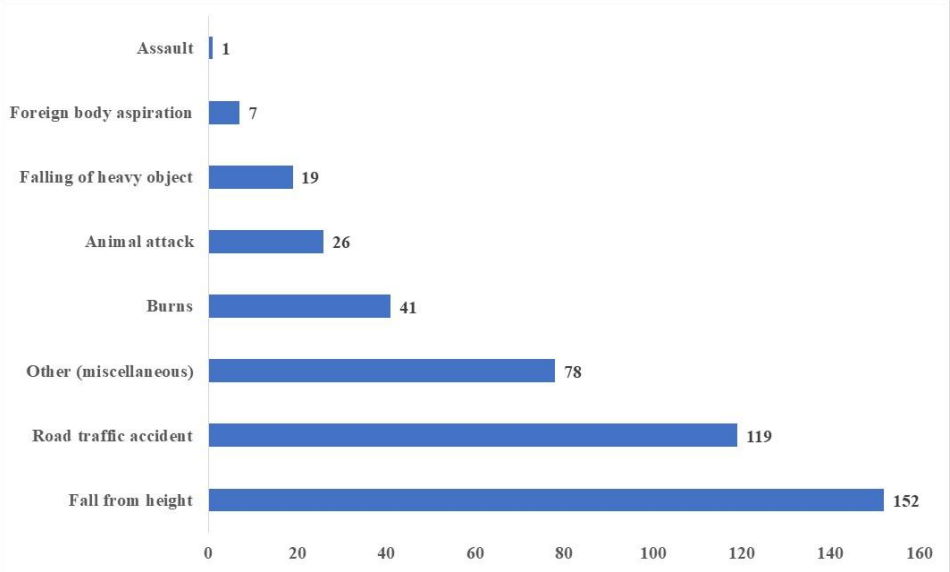


Figure 2 Mechanism of Injury in Paediatric Emergency Presentations

Baseline characteristics by disposition are shown in Table 2. Mean age did not differ across groups ($p = 0.122$), and gender distribution was similar ($p = 0.51$). Mechanism of injury varied significantly by disposition ($p < 0.001$). Place of injury did not differ across groups ($p = 0.42$). Injury site was significantly associated with disposition ($p = 0.002$), with differences observed across body-site categories. Pain severity at arrival differed across disposition groups ($p < 0.001$). Inflammation or swelling at presentation also differed significantly by disposition ($p = 0.025$), whereas bleeding at arrival did not ($p = 0.089$). Complications were more frequent among admitted or referred patients ($p < 0.001$).

Table 2. Baseline Characteristics of Injured Children by Disposition (n = 533)

Characteristic	Discharged (n=270)	Admit/Refer (n=229)	LAMA (n=13)	p-value
Age (years, Mean ± SD)	6.5 ± 3.7	5.9 ± 3.7	7.4 ± 3.5	0.122
Gender				0.51
Male	186 (68.9%)	158 (69.0%)	7 (53.8%)	
Female	84 (31.1%)	71 (31.0%)	6 (46.2%)	
Mechanism of Injury				<0.001
Animal attack	28 (10.4%)	3 (1.3%)	0 (0.0%)	
Assault	5 (1.9%)	1 (0.4%)	0 (0.0%)	
Burns	8 (3.0%)	38 (16.6%)	1 (7.7%)	
Foreign body aspiration	5 (1.9%)	2 (0.9%)	0 (0.0%)	
Fall	108 (40.0%)	100 (43.7%)	6 (46.2%)	
Other	45 (16.7%)	29 (12.7%)	1 (7.7%)	
Road traffic accident	71 (26.3%)	56 (24.5%)	5 (38.5%)	
Place of Injury				0.42
At home	125 (46.3%)	127 (55.5%)	5 (38.5%)	
Road	57 (21.1%)	51 (22.3%)	4 (30.8%)	

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Neighborhood	43 (15.9%)	25 (10.9%)	2 (15.4%)	
Other specified	29 (10.7%)	18 (7.9%)	1 (7.7%)	
Outside home/public place	16 (5.9%)	8 (3.5%)	1 (7.7%)	
Injury Site				0.002
Head / Face / Neck	58 (21.5%)	56 (24.5%)	0 (0.0%)	
Lower limb	32 (11.9%)	24 (10.5%)	2 (15.4%)	
Multiple sites	86 (31.9%)	89 (38.9%)	7 (53.8%)	
Trunk	4 (1.5%)	2 (0.9%)	0 (0.0%)	
Upper extremities	66 (24.4%)	43 (18.8%)	3 (23.1%)	
Pain Severity at Arrival				<0.001
Mild	102 (38.3%)	37 (16.2%)	3 (23.1%)	
Moderate	141 (53.0%)	119 (52.0%)	6 (46.2%)	
Severe	23 (8.6%)	73 (31.9%)	4 (30.8%)	
Inflammation / Swelling at Arrival				0.025
Yes	171 (64.3%)	164 (72.6%)	12 (92.3%)	
No	95 (35.7%)	62 (27.4%)	1 (7.7%)	
Bleeding at Arrival				0.089
Yes	127 (47.9%)	89 (39.7%)	8 (61.5%)	
No	138 (52.1%)	135 (60.3%)	5 (38.5%)	
Complications				<0.001
Yes	64 (24.6%)	112 (49.8%)	4 (36.4%)	
No	196 (75.4%)	113 (50.2%)	7 (63.6%)	

Table 3 presents the results of the final parsimonious binary logistic regression model examining factors associated with admission or referral compared with discharge. Pain severity at presentation showed a clear graded association with disposition. Compared with patients presenting with mild pain, those with moderate pain had higher odds of admission or referral (aOR 1.9, 95% CI 1.3–2.8), while those with severe pain had substantially higher odds (aOR 8.0, 95% CI 4.5–14.0).

Table 3. Factors Independently Associated with Admission or Referral Among Injured Children (n = 520*)

Predictor	Category	Adjusted OR (aOR)	95% CI	p-value
Pain severity (Ref: Mild)	Moderate	1.9	1.3 – 2.8	<0.001
	Severe	8	4.5 – 14.0	<0.001
Complication (Ref: No)	Yes	2.2	1.4 – 3.4	<0.001
Mechanism of injury (Ref: Fall)	Burns	6.5	2.1 – 20.2	0.001
Inflammation / swelling (Ref: No)	Yes	1.4	1.0 – 2.1	0.03

Adjusted odds ratios (aORs) were obtained from Variables with p-values ≥0.05 in the fully adjusted model were excluded. LAMA cases (n = 13) were excluded from regression analyses due to small numbers and are presented descriptively. The final parsimonious model retained predictors with significant independent associations.

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The presence of complications was independently associated with admission or referral, with patients experiencing complications having more than twice the odds of admission or referral compared with those without complications (aOR 2.2, 95% CI 1.4–3.4). Mechanism of injury also remained independently associated with disposition; compared with falls from height, burn injuries were associated with markedly increased odds of admission or referral (aOR 6.5, 95% CI 2.1–20.2). Inflammation or swelling at presentation was also retained in the final model and was associated with increased odds of admission or referral compared with its absence (aOR 1.4, 95% CI 1.0–2.1). All reported associations remained statistically significant after adjustment.

Discussion

This study provides a detailed overview of childhood injury patterns in an urban Pakistani setting and identifies factors linked with admission or referral. A higher proportion of injuries was reported in males (68.7%) compared to females (31.3%). This finding is consistent with a similar study conducted in Karachi, where the male-to-female ratio in pediatric injuries was approximately 2:1 [14]. Past literature attributes this difference to greater outdoor exposure and sociocultural norms that permit more mobility among male children [15]. However, sex was not associated with admission in our study, indicating that higher exposure does not necessarily translate into greater severity, consistent with evidence showing that sex differences do not strongly influence intensive care admission [16].

The mean age of children with unintentional injuries in our study was 6.2 years, aligning with findings from the Global Childhood Unintentional Injury Surveillance (GCUIS), which reported that 60% of injured children were older than 6 years [17]. Developmental immaturity and limited hazard awareness may explain this vulnerability. However, age was not associated with admission in our study, suggesting that clinical severity rather than age determines hospital disposition, consistent with population-based hospitalization studies [18].

Falls were the most common mechanism of injury, consistent with global childhood injury research [19,20]. However, falls were not independently associated with admission in our study, suggesting that many falls may result in minor injuries. This pattern has been reported in emergency department surveillance studies, where falls dominate frequency but not necessarily hospitalization rates [21]. Road traffic accidents were the second most frequent mechanism, reflecting the growing burden of traffic-related pediatric injuries [22]. Almost half of injuries occurred at home, consistent with South Asian evidence that domestic environments contribute significantly to pediatric injury burden [23].

The most commonly affected sites were the upper extremities and the head, together accounting for 28.1% of injuries. This pattern is aligned with pediatric trauma literature, where upper limb injuries are frequently reported due to protective reflexes during falls, and head injuries are common because of a child's relatively larger head-to-body ratio [24]. Pain severity was strongly associated with admission, consistent with pediatric trauma literature where pain intensity is used as a marker of injury severity and guides triage decisions [25]. Complications were also associated with admission, in line with global pediatric trauma evidence showing that early clinical deterioration significantly increases hospitalization likelihood [26]. Moreover, burns were linked with admission, with significantly higher adjusted odds of inpatient care. This finding is consistent with pediatric burn literature showing higher morbidity, risk of infection, and need for fluid management [27].

Beyond individual risk factors, the findings of this study highlight the importance of environmental and contextual determinants of childhood injuries. The predominance of home-based injuries underscores the need for domestic safety interventions, particularly in LMICs where overcrowding, unsafe cooking practices, and lack of child-proofing are common [23]. Evidence from South Asia suggests that parental education and awareness programs can significantly reduce household hazards and improve supervision practices [14]. In Karachi, where rapid

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urbanization has intensified housing density and traffic exposure, community-level interventions such as safer play areas, improved housing design, and traffic calming measures may be critical to reducing injury burden.

Another important implication of this study is the role of emergency department surveillance in shaping injury prevention strategies. Our findings that falls dominate frequency but burns and complications drive admissions mirror global pediatric trauma surveillance data [20,24]. This suggests that emergency departments are not only treatment centers but also valuable data sources for injury epidemiology. Establishing standardized injury surveillance systems across hospitals in Pakistan could provide real-time insights into emerging injury trends, guide resource allocation, and strengthen national child injury prevention policies. Such systems have been successfully implemented in other LMICs and have proven effective in informing targeted interventions [17].

Limitations

This study has several methodological limitations. First, it used a non-probability convenience sampling method, which increases the risk of selection bias. Second, the sample was drawn from a free tertiary care hospital, so children from lower socioeconomic groups may be overrepresented, limiting generalizability. Third, the study design was cross-sectional, so temporal relationships and causal inferences cannot be established. Fourth, injury severity was assessed using clinical proxies (pain, complications, swelling) rather than standardized trauma scores, which may limit comparability with international datasets. Finally, the study was conducted in a single urban hospital, and findings may not reflect rural or multi-center injury patterns in Pakistan.

Conclusion

Despite these limitations, this study provides valuable insights into the burden and patterns of childhood injuries in Karachi. Falls and road traffic accidents were the most frequent mechanisms, while burns, complications, and severe pain were the strongest predictors of admission or referral. Nearly half of injuries occurred at home, underscoring the need for preventive efforts within domestic environments. The findings emphasize the importance of careful clinical assessment in emergency departments to identify children requiring closer monitoring or inpatient care.

Future research should employ multi-center designs, standardized trauma severity scoring, and longitudinal follow-up to better understand injury outcomes. Preventive strategies should prioritize home safety, traffic injury reduction, and early recognition of severe clinical presentations to reduce morbidity and improve pediatric trauma care in Pakistan and similar LMIC settings.

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