Original Article

Patterns, Determinants and Mechanisms of Unintentional Injuries among Children presenting to a Tertiary Care Emergency Department in Pakistan: A Cross-sectional Study

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ABSTRACT

Background: Unintentional injuries remain a contributor to childhood morbidity and mortality, with the disease burden falling disproportionately on children in third-world countries. Therefore, this study aimed to determine the patterns, determinants and mechanisms of unintentional injuries among children presenting to the paediatric emergency of Allama Iqbal Memorial Teaching Hospital, Sialkot.

Methods: An analytical cross-sectional study was conducted from 1st June to 30th November 2024 after IRB approval. Of 389 children aged 0–12 years with unintentional injuries were included by non-probability purposive sampling after taking written informed consent from parents or legal guardians. While children with chronic illness, congenital anomalies and intentional injuries were excluded. A structured questionnaire was administered. Data were analysed in SPSS version 27. Frequencies and percentages were calculated for categorical variables (gender, residence, socio-economic class), and mean ± standard deviation for continuous variables (age, monthly income). The chi-square test was used to assess associations, with p-values ≤ 0.05 considered significant.

Results: Of 389 children, the mean age was 6.6 ± 3.17 years and 248 (63.8%) were male children. Among determinants, inside home was the place of injury for 198 (50.9%) children, family members were caretaker at the time of injury for 382 (98.2%), and daytime was the time of injury among 256 (65.8%), while 167 (43.0%) children were under supervision. Trunk and extremities were the pattern among 248 (63.8%) children, while 256 (65.8%) had soft tissue injuries. Road traffic accidents among 163 (41.9%) and falls 154 (39.6%) were the leading mechanisms. Most injuries occurred during daytime (p = 0.043) and male children were more often unsupervised at the time of injury (p = 0.021).

Conclusion: Road traffic accidents and falls accounted for the majority of unintentional injuries, with male gender, daytime hours and inadequate supervision emerging as the dominant determinants. Trunk and extremities were the predominant anatomical site of injury involving mainly soft tissues as pattern of injuries.

Keywords: Wounds and injuries, accidents, children, emergency services, hospitals.

INTRODUCTION

Unintentional injuries those occurring without prior intent are among the leading contributors to childhood morbidity and mortality across the globe. They include road traffic accidents, falls, burns, drowning, poisoning, suffocation and animal bites.[1] Children are inherently more, vulnerable than adults because of their physical immaturity limited risk perception and dependence on caregivers for a safe environment, and the resulting public health burden is enormous. According to a recent Global Burden of Disease analysis covering 1990–2021, unintentional injuries accounted for an estimated 305,596 deaths and 28.4 million disability adjusted life years among children and adolescents worldwide in 2021, with the largest absolute number of cases reported from India.[2] Road traffic accidents, drowning, falls, burns and poisoning continue to dominate the global cause specific list, with falls being the leading non-fatal mechanism and road traffic accidents the leading fatal one across most paediatric age strata.[2]

The burden is disproportionately borne by low- and middle-income countries (LMICs), where children are exposed to unsafe surroundings such as congested play areas, unprotected construction sites, defective stairways, exposed electrical wiring and improper storage of household chemicals.[3] A recent Indian systematic review reported that road traffic crashes alone contribute almost 85% of unintentional injury deaths and 90% of disability-

ARTICLE INFO

Article History: Received: 12-09-2025 | Accepted: 10-12-2025

Conflict of Interest: The authors declared no conflict of interest exists.

Funding: None.

Citation: Mahwish R, Iqbal T, Aslam I, Khalid A, Liaquat F. Patterns, determinants and mechanisms of unintentional injuries among children presenting to a tertiary care emergency department in Pakistan: A cross-sectional study. J Fatima Jinnah Med Univ. 2026; 20(1):8-14.

DOI: http://doi.org/10.37018/EDRF0987

adjusted life-years lost in developing countries.[3] Reported community-based prevalence figures from the region vary widely: 26% in rural and 17.2% in urban Nepal,[4] 44.6% among under-fives in rural Odisha (India)[5] and 55% among children attending a tertiary-care emergency department in Lahore, Pakistan.[6] Mortality data from southern Iran show crude rates of 37.1 per 100,000 in males and 13.6 per 100,000 in females over a 16-year period.[7]

The anatomical pattern and clinical severity of these injuries are equally important for service planning. Global Burden of Disease estimates indicate that childhood unintentional injuries translate into a wide spectrum of clinical patterns including head injuries, fractures of the upper and lower limbs, soft-tissue wounds, burns, spinal injuries and amputations with the cranial and extremity regions consistently bearing the largest share.[3] Hospital-based evidence supports this distribution as in a recent emergency department cohort from Lahore, around 40% of childhood injury presentations were classified as minor (superficial bruises and lacerations), 35% as moderate (requiring suturing or short observation) and 25% as severe (head trauma, prolonged loss of consciousness or other life-threatening trauma).[6] Documenting both the mechanism and the anatomical pattern in the same dataset therefore matters because the two together determine the immediate clinical care required and the longer term rehabilitation burden.[2]

Risk factors for childhood unintentional injuries are conventionally grouped into host factors (age, sex, behaviour, developmental stage), environmental factors (socioeconomic class, parental education, level of supervision, type of dwelling) and agent-related factors (traffic volume, neighbourhood hazards, deprivation index).[1] The type and severity of injury vary with the child's developmental stage, family environment and activities undertaken at the time of the event.

Despite this growing global recognition, locally generated evidence on the patterns, determinants and mechanisms of unintentional injuries among Pakistani children remains scarce, and most of the published work has been carried out in large metropolitan centres such as Karachi and Lahore.[6] Sialkot, a rapidly urbanising industrial district of Punjab has no published profile of childhood unintentional injuries, even though its growing road traffic density and crowded informal play environments place children at considerable risk. Without locally relevant epidemiological evidence, district-level policymakers cannot design context-specific preventive measures. The present study was therefore designed to determine the patterns and determinants of unintentional injuries in children presenting to the paediatric emergency department of AIMTH, Sialkot.

PARTICIPANTS AND METHODS

An analytical cross-sectional study was conducted in the paediatric emergency department of Allama Iqbal Memorial Teaching Hospital (AIMTH), Sialkot from 1st June to 30th November 2024 after obtaining approval from institutional review board (29/REC/KMSMC dated 21.10.2024). Children of either gender, aged 0–12 years, presenting to the paediatric emergency department with an unintentional injury whose parent or legal guardian provided written informed consent were included. Children with known chronic illnesses or congenital anomalies, those with intentional injuries (assault or self-harm) and those with suspected abuse-related injuries were excluded. A sample of 380 was calculated using the WHO sample size calculator with a 95% confidence level, a 5% absolute precision and an anticipated population proportion of 55%.[6] After adjustment for an anticipated 1–2% rate of incomplete questionnaires, 389 participants were included through non-probability purposive sampling of eligible children.

A structured, interviewer-administered questionnaire was developed after review of previously published studies,[4,6] both of these source questionnaires are themselves adapted from the World Health Organization guidelines for conducting community surveys on injuries and violence.[8] The questionnaire was divided into two sections. Section A included socio-demographic profile such as the child's age, gender, birth order, residence, parental education and occupation, monthly family income and socio-economic class assessed by the modified Kuppuswamy scale.[9] Section B also has three parts. First part included determinants of the unintentional injuries like place and time of injury, day of the week, child's activity at the time of injury, level of supervision and relation of caretaker. Second part comprised of pattern of unintentional injuries like anatomical site (craniofacial, trunk or extremities) and nature of injury (soft-tissue or bony) while third part included mechanism of unintentional injuries (road traffic accidents, fall, animal bite, drowning, poisoning and suffocation).

Pattern of unintentional injuries was defined as the anatomical region affected during the injury (craniofacial, trunk or extremities) and the nature of injury sustained (soft-tissue or bony). Determinants included place, time, day, caretaker relation, child activity and supervision at the time of injury while mechanism of unintentional injuries is the immediate physical cause leading to the injury (road traffic accident, fall and animal bite etc.) and mechanisms were further grouped into traumatic (road traffic accidents, falls and animal bites) and non-traumatic (drowning, poisoning and suffocation) categories for analytical purposes.

Written informed consent was obtained from a parent or legal guardian before recruitment. Data were entered and analysed using SPSS version 27. Frequencies and percentages were calculated for categorical variables (gender, residence, socio-economic class, place, time, mechanism and pattern of injury), and mean and standard deviation for continuous variables (age, monthly income and per-capita income). Associations between socio-demographic characteristics and determinants, mechanisms of unintentional injuries were determined using the chi-square test and $p \leq 0.05$ considered as statistically significant.

RESULTS

A total of 389 children were included in this study. The mean age was 6.6 ± 3.17 years where 248 (63.8%) were male children and 141 (36.2%) female children. Of the participants, 296 (76%) children had literate fathers, although 311 (80%) of the fathers were unemployed. The majority of children 351 (90.2%) were brought to the emergency department directly by family members, while only 124 (32%) had received any form of pre-hospital procedure. On arrival, 317 (81.5%) of the children were fully conscious, and the injury had been witnessed by a family member in 279 (71.7%) instances. After emergency management, 296 (76%) children were discharged from the department, whereas 12 (3.1%) required admission to intensive care. The detailed socio-demographic profile is given in Table 1.

Among the determinants of injury, a total of 198 (50.9%) children had unintentional injury inside home and majority of children 256 (65.8%) suffered at day time. Trunk and extremities were the most common pattern of unintentional injuries in 248 (63.8%) children shown in Table 2.

By mechanism, road traffic accidents 163 (41.9%) and falls 154 (39.59%) together accounted for more than four-fifths of all injuries (Figure 1).

Cross-tabulation using chi square test and where assumptions are not fulfilled then Fisher exact test revealed several statistically significant associations. Male children were significantly more likely to sustain traumatic injuries than female children ($p = 0.019$), to be unsupervised at the time of injury ($p = 0.021$) and to differ in place of injury distribution ($p = 0.05$). Parental education and socio-economic class showed no significant association with the pattern of injury (Table 3 and 4).

Table 1: Socio-demographic profile of participants (n=389)

Attribute	Frequency (n)	Percentage (%)
Gender of children		
Male	248	63.8
Female	141	36.2
Birth order		
1–3	309	79.4
4 and above	80	20.6
Residence		
Rural	194	49.9
Urban	195	50.1
Socio-economic class		
Middle	173	44.5
Lower	216	55.5
Maternal education		
Literate	266	68.4
Illiterate	123	31.6

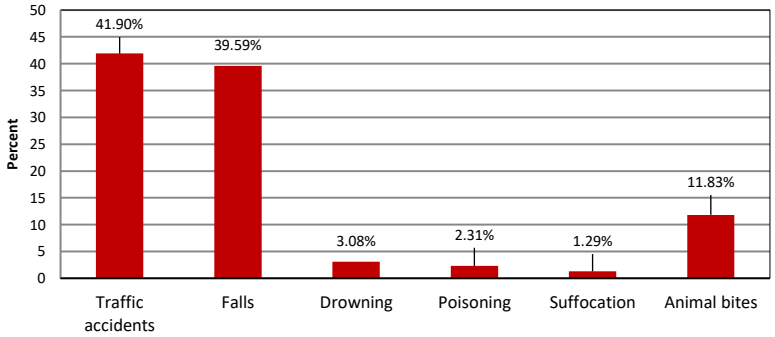

Figure 1: Mechanism of unintentional injuries

Table 2: Determinants and patterns of unintentional injury (n=389)

Determinants	Frequency (n)	Percentage (%)
Place of injury		
Inside home	198	50.9
Outside home	191	49.1
Caretaker at the time of injury		
Family member (primary)	382	98.2
House help (secondary)	7	1.8
Child's activity at the time of injury		
Playing	200	51.4
Sports	189	48.6
Time of injury		
Daytime	256	65.8
Evening and night	133	34.2
Day of injury		
Weekdays	229	58.9
Weekends	160	41.1
Supervision at the time of injury		
Yes	167	43.0
No	222	57.0
Patterns		
Anatomical site of injury		
Craniofacial	141	36.2
Trunk and extremities	248	63.8
Nature of injury		
Soft-tissue	256	65.8
Bony	133	34.2

DISCUSSION

This hospital-based cross-sectional study described the patterns, determinants and mechanism of unintentional injuries in 389 children presenting to a tertiary-care paediatric emergency department in Sialkot, Pakistan. Male children predominance (63.8%) was consistent with regional and international literature. Alhadrami et al. observed a similar male-skewed distribution among children with domestic injuries in Jeddah, Saudi Arabia,[10] while Qayyum et al. reported male predominance in paediatric trauma admissions at a Karachi tertiary-care centre.[11] Greater participation by boys in outdoor and risk-taking activities, earlier independence in mobility and less continuous adult supervision have been the most commonly cited explanations for this gender difference.[12]

Road traffic accidents (41.9%) were the leading mechanism in our study, closely followed by falls (39.6%). This pattern resembles that reported by Nasr et al. from Lahore, where transport-related injuries (35%) preceded falls (30%) in an emergency department based cohort.[6] In contrast, Alhadrami et al. from Saudi Arabia identified falls as the commonest cause of childhood domestic injury[10] however, that study revealed maternal reports of in-home events and therefore would have under-represented road traffic accidents by design. Aboagye et al. from Ghana similarly reported falls as a leading mechanism among in-school adolescents.[12] The discrepancy across settings reflects differences in road traffic density, urban planning, degree of pedestrian segregation and the age group studied. Children in densely trafficked South Asian cities tend to be at higher risk of road traffic injuries than children of comparable age in other settings, as depicted by data from a Peshawar vocational-school youth survey.[13]

For analysis, mechanisms were grouped into traumatic (road traffic accidents, falls and animal bites) and non-traumatic (drowning, poisoning and suffocation) categories. Male children sustained significantly more traumatic injuries than females ($p = 0.019$), a mechanism shown by Satapathy et al., who observed that under-five boys experience domestic injuries more frequently than girls at an Indian urban health training centre.[14] Lack of supervision in male children at the time of injury ($p = 0.021$) is consistent with Salam et al., who reported that primary caregivers of lower socio-economic status, lower educational attainment and larger family size scored significantly lower on injury-prevention knowledge, attitudes and practices in a Karachi-based study,[15] inadequate preventive practice translates, in operational terms, to reduced supervision.

In our study, most injuries occurred during daytime hours (65.8%) and while the child was playing. Banerjee et al. used a case-crossover design in Delhi and found that being engaged in activities other than the child's usual routine typically active play was significantly associated with injury occurrence.[16] Daytime peaks coincide with the

Table 3: Association of demographic characteristics with place, caretaker and time of injury (n=389)

Attributes	Place of injury		Caretaker at time of injury		Time of injury	
	Inside home	Outside home	Family member	House help	Daytime	Evening/Night
Age						
Pre-school (0–5 year)	120 (63.2)	70 (36.8)	188 (98.9)	2 (1.1)	124 (65.3)	66 (34.7)
School-going (6–12 year)	78 (39.2)	121 (60.8)	194 (97.5)	5 (2.5)	132 (66.3)	67 (33.7)
p-value	<0.001*		0.279		0.824	
Gender						
Male	117 (47.2)	131 (52.8)	244 (98.4)	4 (1.6)	162 (65.3)	86 (34.7)
Female	81 (57.4)	60 (42.6)	138 (97.9)	3 (2.1)	94 (66.7)	47 (33.3)
p-value	0.050*		0.714		0.788	
Birth order						
1–3	163 (52.8)	146 (47.2)	302 (97.7)	7 (2.3)	211 (68.3)	98 (31.7)
≥4	35 (43.8)	45 (56.3)	80 (100.0)	0 (0.0)	45 (56.3)	35 (43.8)
p-value	0.151		0.174		0.043*	

*Significant (Chi-square test p ≤ 0.05)

Table 4: Association of demographic characteristics with supervision and mechanism of injury (n=389).

Attributes	Supervision at time of injury		Mechanism of injury	
	Yes	No	Traumatic	Non-traumatic
Age				
Pre-school (0–5 y)	86 (45.3)	104 (54.7)	177 (89.9)	20 (10.1)
School-going (6–12 y)	80 (40.2)	119 (59.8)	186 (96.8)	6 (3.2)
p-value	0.313		0.010*	
Gender				
Male	95 (38.3)	153 (61.7)	237 (95.6)	11 (4.4)
Female	71 (50.4)	70 (49.6)	126 (89.4)	15 (10.6)
p-value	0.021*		0.019*	
Birth order				
1–3	127 (41.1)	182 (58.9)	284 (91.9)	25 (8.1)
≥4	39 (48.8)	41 (51.2)	79 (98.8)	1 (1.3)
p-value	0.218		0.029*	

*Significant (Chi-square test p ≤ 0.05)

period of maximum outdoor activity for this age group, and Jin et al. observed a similar pattern of unsupervised daytime injury among left-behind children in mainland China.[17] In our study, 81.5% of children arrived at the emergency department fully conscious and 76% were discharged after emergency procedures, while only 3.1% required intensive-care admission. Gong et al. similarly reported that preschool children accounted for the majority of unintentional-injury attendances and that most were discharged after emergency-department care in a multicentre Chinese paediatric cohort.[18] These data suggest that, although childhood unintentional injuries are common, most are amenable to outpatient management provided that timely and adequate emergency care is available.

Socio-economic class and parental education did not show statistically significant associations with the determinants of injury in our study, a finding at variance with the systematic review by Mahboob et al., which identified lower family income and parental education as factors associated with childhood unintentional injury across multiple settings.[19] Al-Hajj and colleagues from Lebanon also reported that mothers' knowledge, attitudes and practices toward childhood injury prevention varied with socio-demographic characteristics.[20] This is explained by the relatively homogeneous catchment population of AIMTH, which serves predominantly lower- and middle-class families and therefore offers limited contrast between strata. Larger multicentre work along the lines of the Indian Council of Medical Research taskforce study[21] will be needed to confirm or refute this observation in the Pakistani context.

In terms of anatomical pattern, almost two-thirds of our study children sustained injuries to the trunk and extremities and just over one-third to the craniofacial region, while soft-tissue injuries outnumbered bony injuries by roughly two to one. This anatomical and tissue-level profile is broadly consistent with global estimates compiled in the Indian systematic review by Kumar et al., which list head injuries, limb fractures and superficial soft-tissue wounds as the dominant clinical patterns in childhood unintentional injury.[3] It also accords with the severity grading reported by Nasr et al. from Lahore, where the majority of paediatric injury attendances were

minor or moderate predominantly bruises, lacerations and short-stay observations rather than severe head trauma.[6] Hospital-series data from Karachi paediatric surgery and from the multicentre Chinese emergency-department cohort have similarly described extremity-dominant, soft-tissue-predominant injury profiles in children seen acutely, while the urban-India under-five study by Satapathy et al. observed that head injuries become more prominent in the very youngest age group.[10,14,18] Taken together, the predominance of trunk-and-extremity soft-tissue injuries in our study fits the broader regional pattern and supports the view that, although the volume of childhood unintentional injuries is high, the clinical mix presenting to emergency departments is largely amenable to first-line management without prolonged inpatient care.

The wide paediatric age range covered (0–12 years) and the inclusion of both intra- and extra-domestic injuries strengthen the internal validity of the findings. The principal limitations are the single-centre design and the use of non-probability purposive sampling, which restrict generalisability. The cross-sectional design also precludes causal inference.

CONCLUSION

Road traffic accidents and falls accounted for the majority of unintentional injuries in children presenting to AIMTH, Sialkot, with male gender, daytime hours and inadequate supervision emerging as the dominant determinants. Trunk and extremities were the predominant anatomical site of injury involving mainly soft tissues as pattern of unintentional injuries. To curtail this preventable burden, district-level parental education programmes on home and traffic safety, supervised outdoor play, strict enforcement of road safety legislation around schools and residential areas, and the establishment of a community-based injury surveillance system are recommended.

Author Contributions

RM: Conception and design, analysis and interpretation of data, drafting the article, critical revision for important intellectual content, final approval.
TI: Conception and design, analysis and interpretation of data.
IM: Analysis and interpretation of data, drafting the article.
AK: Acquisition of data, conception and design, analysis and interpretation.
FL: Analysis and interpretation of data, proofreading.

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