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Epidemiology and clinical outcomes of unintentional injuries among children in Central India

Rishika Raghuwanshi[1], Akanksha Tomar[2], Meena Gautam[2], Rajesh Tiwari[2], Vaishali Soni[3], Narayan Raghuwanshi[4] & Abhishek Singh[5,*]

[1]Department of Community Medicine, Atal Bihari Vajpayee Government Medical College, Vidisha, Madhya Pradesh, India; [2]Department of Community Medicine, Netaji Subhash Chandra Bose Medical College, Jabalpur, Madhya Pradesh, India; [3]Department of Community Medicine, Bundelkhand Medical College, Sagar, Madhya Pradesh, India; [4]Department of Community Medicine, Atal Bihari Vajpayee Government Medical College, Vidisha, Madhya Pradesh, India; [5]Department of Community Medicine, Shaheed Hasan Khan Mewati Government Medical College, Nuh, Haryana, India; *Corresponding author

Affiliation URL:
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https://gmcmewat.ac.in/

Author contact:
Rishika Raghuwanshi - E-mail: rishikaraghuwanshi060397@gmail.com
Akanksha Tomar - E-mail: akankshatomar6@gmail.com
Meena Gautam - E-mail: gautammeenu50@gmail.com
Rajesh Tiwari - E-mail: tiwaridrrajesh@yahoo.co.in
Vaishali Soni - E-mail: vaishalisoni737@gmail.com
Narayan Raghuwanshi - E-mail: tejraghuwannmc@gmail.com
Abhishek Singh - E-mail: drabhisheksingh@gmcmewat.ac.in

Abstract:
Unintentional injuries are a leading cause of childhood morbidity and mortality. Therefore, it is of interest to examine the associations between key sociodemographic and environmental factors and major types of unintentional injuries and clinical outcomes among paediatric inpatients. This study was conducted among 306 children aged 0–14 years admitted with unintentional injuries to a tertiary care hospital in central India between September 2023 and August 2024. Among the major injury categories (n=277), injury patterns differed significantly by age (χ^2=16.27, P=0.006), sex (χ^2=33.34, P<0.001) and residence (χ^2=17.75, P=0.003). Children aged ≤5 years were more likely to sustain falls, burns and poisoning, whereas road traffic accidents and animal-related injuries predominated among those aged >5 years. Thus, data shows the need for age- and context-specific injury prevention strategies, including improved home safety and supervision for younger children and targeted interventions to reduce rural hazards such as animal-related injuries and poisoning.

Keywords: Child, injuries, unintentional, paediatric trauma, risk factors, rural population

Background:
Unintentional injuries are a major cause of morbidity and mortality among children particularly in low and middle-income countries (LMICs) **[1]**. Within this age group, transport injuries, drowning, falls, burns and poisoning remain leading causes of injury-related death and disability despite overall declines in mortality since 1990 **[2]**. Comparatively fewer studies have examined how socio-demographic and environmental characteristics relate to specific injury mechanisms and outcomes among children requiring hospital admission **[3]**. Evidence consistently shows that injury risk is not randomly distributed but varies by age, gender, socioeconomic status, family structure and residential environment **[4]**. Indian community-based studies have reported higher prevalence of unintentional injuries among under-five children, boys, children of working mothers, those living in overcrowded or hazardous housing and those residing in rural areas or urban slums **[5]**. Therefore, it is of interest to assess the associations between age, sex and area of residence with major categories of unintentional injuries and clinical outcomes among children aged 0–14 years.

Materials and Methods:
This cross-sectional study was conducted among children admitted with unintentional injuries to Netaji Subhash Chandra Bose Medical College and Hospital located in central India. All children aged 0–14 year admitted with unintentional injuries between September 1, 2023 and August 31, 2024 formed the sampling frame. Children leaving against medical advice and those with intentional injuries (self- harm, assault, suspected abuse) were also excluded. Twenty cases in every month of the data collection period were collected. Finally 306 children were included in the study. The casualty register was reviewed on three alternate days each week to identify children admitted due to unintentional injuries. The register contained information on the children, their type of injury and the department to which they were referred (Ophthalmology, Neurosurgery, Paediatrics, ENT and Orthopaedics). Following identification in the casualty register, the injured children were tracked to their respective admitting departments. This ensured comprehensive data collection from the relevant patient population. Data was collected using a pre-tested, self-structured questionnaire administered through face-to-face interviews with the primary caregivers of the injured children. Additionally, a physical examination of the child was conducted to gather further information on the nature and extent of their injuries. This systematic approach allowed for the collection of detailed information regarding the circumstances, nature and consequences of unintentional injuries in this paediatric population within the specified hospital setting. Ethical approval for the overall study was obtained from the Institutional Ethics Committee of NSCB Medical College, Jabalpur (approval number IEC/2023/7335-93 dated 18/08/2023). Written informed consent was taken from parents or primary caregivers, with assent from older children as appropriate.

Results:
The overall study sample comprised 306 children. However, tables examining associations between socio-demographic variables and specific injury mechanisms were restricted to the six principal injury categories, resulting in an analytic subset of

277 cases; the remaining records were classified as other mechanisms or had incomplete coding for the relevant variable. Among the 306 children, 31 (10.1%) were infants (1 month–1 yr), 120 (39.2%) were aged 1–5 yr, 65 (21.2%) were 6–10 yr and 90 (29.4%) were 11–14 yr. Thus 151 (49.3%) injuries occurred in children ≤5 yr and 155 (50.7%) in those >5 yr. Boys accounted for 166 (54.2%) cases and girls for 140 (45.8%). A total of 209 (68.3%) children resided in rural areas and 97 (31.7%) in urban areas. Among children aged ≤5 years, falls and road traffic injuries were equally common (28 (20.7%) each), followed by burns (27 (20.0%)) and poisoning (22 (16.3%)). In children aged >5 years, animal-related injuries (45 (31.7%)) and road traffic injuries (42 (29.6%)) predominated. The association between age group and injury type was statistically significant ($\chi^2 = 16.27$, df = 5, P = 0.006). Among boys, road traffic injuries (51 (33.8%)) and burns (32 (21.2%)) were more frequent, whereas among girls, animal-related injuries (40 (31.7%)) and poisoning (26 (20.6%)) were more common. The association between sex and injury type was also statistically significant ($\chi^2 = 33.34$, df = 5, $P < 0.001$) (**Table 1**). The distribution of major injury types differed significantly by area of residence. Rural children had a markedly higher proportion of animal-related injuries (55 (79.7%)) and poisoning (29 (90.6%)), whereas burns were relatively more frequent among urban children (22 (45.8%)) compared with other injury categories. RTAs also occurred more often among rural children (45 (64.3%)) than urban children (25 (35.7%)) (**Table 2**). Most injuries were classified as major rather than severe. Severe injury was most common in road traffic injuries, where 14 of 44 cases (31.8%) were severe, compared with much lower proportions for burns (2 (6.9%)), falls (1 (2.7%)) and animal-related injuries (1 (1.6%)). All poisoning and drowning cases in this subset were categorised as major injuries (**Table 3**). Most children were discharged in stable condition across all injury categories. The highest mortality proportions were seen in drowning (2/9, 22.2%), animal-related injuries (14/69, 20.3%) and road traffic injuries (12/68, 17.6%). Disability at discharge was most frequent after burns (5 (10.9%)) and road traffic injuries (7 (10.3%)) (**Table 4**).

Table 1: Distribution of major injury types by age and sex (n = 277)

Variable	Category	Road traffic n (%)	Animal-related n (%)	Fall n (%)	Burn n (%)	Poisoning n (%)	Drowning n (%)	Test of significance
Age group	≤5 yr	28 (20.7)	24 (17.8)	28 (20.7)	27 (20.0)	22 (16.3)	6 (4.4)	χ^2=16.27,
	>5 yr	42 (29.6)	45 (31.7)	21 (14.8)	21 (14.8)	10 (7.0)	3 (2.1)	df = 5, P = 0.006
Sex	Male	51 (33.8)	29 (19.2)	28 (18.5)	32 (21.2)	6 (4.0)	5 (3.3)	χ^2= 33.34,
	Female	19 (15.1)	40 (31.7)	21 (16.7)	16 (12.7)	26 (20.6)	4 (3.2)	df = 5, P < 0.001

Table 2: Distribution of major injury types by area of residence (n = 277)

Injury type	Urban n (%)	Rural n (%)	Total n
Road traffic	25 (35.7)	45 (64.3)	70
Animal-related	14 (20.3)	55 (79.7)	69
Fall	19 (38.8)	30 (61.2)	49
Burn	22 (45.8)	26 (54.2)	48
Poisoning	3 (9.4)	29 (90.6)	32
Drowning	3 (33.3)	6 (66.7)	9
Total	86	191	277

Table 3: Severity of major injury types (n = subset with severity recorded)

Injury type	Major n (%)	Severe n (%)	Total n
Road traffic	30 (68.2)	14 (31.8)	44
Animal-related	61 (98.4)	1 (1.6)	62
Fall	36 (97.3)	1 (2.7)	37
Burn	27 (93.1)	2 (6.9)	29
Poisoning	31 (100.0)	0 (0.0)	31
Drowning	9 (100.0)	0 (0.0)	9

Table 4: Outcome at discharge by major injury type (n = subset with outcome recorded)

Injury type	Discharged stable n (%)	Discharged with disability n (%)	Death n (%)	Total n
Road traffic	49 (72.1)	7 (10.3)	12 (17.6)	68
Animal-related	54 (78.3)	1 (1.4)	14 (20.3)	69
Fall	46 (93.9)	2 (4.1)	1 (2.0)	49
Burn	36 (78.3)	5 (10.9)	5 (10.9)	46
Poisoning	30 (93.8)	0 (0.0)	2 (6.2)	32
Drowning	7 (77.8)	0 (0.0)	2 (22.2)	9

Discussion:

Findings of our study show clear heterogeneity in injury mechanisms across demographic groups, with statistically significant associations for age group, sex and residence. These findings support the view that childhood injuries are strongly shaped by developmental stage, gendered activity patterns and living environment rather than occurring randomly **[6, 7]**. Among children aged ≤5 years, falls (20.7%), road traffic injuries (20.7%), burns (20.0%) and poisoning (16.3%) constituted the major injury burden, whereas among children >5 years, animal-related injuries (31.7%) and road traffic injuries (29.6%) predominated. Younger children are especially vulnerable to domestic injuries because of immature motor coordination, exploratory behaviour, inability to recognise hazards and constant dependence on caregiver supervision **[8]**. In contrast, older children have greater mobility and more outdoor exposure, which may explain their higher involvement in road traffic and animal-related events **[9]**. The sex pattern was also marked. Boys had higher proportions of road traffic injuries (33.8%) and burns (21.2%), while girls had higher proportions of animal-related injuries (31.7%) and poisoning (20.6%). The excess of road traffic injuries among boys is in line with previous Indian and international studies showing that boys are more likely to engage in outdoor activities, unsupervised travel and risk-taking behaviour **[10]**. The comparatively high proportion of poisoning among girls in this hospital cohort may reflect gender-linked domestic exposure patterns, including time spent in household environments where fuels, medications and toxic agents are accessible. While this explanation remains inferential, the finding is sufficiently strong to justify targeted preventive messaging for safe storage of hazardous household substances irrespective of child sex. Outcome patterns provide additional

insight into injury burden beyond occurrence alone. Although most children were discharged in stable condition, mortality was highest for drowning (2/9, 22.2%), animal-related injuries (14/69, 20.3%) and road traffic injuries (12/68, 17.6%). Burns also had considerable adverse outcome burden, with 5 deaths (10.9%) and 5 children discharged with disability (10.9%). Another study reported that burn-related injuries were more common among children aged 1–4 years. Children under four years of age spend most of their time in the home environment and are frequently placed on the ground or floor, where they can easily access hazardous objects such as hot liquids, cooking utensils, electrical appliances and open flames, thereby increasing their risk of burn injuries **[11]**. These findings suggest that animal-related injuries and RTAs are not only common in this setting but also disproportionately severe in terms of fatality, while burns contribute meaningfully to both mortality and disability. Similar trends have been described in paediatric trauma and snakebite literature from India and other LMIC settings, where delays in referral, limitations in pre-hospital care and restricted access to definitive treatment worsen prognosis **[12, 13]**. From a public health perspective, for younger children, the data argue for prioritising safer home environments, better caregiver supervision, stair and rooftop protection, burn prevention in cooking areas and secure storage of medicines and toxic substances. For older children, especially boys, road safety measures such as safer pedestrian environments, helmet use, traffic calming and school-based road safety education are likely to yield benefit **[14]**. For rural communities, targeted interventions to reduce snakebite and other animal-related injuries, along with improved storage of pesticides and fuels, should be central to child injury prevention planning **[15]**.

Conclusion:

Younger age (≤5 years), male sex and rural residence were the major determinants of unintentional injury patterns and outcomes among children. The marked disparities observed across age, sex and place of residence highlight the need for targeted, equity-focused injury prevention strategies that strengthen household safety, supervision, safer road environments and mitigation of rural hazards to reduce the preventable burden of childhood injuries in Central India.

Declaration of conflicting interest:
None

Declaration on publication ethics:

The author's state that they adhere with COPE guidelines on publishing ethics as described elsewhere at https://publicationethics.org/. The authors also undertake that they are not associated with any other third party (governmental or non-governmental agencies) linking with any form of unethical issues connecting to this publication. The authors also declare that they are not withholding any information that is misleading to the publisher in regard to this article.

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