

# Paediatric trauma aetiology, severity and outcome

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## ABSTRACT

**Background:** Paediatric injuries are a major cause of mortality and disability worldwide and account for a significant burden on countries like India with limited resources. There are very few studies from developing nations describing the outcome of paediatric trauma. **Methodology:** This retrospective study was done to assess the pattern and outcome of unintentional paediatric trauma in the paediatric population. The patients were categorised into four age groups of <1 year, 1-5 years, 6-10 years and 11-15 years. The data were compared regarding the mode of trauma, new injury severity score (NISS), type of injury and place of injury among different age groups. **Results:** A total of 1587 paediatric patients below 15 years of age presenting in the Emergency Department of CMC, Vellore were studied over a period of 1 year. Two-thirds were boys (1039: 66.6%). Fall on level ground (28.2%) and road traffic accidents (RTA) (26.5%) were the two most common modes of injury. A gradual change in the place of incident from home to the road with advancing age was noticed. The upper limb (30.8%) and the face (26.2%) were the most common parts of the body to be injured. One-third (35.8%) of the sustained serious injuries was a fracture or a dislocation. RTA (OR: 1.56; 95%CI: 1.08-2.26) and age  $\geq$  5 years (OR: 1.17; 95%CI: 1.08-1.26) were found to be independent predictors of severe injury (NISS >8). Only 15% required hospital admission. **Conclusion:** Fall on level ground and RTAs are the most common modes of injury in the paediatric population. The place of injury shows a gradual change from the confines of home to the open dangerous roads and playgrounds with increasing age with RTA and age  $\geq$  5 years being independent predictors of severe injury.

**Keywords:** Child injuries, paediatric trauma, trauma, unintentional trauma

## Introduction

Children constitute a major part of our community and they grow up to be the future. It is important to identify aetiology for paediatric trauma as we can improvise the community awareness of the same. A huge component of the trauma happens in our community which could be avoidable. Due to continuous efforts and researches in the trauma care, considerable reduction in child mortality and disability has occurred in the recent decennary. Most of the initiatives have focused on reducing the burden of trauma in adults. Even though many child counselling programmes are being

arranged by the government and non-government organisations, children are becoming victims of trauma on roads, playground, home or at school. Paediatric injuries are the major cause of mortality and disability worldwide and account for a significant burden on countries with limited resources like India. Road accident analysis done by Government of Tamil Nadu reveals trauma to be one of the leading causes of child mortality.<sup>[1]</sup> There are very few studies from India especially Tamil Nadu describing the pattern and outcome of paediatric trauma.<sup>[2,3]</sup> Children between 0 to 15 years contribute to one-third of the total population of India. The detailed analysis of pattern, outcome, mechanism of injury and so on of the paediatric unintentional trauma can give possible insight into its prevention and intervention at the initial level to decrease the mortality and disability.

This study is an attempt to describe the pattern of trauma, type of injuries and severity among the paediatric population. As trauma

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burden, pattern, mode of injury, site of injury and outcome varies from place to place and in different age groups and sex, it is essential to understand these characteristics to develop effective trauma prevention strategies. The aim of this study is to assess the pattern and outcome of unintentional paediatric trauma in the paediatric population.

## Materials and Methods

### Study design

This was a retrospective cohort study of paediatric patients presented with unintentional trauma in 2017.

### Setting

The study was conducted in the Emergency Department (ED) of Christian Medical College Hospital, Vellore, which is a large tertiary care hospital in south India. The ED is a 50-bed department and tends to about 300 patients per day including trauma and non-trauma patients.

### Participants

We recruited all paediatric patients under the age of 15, presenting with unintentional trauma to our ED during the study period. We reviewed a total of 1587 patient's charts over a period of 12 months (January 2017 to December 2017).

### Variables

The charts were reviewed and the relevant details of history, clinical findings, laboratory investigations and X-ray findings were documented in the study form. The management in ED, conservative, minor or major surgical was noted. The outcome of the patients from the ED with regards to admission discharged and leave against medical advice (LAMA) were documented.

### Outcome variable

Hospital admission and major surgical interventions required.

### Bias

This is a retrospective cohort study, and therefore we could not control exposure or outcome assessment, and instead relied on others for accurate record-keeping.

### Study size

All children under 15 years suffering from unintentional trauma in the study period (1 year) were recruited in the study to observe the seasonal pattern and outcome.

### Injury severity scoring

Injury severity was assessed using injury severity score (ISS) and the new injury severity score (NISS), which are internationally validated scoring systems used to determine the severity of injury where the score divides the body into 6 areas, and injuries in each areas are given scores between 0–6 with '6' being the most severe. A formula is then used to

calculate the composite NISS score. Higher values of NISS suggest more severe injury. (NISS  $\geq 8$  correlates with severe polytrauma)

### Statistical analysis

The analysis had done using statistical package for social sciences for Windows (SPSS Inc. Released 2015, version 23.0. Armonk, NY, USA). Factors for severity of injury (NISS  $> 8$ ) were determined by bivariate followed by multivariate logistic regression analysis and their 95% confidence intervals (CI) were calculated. For all tests a two-sided *P* value less than 0.05 was considered statistically significant.

### Ethical considerations

This study was approved by the institutional review board prior to the commencement of the study, (IRB Min no: 12222 dated 28<sup>th</sup> August 2019). Patient confidentiality was maintained using unique identifiers and by password-protected data entry software with restricted users.

## Results

During the total retrospective cohort analysis, 13604 trauma patients presented to our ED during the period of January 2017 to December 2018, among them 1587 paediatric patients presented with the history of unintentional trauma under the age of 15 years.

### Demographic profile

The age and gender distribution of trauma-related paediatric cases were assessed according to four different categories:  $< 1$  year, 1–5 years, 6–10 years and 11–15 years. Most of the paediatric trauma cases were seen in males 66.6%, ( $n = 1039$ ), the rest of the characteristics are described in Table 1. Fall on level ground (28.2%) and road traffic accidents (RTA) (26.5%)

Table 1: Baseline characteristics

Characteristics	Number (%)
Mean age in years (SD): 6.4 (4.2)	
Sex	Male 1039 (66.6)
Triage priority level	Priority 1 80 (5)
	Priority 2 574 (36.8)
	Priority 3 904 (58.2)
Age group	$< 1$ Year 46 (3)
	1-5 Years 727 (46.6)
	6-10 Years 445 (28.5)
	11-15 Years 330 (21.9)
Glasgow Coma Scale	13-15 (mild) 1501 (96.3)
	9-12 (moderate) 23 (1.4)
	$< 9$ (severe) 34 (2.3)
Place of Injury	Inside the house 796 (51)
	Road 427 (27.4)
	Playground/around the house 249 (16)
	School 69 (4.4)
	Others 17 (1.2)

were the two most common modes of injury. A gradual change in the place of the incident from the confines home to the open dangerous roads with advancing age was noticed [Figure 1]. On the comparison of different types of road traffic accidents with age group, it was revealed that 6–10 years comprised the most group involved in road traffic accidents, with motorcycle being the most common type of vehicle involved. Triage priority level and various types of injuries are shown in the STROBE diagram [Figure 2].

### Regions of body involved, and injuries sustained

We noticed that most of the priority 1 patients had suffered mild-to-moderate head injury, or crush injury to the extremities.

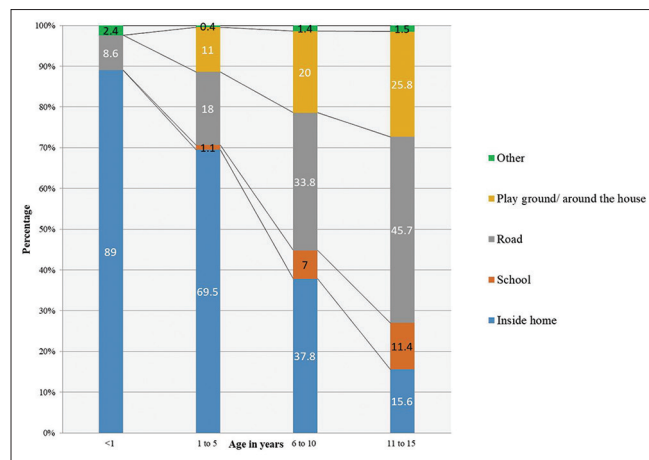


Figure 1: Age versus places of injury

Priority 2 patients comprised of patients with minor-to-major abrasion laceration most commonly on the upper limb and face. Among these 1587 patients, 180 of them had NISS score of more than or equal to 8 while majority (368) had a score of 0–7 [Table 2]. Injuries sustained were predominantly lacerations (40%) and fractures (33%) with joint dislocation in 2.8%, abrasion 14%, haematoma 12% and sprain in 4% being other injuries. Most of the injuries were sustained in the extremities (upper limb 30.8%, lower limb 17.5%), face (26.6%), scalp (13.7%), head (6.6%), thorax (3.6%), abdomen (2.6%), back (0.7%) and spine (0.2%). RTA (OR: 1.56; 95% CI: 1.08–2.26) and age  $\geq 5$  years (OR: 1.17; 95% CI: 1.08–1.26) were found to be independent predictors of severe injury (NISS >8) [Table 3].

Table 2: Comparison of ISS and NISS with age

Age	Score	ISS (%)	NISS (%)
<1 year	0-7	43 (93.4)	43 (93.4)
	8-13	1 (2)	1 (2)
	$\geq 14$	2 (4.6)	2 (4.6)
1-5 years	0-7	702 (96.5)	650 (89.4)
	8-13	19 (2.6)	68 (9.3)
	$\geq 14$	6 (0.9)	9 (1.3)
6-10 years	0-7	432 (97)	378 (85)
	8-13	7 (1.5)	58 (13)
	$\geq 14$	6 (1.5)	9 (2)
11-15 years	0-7	322 (97.4)	297 (90)
	8-13	4 (1.3)	29 (8.7)
	$\geq 14$	4 (1.3)	4 (1.3)

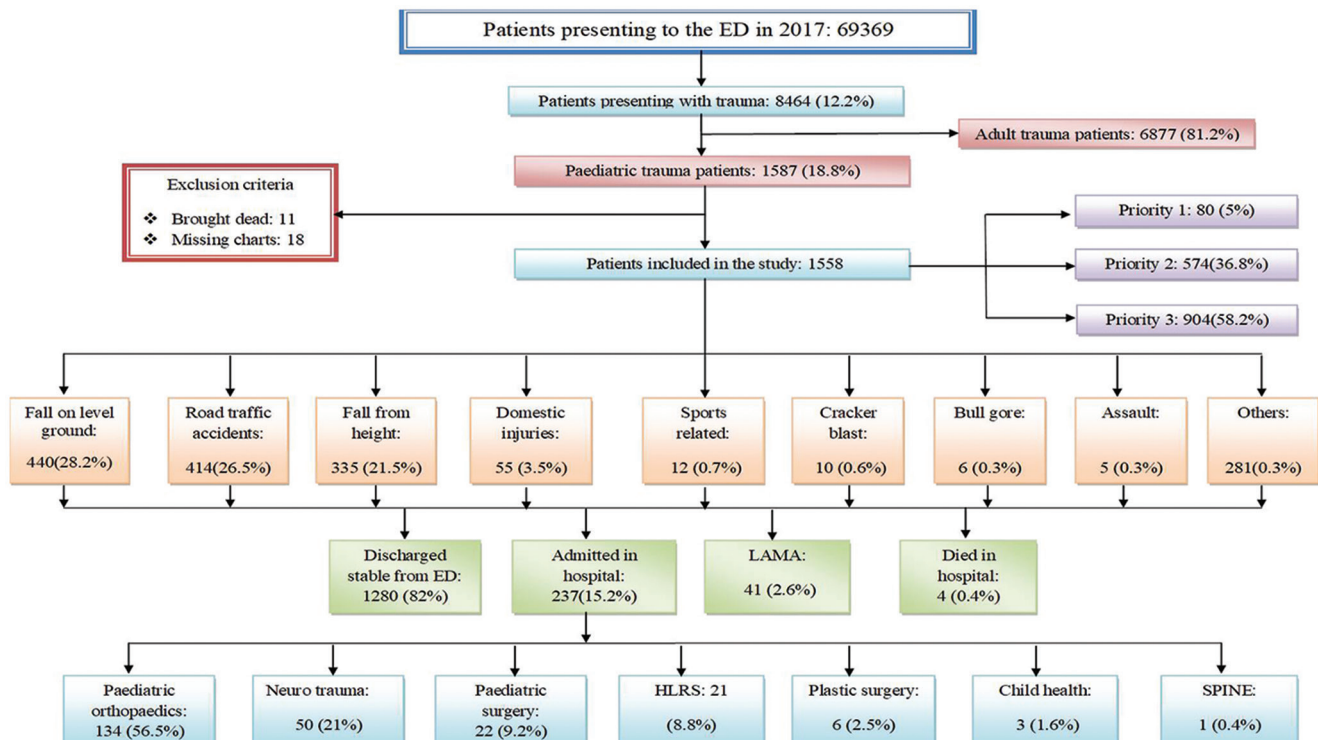
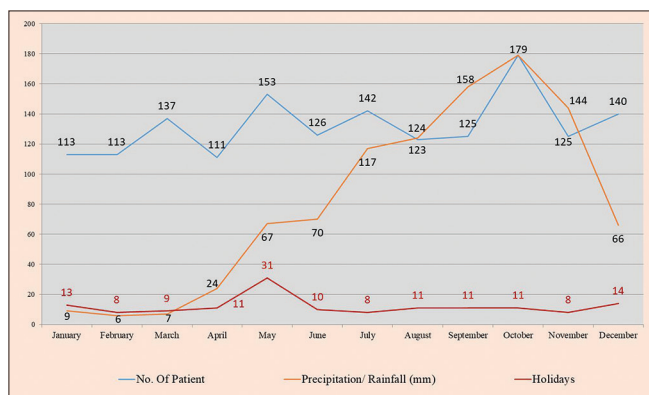


Figure 2: STROBE diagram

**Table 3: Bivariate and multivariate logistic regression analysis for factors associated with severe trauma (NISS >8)**

Variable	NISS >8 n=190 (%)	NISS <8 n=1368 (%)	Bivariate analysis		Multivariate analysis	
			Unadjusted OR (95% CI)	P	Adjusted OR (95% CI)	P
Age ≥5 years	14 (76.8)	765 (55.9)	2.62 (1.84-3.73)	<0.001	1.17 (1.08-1.26)	<0.001
Male sex	190 (100)	850 (62.1)	0.82 (0.79-0.84)	<0.001	1.17 (0.78-1.74)	0.99
Fall on level ground	40 (21.1)	400 (29.2)	0.65 (0.45-0.93)	0.02	0.95 (0.83-1.09)	0.49
Fall from height	36 (18.9)	299 (21.9)	0.84 (0.57-1.2)	0.39	0.94 (0.53-2.1)	0.87
Road traffic accident	70 (36.8)	344 (25.1)	1.74 (1.26-2.39)	<0.001	1.56 (1.08-2.26)	0.018
Triage priority1	19 (10)	61 (4.5)	2.38 (1.39-4.08)	<0.001	0.52 (0.29-0.93)	0.027

**Figure 3: Seasonal pattern in paediatric trauma in relation to precipitation and holidays**

### Seasonal pattern of the incident

There was an increasing trend in the number of incidents during the months of May, October and December probably due to the school holidays in May (1 month) and December (15 days- Christmas) followed by the heavy rainfall (Chennai flood, 2017) during the month of October [Figure 3].

### Management, ED and hospital outcome

Patients were initially resuscitated by the ED team and referred for further management to various trauma surgical teams. The trauma specialties involved in admitting patients were paediatric orthopaedics 134 (56.6%), neurotrauma 50 (21%), paediatric surgery 22 (9.2%), HLRS 21 (8.8%), plastic surgery 6 (1.6%), child health 3 (1.6%) and spine 1 (0.4%) [Figure 2]. Most patients (921) underwent conservative management, 505 patients underwent minor surgical (suturing, splinting, casting) and 161 for major surgical procedures. Among the study population, 1280 (82%) patients were successfully discharged from the ED whereas only 237 (15.2%) required hospital admission. The patients who were not admitted were either died in hospital i.e. 4 (0.4%) or LAMA i.e. 41 (2.6%).

### Discussion

Our study highlights the aetiology, severity and outcome of trauma among children presenting as acute emergencies. Children are very prone to injuries in our community with their ever-energetic and naïve behaviour. Hence, paediatric trauma is different from adult trauma in presentation as well

as the acquisition of injury. In our country, the play area is not restricted to parks or playgrounds. They mostly use the premises of their home, roads and open spaces with uneven terrain in the community for their recreation which is divergent from the western world, where there are designated play areas or parks. This makes them more vulnerable to trauma. This study would help us understand the need to improve the playground safety and monitoring of children by both parents and teachers at home and school premises. The prevalence of paediatric trauma in our study (12%) is similar to rates seen in other studies by Singhi *et al.*, Sharma *et al.*, Verma *et al.* and Abhilash *et al.*<sup>[2-5]</sup> In all the age groups boys were more prone than girls as they are more adventurous than girls this is similar to studies by Chowdhury *et al.*, Kirsh *et al.* and Ong *et al.*<sup>[2,3,5-8]</sup> We found that most of the trauma occurred inside the house as children <5 years constituted a major part of the study this is similar to other studies. This is self-explanatory as children in this age group are mostly taken care of by the family or extended family members in the confines of their homes. Children are the centre of our community and our cultural practise makes the families involve closely in their upbringing. Sending children to the day-care facility or early schooling is still not fully formed as a practice in our country. Hence, the particular result of the distribution of the place of injuries in our study.

Falls constitute the major mechanism of injury (49.7%) closely with road traffic accidents consistent with our previous study and all over the world. We found that most of the injuries were in the extremities followed by head this is similar to studies from India and the west wherein head and extremities are the most common in children.<sup>[2,8-11]</sup>

Consequently, children more than 5 years were more prone for severe injuries with NISS >8 as they spend more time outside their home with road traffic accident being the commonest injury in the higher age group as shown in other studies.<sup>[12-14]</sup> Children have growing bones with a significant part of their body surface area constituted by extremities, injuries can leave lasting sequelae and disabilities which is a big disadvantage for our community as they are the growing future. Boys were prone for severe injuries and triage priority I children were evidently under higher severity score category. We found on multivariate analysis that higher age group and road traffic accidents only were statistically significant correlating with severe injuries. The strength of our study lies in the fact that we used the ISS

and NISS scoring system to determine the injury severity in our analysis.

In our country, there is ever-increasing traffic with no enforcement or adherence to traffic rules resulting in an alarming increase in road traffic accidents resulting in petrifying fatalities. There is a need to improvise awareness among parents and pre-hospital care providers for road safety as we all know first aid or primary care is an absolutely essential need for improved outcomes.<sup>[15-17]</sup> Our ED outcome of paediatric trauma was satisfactory with 82% discharged from the ED and only 15% requiring hospital admission. This is an encouraging result as many of these incidents are preventable if appropriate action is taken by the respective government authorities in public areas and responsible family members at home. These measures might decrease unnecessary emergency visits due to trauma among children.<sup>[18-21]</sup> We as a developing country have to maximise our efforts in trauma prevention, improve our primary care and pre-hospital services thereby providing high-quality trauma care.<sup>[22]</sup> Trauma is a major public health concern resulting in a dire need to establish good services as well as a data registry for the same.<sup>[23]</sup>

Our study has certain limitations. Being a single medical centre study there may have been a patient selection and referral pattern bias. Missing charts is another limitation of our retrospective study. Our study provides a detailed insight into the aetiology, age group distribution, injury spectrum and outcome.

## Conclusion

Our study shows that trauma in children constitutes a significant proportion to overall trauma. Infants and toddlers are more prone for falls and injuries inside the homes. Children >5 years and RTAs are independent factors for sustaining severe trauma. Since most of the injuries occur at home, awareness propagation and injury prevention education will benefit our community. This plays a pivotal role in reducing morbidity and improving our children's future.

## Research quality and ethics statement

The authors of this manuscript declare that this scientific work complies with reporting quality, formatting and reproducibility guidelines set forth by the EQUATOR Network. The authors also attest that this clinical investigation was determined to require Institutional Review Board/Ethics Committee review, and the corresponding protocol/approval number is IRB Min no: 12222 dated 28<sup>th</sup> August 2019. We also certify that we have not plagiarized the contents in this submission and have done a Plagiarism Check.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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