Epidemiology of paediatric injuries in Nepal: evidence from emergency department injury surveillance

Dan Magnus,1 Santosh Bhatta,2 Julie Mytton,2 Elisha Joshi,3 Sumiksha Bhatta,3 Sunil Manandhar,4 Sunil Joshi3

ABSTRACT

Background Globally, injuries cause >5 million deaths annually and children and young people are particularly vulnerable. Injuries are the leading cause of death in people aged 5–24 years and a leading cause of disability. In most low-income and middle-income countries where the majority of global child injury burden occurs, systems for routinely collecting injury data are limited.

Methods A new model of injury surveillance for use in emergency departments in Nepal was designed and piloted. Data from patients presenting with injuries were collected prospectively over 12 months and used to describe the epidemiology of paediatric injury presentations.

Results The total number of children <18 years of age presenting with injury was 2696, representing 27% of all patients presenting with injuries enrolled. Most injuries in children presenting to the emergency departments in this study were unintentional and over half of children were <10 years of age. Falls, animal bites/stings and road traffic injuries accounted for nearly 75% of all injuries with poisonings, burns and drownings presenting proportionately less often. Over half of injuries were cuts, bites and open wounds. In-hospital child mortality from injury was 1%.

Conclusion Injuries affecting children in Nepal represent a significant burden. The data on injuries observed from falls, road traffic injuries and injuries related to animals suggest potential areas for injury prevention. This is the biggest prospective injury surveillance study in Nepal in recent years and supports the case for using injury surveillance to monitor child morbidity and mortality through improved data.

BACKGROUND

Globally, injuries cause >5 million deaths annually—a similar number to those from HIV/AIDS, tuberculosis and malaria combined.1 Children and young people are a particularly vulnerable group and injuries are the leading cause of death in people aged 5–24 years globally,2 3 and of disability for people aged 5–44 years.4

The majority of global child mortality and morbidity from injuries occurs in low-income and middle-income countries (LMICs).4 5 Paediatric trauma has been highlighted as a global health priority, yet challenges exist to identify injured children in LMICs and conflict settings,6 resulting in calls for better data and for injury surveillance.7 Reliable estimates of injury burden in Nepal are limited.8 In 2017, injuries were estimated to account for nearly 10% of all deaths in Nepal, with transport injuries, falls, drowning, animal related, burn, self-harm and interpersonal violence as the leading causes.9 Children living in Nepal face significant health challenges, with an under-5 mortality of 39 per 1000 live births.10

The quality of data relating to childhood and adult injury is inversely correlated to where the greatest problems exist. Existing data on trauma in most LMICs remain poor, with LMIC injury data constituting around 1% of all data. The use of injury surveillance systems has been proposed as a way to improve this.11 The collection and use of data on risk factors, incidence, severity, outcomes and costs can assist in identifying populations at risk, implementing and evaluating prevention programmes and formulating and evaluating policy.12 This study was designed to inform injury prevention activities and policy development and is focused on surveillance and data collection tools to describe the epidemiology of childhood injury.

METHODS

Objectives of this mixed methods study were (i) to design an injury surveillance tool and data
collection process; (ii) prospective collection of data on injuries presenting to two hospital emergency departments over 12 months; (iii) process evaluation to explore the barriers and facilitators to sustainability (reported separately). The published study protocol describes data collector recruitment and training, data tool testing and quality assurance. This paper reports injury cases presenting in children under the age of 18 years. The data on adult patients are reported separately.

The Makwanpur district of Nepal has an estimated population of 420,477, including 174,417 children aged 0–17 years inclusive (50.2% male). Most of the population live in rural areas (83%). Both study hospitals are in Hetauda, a sub-metropolitan city approximately 120 km southeast of Kathmandu. Both are secondary care hospitals and have the facilities to provide treatment for major and minor trauma. Most local injury cases attend these hospitals because of the long distances to other tertiary care hospitals and poor transportation systems. Hetauda hospital is a government-funded district hospital with 110 beds serving about 300 emergency and outpatient attendances per day. There are 19 doctors and 47 nursing and paramedic staff. Chure Hill Hospital is a private hospital with 25 beds serving about 60 emergency and outpatient attendances per day. There are 12 doctors and 65 nursing and paramedic staff (source: verbal inquiry with the hospital management authority).

For inclusion in the surveillance study, patients met the following criteria: presenting to either of the two study hospitals, with a new injury, of any cause, within 7 days of the injury event. Exclusion criteria were: repeated attendance in the same department for the same injury; previous attendance in other study site for the same injury; or injury sustained >7 days prior to presentation. Data were collected from patients presenting with injuries between 1 April 2019 and 24 March 2020 inclusive (data collection ended 1 week earlier than scheduled because of the COVID-19 pandemic). A standardised data collection form was developed from existing tools and adapted for the Nepalese context. Once urgent clinical care had been given, data collectors approached the patient (or carer, where necessary and appropriate) for consent to participate. Verbal consent was recorded on tablet computers together with anonymised patient data on sociodemographics, date of injury, mechanism of injury, clinical presentation, diagnosis, severity of injury and disposition. Data collectors were trained how to categorise the diagnosis based on information collected from patients/carers, thereby reducing the risk of misclassification. The level of injury severity was agreed by the data collector in conjunction with the clinical staff and was classified depending on the level of skilled emergency care required. Data were entered electronically using Research Electronic Data Capture software, where they were encrypted and uploaded to a secure online database. The final non-identifiable dataset was exported for analysis using SPSS.

For data analysis, frequency data were explored by age, sex, ethnic group, setting of injury event, type and mechanism of injury and disposition. Rates of injuries by age and sex were calculated using Makwanpur population estimates from the 2011 census. Associations between injury severity, sex and age group were explored using χ² analysis, and two age groups (<15 years and 15–17 years) to compare injury severity in younger children with young adults.

RESULTS
The total number of patients that presented to the emergency departments during the study period was 33,046, of which 10,154 (30.7%) were patients of any age with injuries who were eligible for inclusion and consented. For the nested study reported here relating to children with injuries, 2696 (26.6%) were patients under the age of 18 years, with 2274 (84.3%) presenting to Hetauda hospital and 422 (15.7%) to Chure Hill hospital (figure 1).

Most children presenting with injuries to the emergency departments were male (66%) and <10 years of age (56.3%). Sociodemographic and injury characteristics are shown in table 1.

Where did childhood injuries occur?
The most common location for childhood injury in this study was at home (n=1576, 58%) followed by the highway/road (n=636, 24%), together accounting for 82% of all injuries. While the majority of injuries sustained on the road/highway were due to road traffic (386/636, 61%), 160/636 children (25%) were injured by animal bites/stings and 90/636 (14%) by falls.

What were children doing when they were injured?
The most common activity at the time of the injury occurrence was ‘leisure/play’ (70.1%), followed by ‘travelling’ (11%) and ‘work’ (7.5%). Most children injured during ‘work’ were aged 15–17 years, but it is noteworthy that 45% of children injured while working were aged 5–14 years.

What do the data tell us about injury mechanisms in children?
Falls (35.6%), animal bites and stings (28.4%) and road traffic injuries (13.9%) accounted for nearly 75% of all child injuries presenting to emergency departments in this study. A large majority of animal-related injuries were from dog bites accounting for 555/728 (76%) of these injuries, followed by injuries from cats (5%), scorpions (5%) and snakes (4%). Animal bites mostly affected children aged 5–9 years (36% of all bite injuries). Some injury mechanisms were notably infrequent—drowning (0.3%); unintentional poisonings (2.0%); burns and scalds (2.0%).
What types of injury did children sustain?
The majority of injuries (51.1%) presenting to emergency departments were cuts, bites and open wounds, followed by bruises/superficial injuries (14.2%), fractures (11.1%), sprains/dislocations (9.0%), head injury/concussion (3.1%) and burns (2.5%).

Was there much self-harm and what kind?
Self-harm presentations accounted for 2.2% (n=61) of all child injury attendances in this study. Self-harm was the most common in females (72%) and mostly in children aged 15–17 years (75%). Over half (62.3%) of self-harm presentations were from poisonings/overdose followed by strangulation/hanging (20%). Intentional poisonings made up 43% of poisoning cases with pesticide and insecticide poisoning accounting for 38% of self-harm poisonings. There were no deaths from intentional poisonings.

What about violence and assault?
There were 75 assault-related injury presentations representing 2.8% of all child injury attendances.

Assault was the most common in males (79%) and in those aged 15–17 years (50.7%). The most common causes of assault injuries were ‘bodily force’ (57.3%); being injured by a blunt object (24%) or being stabbed/cut (10.7%). These three injury mechanisms together accounted for 92% of assault injuries. Alcohol was identified as a factor in 9% of injuries ensuing from violence and assault but other drugs were not implicated in cases.

Injury severity and disposition
In this study, 61% (n=1645) of injuries were recorded as ‘minor’ with ‘moderate’ severity injuries accounting for 30.2% (n=813) of injury presentations. Severe injuries accounted for 4.1% (n=111) of childhood injury presentations. Age and sex associations with injury severity are shown in table 3.

The in-hospital mortality for injured children in this study was around 1% (21 children). Ten of the 21 deaths (48%) were due to self-harm hanging/strangulation. Of the children that died, nine were 15–17 years of age (43%); six were aged 10–14 years (29%) and five were in the 0–4 age group (24%). The mechanisms of injury leading to death in children aged 0–4 years were road traffic injuries, choking/suffocation and drowning.

DISCUSSION
This study illustrated the feasibility of establishing injury surveillance in a government and private hospital in Nepal, and provides the largest prospective dataset published in recent years and the only one to yield so much data on the paediatric population.
Most childhood injuries in this study were falls, animal bites and stings and road traffic injuries and predominantly affected male children under the age of 10 years. This resembles systematic review findings relating to injury burden in Nepal which, though in all age groups, found that the leading types of injury were falls, road traffic injuries and cuts.10 The Nepal injury literature has previously shown that road traffic injuries are common in school aged children,23 and that falls were the most common presentation, predominantly in young adults.10 Our Nepal injury literature has previously shown that road traffic injuries are common in school aged children,23 and that falls were the most common cause of non-fatal injury in children.24 In contrast to the published literature which reported the importance of snake-bites in children,25 we found that dog bites were a more significant issue. Our data support a focus on these three mechanisms for childhood injury prevention.

Burn injuries are a leading cause of morbidity and mortality in Nepal,26 however, relatively few children with minor to moderate burns attend health facilities, with most receiving care at home.27 The relatively low proportion of childhood burns and scalds in this study is similar to that reported in the published literature which reported the importance of snake-bites in children,25 we found that dog bites were a more significant issue. Our data support a focus on these three mechanisms for childhood injury prevention.

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Table 2 Distribution of injuries by age group, sex and mechanism of injury among children attending emergency of hospitals in Makwanpur district, Nepal, April 2019–March 2020

<table>
<thead>
<tr>
<th>Age groups and sex</th>
<th>0–4 years</th>
<th>5–9 years</th>
<th>10–14 years</th>
<th>15–17 years</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Total (%)</th>
<th>Rate/1000 children*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unintentional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>239 (36.9)</td>
<td>328 (38.5)</td>
<td>249 (38.4)</td>
<td>96 (23.2)</td>
<td>636 (37.4)</td>
<td>276 (32.2)</td>
<td>912 (35.6)</td>
<td>5.2</td>
</tr>
<tr>
<td>Animal or insect related</td>
<td>175 (27.0)</td>
<td>260 (30.5)</td>
<td>190 (29.3)</td>
<td>103 (24.9)</td>
<td>470 (27.6)</td>
<td>258 (30.1)</td>
<td>728 (28.4)</td>
<td>4.2</td>
</tr>
<tr>
<td>Road traffic injury</td>
<td>49 (7.6)</td>
<td>108 (12.7)</td>
<td>86 (13.3)</td>
<td>113 (27.4)</td>
<td>223 (13.1)</td>
<td>133 (15.5)</td>
<td>356 (13.9)</td>
<td>2.0</td>
</tr>
<tr>
<td>Injured by a blunt object</td>
<td>54 (8.3)</td>
<td>74 (8.7)</td>
<td>49 (7.6)</td>
<td>24 (5.8)</td>
<td>150 (8.8)</td>
<td>51 (5.9)</td>
<td>201 (7.9)</td>
<td>1.2</td>
</tr>
<tr>
<td>Stabbed, cut or pierced</td>
<td>20 (3.1)</td>
<td>56 (6.6)</td>
<td>49 (7.6)</td>
<td>51 (12.3)</td>
<td>127 (7.5)</td>
<td>49 (5.7)</td>
<td>176 (6.9)</td>
<td>1.0</td>
</tr>
<tr>
<td>Fire, burn or scald</td>
<td>42 (6.5)</td>
<td>10 (1.2)</td>
<td>9 (1.4)</td>
<td>4 (1.0)</td>
<td>27 (1.6)</td>
<td>38 (4.4)</td>
<td>65 (2.5)</td>
<td>0.4</td>
</tr>
<tr>
<td>Poisoning</td>
<td>33 (5.1)</td>
<td>6 (0.7)</td>
<td>5 (0.8)</td>
<td>8 (1.9)</td>
<td>26 (1.5)</td>
<td>26 (3.0)</td>
<td>52 (2.0)</td>
<td>0.3</td>
</tr>
<tr>
<td>Suffocation/Choking</td>
<td>24 (3.7)</td>
<td>5 (0.6)</td>
<td>2 (0.3)</td>
<td>5 (1.2)</td>
<td>20 (1.2)</td>
<td>16 (1.9)</td>
<td>36 (1.4)</td>
<td>0.2</td>
</tr>
<tr>
<td>Electrocution</td>
<td>2 (0.3)</td>
<td>0 (0.0)</td>
<td>3 (0.5)</td>
<td>7 (1.7)</td>
<td>10 (0.6)</td>
<td>2 (0.2)</td>
<td>12 (0.5)</td>
<td>0.1</td>
</tr>
<tr>
<td>Other</td>
<td>9 (9.5)</td>
<td>5 (0.6)</td>
<td>6 (1.0)</td>
<td>2 (0.5)</td>
<td>13 (0.8)</td>
<td>9 (0.1)</td>
<td>22 (0.9)</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>647 (100)</td>
<td>852 (100)</td>
<td>648 (100)</td>
<td>413 (100)</td>
<td>1702 (100)</td>
<td>858 (100)</td>
<td>2560 (100)</td>
<td>14.7</td>
</tr>
<tr>
<td>Self-harm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poisoning</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>6 (6.2)</td>
<td>32 (69.6)</td>
<td>7 (41.2)</td>
<td>31 (70.5)</td>
<td>38 (62.3)</td>
<td>0.2</td>
</tr>
<tr>
<td>Hanging</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>3 (23.1)</td>
<td>9 (19.6)</td>
<td>4 (23.5)</td>
<td>8 (18.2)</td>
<td>12 (19.7)</td>
<td>0.1</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0.0)</td>
<td>2 (0.1)</td>
<td>4 (30.8)</td>
<td>5 (10.9)</td>
<td>6 (35.3)</td>
<td>5 (11.4)</td>
<td>11 (18.0)</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>0 (0.0)</td>
<td>2 (0.1)</td>
<td>13 (100)</td>
<td>46 (100)</td>
<td>17 (100)</td>
<td>44 (100)</td>
<td>61 (100)</td>
<td>0.3</td>
</tr>
<tr>
<td>Assault</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bodily force (physical violence)</td>
<td>3 (50.0)</td>
<td>1 (8.3)</td>
<td>11 (57.9)</td>
<td>28 (73.7)</td>
<td>37 (62.7)</td>
<td>6 (37.5)</td>
<td>43 (57.3)</td>
<td>0.2</td>
</tr>
<tr>
<td>Injured by a blunt object</td>
<td>2 (33.3)</td>
<td>8 (66.7)</td>
<td>4 (21.1)</td>
<td>4 (10.5)</td>
<td>13 (22.0)</td>
<td>5 (31.3)</td>
<td>18 (24.0)</td>
<td>0.1</td>
</tr>
<tr>
<td>Other</td>
<td>1 (16.7)</td>
<td>3 (24.9)</td>
<td>4 (21.1)</td>
<td>6 (15.7)</td>
<td>9 (15.3)</td>
<td>5 (31.5)</td>
<td>14 (18.7)</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>6 (100)</td>
<td>12 (100)</td>
<td>19 (100)</td>
<td>38 (100)</td>
<td>59 (100)</td>
<td>16 (100)</td>
<td>75 (100)</td>
<td>0.4</td>
</tr>
</tbody>
</table>

*Rates calculated using population estimates for Makwanpur from the 2011 census.

| Table 3 Association between injury severity and (i) sex; (ii) age group among children attending emergency of hospitals in Makwanpur district, Nepal, April 2019–March 2020

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Minor/Moderate n (%)</th>
<th>Severe n (%)</th>
<th>Total n (%)</th>
<th>$\chi^2$ (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1716 (66%)</td>
<td>60 (54%)</td>
<td>1776 (100)</td>
<td>7.261 (0.007)</td>
</tr>
<tr>
<td>Female</td>
<td>867 (24%)</td>
<td>51 (46%)</td>
<td>918 (100)</td>
<td>0.559 (1.000)</td>
</tr>
<tr>
<td>Total</td>
<td>2583 (100)</td>
<td>111 (100)</td>
<td>2694 (100)</td>
<td></td>
</tr>
<tr>
<td>&lt;15 years</td>
<td>2128 (82%)</td>
<td>69 (62%)</td>
<td>2197 (100)</td>
<td>28.93 (&lt;0.001)</td>
</tr>
<tr>
<td>15–17 years</td>
<td>455 (18%)</td>
<td>42 (38%)</td>
<td>497 (100)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2583 (100)</td>
<td>111 (100)</td>
<td>2694 (100)</td>
<td></td>
</tr>
</tbody>
</table>
use of digital data tools and continuing support and feedback on the surveillance process. Data from injury surveillance can highlight opportunities for prevention and policy change. To support the development of evidence-based injury prevention and prehospital care in Nepal, the establishment of functioning hospital-based injury surveillance systems are an important approach.

CONCLUSION

This study confirms that injuries affecting children in Nepal represent a significant issue. The data observed on injuries from falls, road traffic injuries and injuries related to animals suggest potential areas for injury prevention. This is the biggest prospective injury surveillance study in Nepal in recent years and supports the case for using injury surveillance to monitor child morbidity and mortality through improved data.

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Contributors The study was conceived by JM, SaB, SKJ and DM. The study design, methods and data analysis plan were drafted by DM, SaB and JM and refined and implemented with SKJ, SM, Ei and SuB. SuB and SaB provided technical input for delivery of the study, data collection, analysis and quality assurance, with data collection supported by SM. DM drafted and finalised the manuscript. All authors contributed to drafts and approved the final manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

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Data availability statement Data are available on reasonable request. All data relevant to the study are included in the article or uploaded as supplementary information. All data relevant to the study are included in the article or are available on reasonable request.

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