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Original Article

Paediatrics Section

Clinical Profile of Paediatric Head Injury Patients at a Tertiary Care Teaching Hospital of Gujarat, Western India: Prospective Observational Study

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ABSTRACT

Introduction: Paediatric Traumatic Brain Injury (TBI) is a leading cause of morbidity and mortality in children. The accompanying Cervical Spine Injuries (CSI) are not well studied in the Indian subcontinent, particularly with respect to adherence to stabilisation protocols during inter-hospital referrals.

Aim: To evaluate the clinical profile, neuroimaging characteristics, and outcomes of paediatric TBI cases at a tertiary care hospital in Gujarat, Western India.

Materials and Methods: The present one-year, prospective, observational study included 95 paediatric patients (1 month to 18 years) with head injuries who presented to a tertiary care teaching hospital in Gujarat, Western India, between October 2023 and September 2024. Data were collected on demographics, mechanisms of injury, symptoms, neuroimaging, transport, cervical spine immobilisation, hospital course, and outcomes. Descriptive and inferential analyses were used to describe the profile and examine associations between key parameters.

Results: Among 95 patients, 74 (77.9%) were males. Nearly half (47, 49.5%) were below eight years of age. Falls (39, 41.1%) and Road Traffic Accidents (RTA) (38, 40%) were the most common causes of injury. Only 2 (2.1%) children received cervical spine immobilisation during transport. Of the total, 31 (32.6%) were moderate-to-severe cases, and neuroimaging was indicated or performed in 30 (31.9%). Out of these 30, Subdural haematoma (13, 43.3%) and cerebral contusions (10, 33.3%) were the most frequent radiological findings. Most patients (60, 63.2%) were discharged within 48 hours. Full recovery occurred in 77 (81.1%), while 17 (17.9) had disabilities and 1 (1.1%) died. Lack of cervical spine stabilisation and the need for intubation were significantly associated with poorer outcomes ($p<0.05$).

Conclusion: Most patients were male, and mild-to-moderate head injuries were common. A substantial number of severe cases were also noted, with subdural hematoma and contusions strongly linked to poor neurological outcomes. Only two patients received cervical spine stabilisation during transport, highlighting a major gap in prehospital trauma care.

Keywords: Cervical spine stabilisation, Road traffic accidents, Transport, Traumatic brain injury

INTRODUCTION

Traumatic Brain Injury (TBI), often referred to as the "silent epidemic," remains a major public health concern and is the leading cause of trauma-related death and disability globally [1]. The incidence of paediatric TBI varies by region, with the main causes being RTAs, falls, and non-accidental trauma. Several studies suggest that paediatric TBI accounts for 20-30% of all TBI cases, with RTAs being the predominant cause in many regions due to rapid urbanisation and inadequate safety practices [1-4]. India lacks national-level paediatric TBI data, unlike many developed countries [3].

Paediatric TBI has several distinctive characteristics compared to adult TBI due to age-related anatomical and physiological differences, variations in injury patterns, and challenges in neurological assessment in children [4]. Beyond immediate neurological damage, long-term cognitive, behavioural, and physical functions may be affected due to the ongoing development of the brain. Children are also more vulnerable to secondary brain injuries, emphasising the importance of early intervention and proper stabilisation.

Paediatric spine fractures are uncommon, representing 1-2% of all paediatric trauma cases [5]. However, even minimal structural damage can result in severe outcomes due to the high flexibility of the paediatric spine. Reports indicate that up to 60% of affected children may experience lasting neurological impairment, with mortality rates reaching 40% [5]. CSI associated with paediatric head injury is poorly studied in India, particularly regarding adherence to stabilisation protocols during inter-hospital transfers.

The present study aimed to generate region-specific data from a private medical college that serves as the only tertiary care referral centre for paediatric trauma in the district. The hospital provides emergency services, neurotrauma care, a Paediatric Intensive Care Unit (PICU), and neurosurgical facilities, making it a major referral destination for paediatric trauma cases. Hence the present study was done to evaluate the clinical profile, neuroimaging characteristics and outcomes of paediatric TBI cases.

MATERIALS AND METHODS

The present prospective, observational study was conducted at Pramukhswami Medical College and Shree Krishna Hospital, Gujarat, between October 2023 and September 2024, after approval from the institutional ethics committee (IEC/BU/148/Faculty/04/331/2023).

Inclusion criteria:

- Head injury of any severity;
- One month to 18 years of age.

Exclusion criteria: Patients who were discharged against medical advice within two hours of their emergency room visit.

All paediatric patients who registered at the Outpatient Department (OPD) of General Surgery and/or Paediatrics or at the Emergency

Department during the 12-month study period were approached for study enrolment.

Study Procedure

A structured case proforma was used to systematically collect data on demographics, prehospital care and cervical spine stabilisation, clinical features, and outcomes. Data variables included age, sex, residence (rural/urban), socioeconomic status, mode and mechanism of injury, and details of prehospital management and transport. Clinical and radiological assessments were also recorded. The Glasgow Coma Scale (GCS) was used to classify severity: GCS ≥13/15 as mild, 9-12/15 as moderate, and ≤8/15 as severe [6]. Associated injuries (CSI, long bone fractures, thoracic/abdominal trauma), length of hospital stay, complications, and outcomes were also documented. The primary focus of the present study was to assess adherence to cervical spine stabilisation during transport and short-term clinical outcomes. All information was entered into Microsoft Excel after obtaining informed consent.

STATISTICAL ANALYSIS

Data were analysed using Statistics and Data , Version 18 (STATA 18). Descriptive statistics such as frequency, percentage, median and Interquartile Range (IQR) were used to summarise the data. Chi-square and Fisher's exact tests were used to assess associations. A p-value <0.05 was considered statistically significant.

RESULTS

The study analysed 95 paediatric head injury cases. The median (Q1, Q3) age of the cohort was 10 (5.5,15) years. Baseline characteristics are shown in [Table/Fig-1]. Nearly half of the children (47, 49.5%) were between one month and eight years of age, while 43 (45.3%) were between 15-18 years. Only 5 (5.2%) children were aged 9-14 years. Males comprised a significant proportion of the cohort (74, 77.9%).

Variables	Category	n=95 (%)
Age (years)	1 month-8 years	47 (49.5)
	9-14	5 (5.2)
	15-18	43 (45.3)
Sex	Male	74 (77.9)
	Female	21 (22.1)
Location of occurrence	Home	15 (15.8)
	Outside	80 (84.2)
Cause of injury	Fall from height	39 (41)
	Motor vehicle accident	38 (40)
	Passenger	13 (13.7)
	Pedestrian	5 (5.3)
Mode of transport	By 108 ambulance	24 (25.3)
	Self	71 (74.7)
Prehospital treatment	Yes	20 (21)
Cervical stabilisation during transport	Yes	2 (2.1)
Time of arrival	<1 hour	2 (2.1)
	1-24 hours	93 (97.9)
Need for intubation at arrival	Yes	12 (12.6)
Associated extracranial injury	No injury	46 (48.4)
	Soft tissue injury	22 (23.2)
	Chest or abdomen injury	2 (2.1)
	Bone fracture	25 (26.3)
Severity of head injury	Mild	64 (67.3)
	Moderate	19 (20.0)
	Severe	12 (12.6)
Symptoms on presentation	Pain at the site of injuries/ Impact	49 (51.6)
	Vomiting	31 (32.6)
	Bleeding from any site	23 (24.2)
	Loss of consciousness	15 (15.8)
	Seizures	12 (12.6)
	Inconsolable cry	1 (1.1)
Neuroimaging status	Not indicated/Not done	65 (68.4)
	Done	30 (31.6)
Hospital Stay	<48 hours	60 (63.2)
	49 hours-1 week	23 (24.2)
	More than 1 week	12 (12.6)
Outcomes	Discharge	82 (86.3)
	DAMA*	12 (12.6)
	Death	1 (1.1)
Neurological outcomes (n=94)**	Recover fully	77 (81.1)
	Focal deficit	14 (14.7)
	Depressed mentation	3 (3.2)

[Table/Fig-1]: Baseline characteristics of patients with head injury.
*Discharge Against Medical Advice, **Include neurological outcomes among discharged/DAMA patients

Falls from height (39, 41%) and motor vehicle accidents or RTA (38, 40%) were the leading causes of injury. Most incidents (80, 84.2%) occurred outside the home. Only 20 (21%) children received any form of prehospital treatment. Proper cervical spine immobilisation was provided in only 2 (2.1%) cases. While 24 (25.3%) children arrived via the 108 ambulance service, the majority (71, 74.7%) were transported in self-arranged vehicles.

Only 2 (2.1%) children arrived within one hour of injury; all others arrived after one hour but within 24 hours. Bone fractures (25, 26.3%) and soft tissue injuries (22, 23.2%) were the most common associated extracranial injuries. Of the 95 cases, 12 (12.6%) were severe, 19 (20%) moderate, and 64 (67.3%) mild.

The most common presenting symptom was pain at the site of injury (49, 51.6%), followed by vomiting (31, 32.6%), loss of consciousness (15, 15.8%), and seizures (12, 12.6%). Bleeding from any site was observed in 23 (24.2%) cases. Neuroimaging was performed in 30 (31.6%) patients, with subdural hematoma being the most common finding (13, 43.3%) among them. Details of neuroimaging findings are provided in [Table/Fig-2].

Category	Subcategory	n (%)
Neuroimaging status (n=95)	Not indicated/Not done	65 (68.4)
	Neuroimaging done	30 (31.6)
Neuroimaging findings* (n=30)	Subdural haematoma	13 (43.3)
	Contusion	10 (33.3)
	Brain oedema	07 (23.3)
	Skull fracture	07 (23.3)
	Subarachnoid haemorrhage	07 (23.3)
	Epidural haematoma	04 (13.3)
	Diffuse axonal injury	02 (06.7)
	Herniation	01 (03.3)
	No abnormality detected	04 (13.3)

[Table/Fig-2]: Neuroimaging findings in patients with paediatric head injury.
*More than one finding is possible in the same patient

Most children (60,63.2%) were discharged within 48 hours, typically those with mild to moderate injuries. However, 12 (12.6%) required hospitalisation for more than one week. Outcomes were predominantly favourable: 77 (81.1%) children fully recovered, while 17 (17.9%) had some degree of disability. Only one death occurred.

Associations between age, time of arrival, and cause of injury with sex are shown in [Table/Fig-3]. Associations between outcomes and injury-related parameters, as well as prehospital and hospital management factors, are presented in [Table/Fig-4,5].

Parameters	Gender		p-value*
	Male	Female	
	n=74 (%)	n=21 (%)	
Age			
1 month-8 years	37 (50.1)	10 (47.6)	0.561
9-14 years	03 (04.0)	02 (09.5)	
15-18 years	34 (45.9)	09 (42.9)	
Time from injury to arrival at the hospital			
<1 hour	02 (02.7)	0	>0.999
1-24 hours	72 (97.3)	21 (100)	
Mode of transport			
By 108 Ambulance	18 (24.3)	06 (28.6)	0.777
Other than 108 Ambulance/ any equipped Ambulance	56 (75.7)	15 (71.4)	

[Table/Fig-3]: Association of age, time of arrival, and mode of injury with gender.
*Based on Fisher's-exact test

Parameters	Outcomes		p-value*
	Death/ Discharged against medical advice/Disability	Fully recovered among discharged patients	
	n=25(%)	n=70(%)	
Cause of injury			
Fall from height	10 (40)	29 (41.4)	0.286
Motor vehicle accident	08 (32)	30 (42.9)	
Passenger	04 (16)	09 (12.9)	
Pedestrian	03 (12)	02 (02.9)	
Associated extracranial injuries			
No injury	03 (12)	43 (61.4)	<0.001
Soft tissue injury	11 (44)	11 (15.7)	
Bone fracture	11 (44)	14 (20.0)	
Chest or abdomen injury	00 (00)	02 (02.9)	
Mode of transport			
By 108 Ambulance	05 (20.0)	19 (27.1)	0.597
Other than 108 Ambulance/ any equipped Ambulance	20 (80.0)	51 (72.9)	
Cervical spine stabilisation during transport			
Yes	02 (08.0)	00 (00.0)	0.017
No	23 (92.0)	70 (100)	
Intubation was required on arrival at the emergency department			
Yes	10 (40)	02 (02.9)	<0.001
No	15 (60)	68 (97.1)	

[Table/Fig-4]: Association of outcome with relevant injury parameters, prehospital and hospital management.
*Based on Fisher's-exact test

Parameters	Neurological outcomes among discharges and DAMA* cases			p-value*
	Fully recovered	Focal Deficit	Depressed mentation	
	n=77(%)	n=14(%)	n=3(%)	
Cause of injury				
Fall from height	34 (44.2)	05 (35.7)	00 (0.0)	0.001
Motor vehicle accident	31 (40.3)	04 (28.6)	02 (66.7)	
Passenger	10 (13.0)	02 (14.3)	01 (33.3)	
Pedestrian	02 (02.6)	03 (21.4)	00 (00.0)	
Site/side of impact				
Right Side	61 (79.2)	11 (78.6)	01 (33.3)	0.178
Left Side	16 (20.8)	03 (21.4)	02 (66.7)	
Prehospital treatment				
Yes	16 (20.8)	04 (28.6)	00 (00.0)	0.647
No	61 (79.2)	10 (71.4)	03 (100)	
Mode of transport				
By 108 Ambulance	20 (26)	03 (21.4)	01 (33.3)	0.613
Other than 108 Ambulance/ any equipped Ambulance	57 (74)	11 (78.6)	02 (66.7)	
Cervical spine stabilisation during transport				
Yes	01 (01.3)	01 (07.1)	00 (00.0)	0.366
No	76 (98.7)	13 (92.9)	03 (100)	
Requirement of intubation on arrival at the emergency department				
Yes	04 (05.2)	05 (35.7)	02 (66.7)	<0.001
No	73 (94.8)	09 (64.3)	01 (33.3)	
Associated extracranial injuries				
No injury	45 (58.4)	01 (07.1)	00 (00.0)	<0.001
Soft tissue injury**	11 (14.3)	09 (64.3)	01 (33.3)	
Chest or abdomen injury	02 (02.6)	00 (00.0)	00 (00.0)	
Bone fracture	19 (24.7)	04 (28.6)	02 (66.7)	

[Table/Fig-5]: Association of neurological outcome with relevant injury parameters, prehospital and hospital management.
*Based on Fisher's-exact test, ** One death occurred in this associated extracranial injury

There was no statistically significant association between sex and age, time of arrival, or cause of injury. Lack of cervical spine stabilisation was significantly associated with death and discharge against medical advice (p=0.017). Death and discharge against medical advice were also significantly associated with extracranial injuries and the need for intubation upon arrival at the emergency department (p<0.001 for both). Poor neurological outcomes were significantly associated with extracranial injuries and the need for intubation (p<0.001 for both).

DISCUSSION

India is undergoing significant transitions across sociodemographic, epidemiological, technological, and media domains. Over the last two decades, the country has experienced rapid urbanisation, increased motor vehicle usage, industrial growth, and population migration due to socio-economic developments. In India, trauma is becoming a widespread issue, resulting in serious and extensive consequences for individuals, and is a major contributor to illness and fatalities among children [1-3].

Immediate medical attention is crucial for childhood injuries, as they are associated with high rates of mortality and long-term disabilities. Injuries account for 5.4% (265,000-348,000) of annual childhood fatalities globally [7].

The TBI is a severe and common type of injury, and is the most prevalent form among children [8]. While mild TBI generally has a favourable prognosis, severe TBI can result in significant disability. Factors contributing to poor outcomes in paediatric TBI include delays in seeking hospital care, inadequate pre-hospital management, and poor adherence to trauma management protocols. CSI frequently occur alongside TBI, particularly in cases of high-impact trauma such as road traffic accidents and falls. The anatomy of the paediatric cervical spine differs from that of adults, with increased ligamentous laxity, underdeveloped muscle strength, and a relatively larger head-to-body ratio, making children more vulnerable to CSI during traumatic events [9,10]. Among individuals who experience a CSI, up to 35% may also suffer from an associated neurological injury. Due to the difficulty in identifying the causes of neurological deterioration following cervical trauma, it is standard practice to maintain cervical spine stabilisation in patients where the

Parameters	Present study (2024)	Dara PK et al., (2018) [14]	Kumar B et al., (2023) [15]	Rathod LB et al., (2021) [16]	Pujari CG at al., (2024) [17]	Khanna SK et al., (2025) [18]
Place of the study	Karamsad, (Gujarat)	Western Rajasthan	Etawah, Uttar Pradesh	Mumbai, Maharashtra	Bengaluru, Karnataka	Five neuro-centers of Northern India
Total number of patients	95	188	53	203	316	2250
Male:female ratio	3.5:1	1.1:1	1.4:1	1.4:1	1.6:1	3.4:1
Commonest age group	1 month to 8 years (49.5%)	1-3 years (35%)	5 to 10 years (41.5%)	1 to 6 years (74.4%)	Less than 5 years (49.1%)	6 months to 2 years (37.3%)
The commonest cause of TBI	Fall (41.1%)	Fall (61.5%)	Fall (40.7%)	Fall (70%)	Fall (53.4%)	Fall (64,6%)
Commonest symptoms/ presentation	Vomiting and loss of consciousness	Bleeding from the ear and vomiting	Vomiting and facial injury	Vomiting and headache	Hypotension	Vomiting and loss of consciousness
Abnormal CT scan brain%	32.6%	60.19%	69.8%	56%	72%	22%
Mortality	1.1%	0%	3.7%	1%	28%	0.1%

[Table/Fig-6]: Comparative analysis between the present study and other studies [14-18].
CT: Computed tomography

injury mechanism suggests a potential CSI until it can be ruled out [11]. Paediatric TBI also represents a substantial burden on public health systems worldwide, particularly in Low and Middle-Income Countries (LMICs) such as India [12].

In the present study, the median (Q1, Q3) age was 10 (5.5, 15) years, which is somewhat higher than the 7.6 years reported by Madaan P et al., [13]. In the present study, children aged one month to 18 years accounted for nearly half of the cases (49.5%), and 77.9% were male. A comparison of common parameters from the present study with other studies is provided in [Table/Fig-6] [14-18]. All referenced studies are Indian studies on paediatric head injury [14-18]. Rathod LB et al., reported staircase falls as a significant subgroup, indicating indoor hazards in low-income urban households [16]. Garg K et al., (2017) from a trauma ICU in Delhi noted low-velocity trauma as the predominant cause, highlighting preventable household accidents [19].

In the present study, Computed Tomography (CT) imaging revealed subdural haematomas (13.7%), contusions (10.5%), and skull fractures (7.4%) as the three most common findings, whereas Madaan P et al., reported skull fractures as the most frequent finding [13]. Neuroimaging utilisation was low in the present study (32.6%), possibly because it was not indicated or not performed due to financial constraints. However, in the study by Kumar B et al., imaging was performed in all 53 subjects, with 73.5% showing abnormal findings, the most common being cerebral oedema [15]. Garg K et al., reported 38% mild, 15% moderate, and 47% severe TBI cases, and noted that mild cases were discharged early [19]. However, in the present study, most cases (67.3%) involved mild TBI. The short length of hospital stay (<48 hours) in 60 patients (63.2%) also indicates that the study cohort largely comprised mild TBI cases. Recent studies have provided valuable insights into clinically important intracranial injuries, demonstrating reduced utilisation of CT scans or neuroimaging by applying the Scandinavian guideline for the management of children with TBI (SNC16-Scandinavian Neurotrauma Committee guideline published in 2016) or by using biomarkers such as Neurofilament Light chain protein (NfL) and N-terminal prohormone of Brain Natriuretic Peptide (NTproBNP) [20,21]. These approaches were found to be safe in children and appear promising in avoiding unnecessary exposure to high doses of radiation.

A critical finding in the present study was the suboptimal pre-hospital care. In LMICs, trauma care systems are rarely well established. Injured children are typically taken directly to the nearest hospital by bystanders who have no formal training in transporting and resuscitating trauma patients, and less frequently by ambulances (public or private). The absence of prehospital care systems results in many injured children arriving at the hospital in a compromised condition due to delays, inadequate or absent first aid, and improper modes of transportation [13].

A recent study from Iceland with nearly 11 years of data suggested that children who present to the emergency department with TBI generally have mild injuries [22]. The authors also emphasised the important role of paediatric emergency nursing staff in providing specialised follow-up care to prevent subsequent complications in children with head injury.

A significant epidemiological investigation into childhood trauma in the USA examined the National Paediatric Trauma Registry over a 10-year period and found that among 75,172 injured children, only 1.5% had a CSI (1,098 patients) [12]. In the present study, only 2.1% of children were transported with cervical spine precautions, and ambulance utilisation was 25.3%. The present study reports full recovery in 77 (81.3%) patients, while disability in the form of depressed mental status and focal deficits occurred in the remaining patients, with a mortality rate of 1.1% (n=1). Rathod LB et al., reported 92.1% recovery but noted underreporting of late neurocognitive deficits due to lack of follow-up [16]. Kumar B et al., found full recovery in 86.7% and mortality in 3.7% [15].

For outcome reporting, one multicentre study applied the Glasgow Outcome Score [18]; however, the present study did not. Neumane S et al., (2021), in a French cohort, found persistent disability in 80% of children two years after severe TBI, indicating that early recovery does not necessarily equate to full functional restoration, especially in cognitive and behavioural domains [23]. Neumane S et al., in their two-year prospective study, also emphasised that persistent cognitive, emotional, and physical deficits are common, even among those who initially appeared to be recovering during the early days of hospitalisation [23]. They advocated the use of the Paediatric Injury Functional Outcome Scale (PIFOS), which has been validated for tracking neurodevelopmental recovery longitudinally.

Limitation(s)

A major limitation of the present study was that it was conducted at a single centre and involved a relatively small number of severe cases, which limits the generalisability of the findings to other regions or healthcare settings with different trauma referral patterns, infrastructures, and resources. Additionally, the present study did not discuss paediatric scoring systems for functional or outcome evaluation after injury.

CONCLUSION(S)

In conclusion, paediatric TBI remains a significant public health concern, particularly affecting young boys through preventable causes such as falls and RTAs. Short-term outcomes were poor in one-tenth of the patients. Although CSI were less frequent, adherence to cervical spine stabilisation protocols during transport was often inadequate and may have contributed to poorer outcomes. Substantial challenges persist in prehospital care, compliance with cervical spine stabilisation guidelines, and in tracking long-term consequences or rehabilitation needs.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 08, 2025
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- Financial or Other Competing Interests: None
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