



# Epidemiology and etiology of hospitalized pediatric trauma: An experience from the referral trauma hospital of Iran

Seyed Mohammad Soltani <sup>1</sup>, Behrang Rezvani Kakhki <sup>2</sup>, Seyed Mohammad Mousavi <sup>2</sup>, Hosein Zakeri <sup>2</sup>, Seyed Reza Ahmadi Koupaei <sup>2</sup>, Sayyed Majid Sadrzadeh <sup>2</sup>, Elnaz Vafadar Moradi <sup>2\*</sup>

<sup>1</sup> Student Research Center, Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>2</sup> Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

\* **Corresponding author:** Elnaz Vafadar Moradi. Assistant Professor of Emergency Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. **Email:** Vafadarme@mums.ac.ir

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## Abstract

**Background:** Trauma accounts for long-term morbidity in children and its patterns depend on the cultural aspects of communities.

**Objectives:** In the current study, we aimed to evaluate the epidemiology and etiology of trauma in pediatric patients.

**Methods:** In this cross-sectional study, medical records of 299 children below 15 years old who had referred to Hashemi Nejad Trauma Center, Mashhad, Iran, from 2017 to 2018, were evaluated. All relevant medical data were collected. Patients were categorized into three age groups: 0-2, 3-6 and 7-15 years old. Variables were compared between different age groups and genders.

**Results:** The main cause of trauma were road traffic accidents (51.8%) and falling from heights (31.4%). Common anatomical sites of trauma included the limbs, followed by head and neck (45.3% and 36.2%, respectively). Accident rates were highest between the hours of 13 to 19 (43.8%). There were no significant differences in comparing variables between genders ( $p>0.05$ ). In pediatrics aged 0-2 years old, head and neck injuries were the most common sites of trauma (67.9%) ( $p=0.001$ ). Road traffic accident rates increased from the ages of 0-2 to the ages of 7-15 years old ( $p=0.060$ ).

**Conclusions:** Prevention is one of the main interventions to decrease the morbidity and mortality related to pediatric trauma. Moreover, by evaluating the etiology of trauma and assessing the medical providing facilities could find the Achilles Heel and try to improve them.

**Keywords:** Pediatric, Injury, Epidemiology, Childhood, Trauma.

## Introduction

Trauma is one of the main reasons of mortality in the first three decades of life, especially in children aged 1 to 14 years old.<sup>[1]</sup> Annually, pediatric trauma accounts for over 80% of all 875,000 death in children below 18 years old in developing countries.<sup>[2]</sup> Pediatrics trauma refers to any physical or wound experienced by a child or adolescent. This can include injuries from accidents, falls, sport-related incidents, abuse or violence. Injuries followed by trauma in children lead to long-term disability besides significant psychological and financial burden for the injured child, his/her parents and the society.<sup>[3]</sup> It is important to seek immediate medical attention for pediatric trauma to ensure proper diagnosis and treatment. Children may require specialized care due

to their smaller size and developing bodies. Studies in Europe have estimated that accidents accounts for more than 19% of the disability adjusted life years (DALYs) in individuals under the age of 19 years old.<sup>[4]</sup> Inability to timely recognize and react to the danger as well as immature risk assessment in children below the 10 years old, puts them at higher risks of accident.<sup>[5]</sup>

Pediatric trauma epidemiology and etiology are crucial for understanding the patterns, causes, and risk factors associated with injuries in children.<sup>[6]</sup> By standing these accepts, healthcare professionals can develop effective prevention strategies, improve treatment protocol, and ultimately reduce the burden of pediatric trauma on individuals, families, and society as a whole. Epidemiological studies provide valuable information on

the incidence, prevalence, and trends of pediatric trauma.<sup>[7]</sup> This data helps identify high-risk populations, geographic areas with higher rates of injuries, and common mechanisms of injury.<sup>[4]</sup> By understanding these patterns, healthcare providers can target interventions to prevent injuries in vulnerable populations and reduce the overall burden of trauma.<sup>[8]</sup>

Additionally, studying the etiology of pediatric trauma helps identify specific risk factors that contribute to injuries in children.<sup>[5-7]</sup> These risk factors can be related to individual characteristics (such as age or gender), environmental factors (such as home or community safety measures), or behavioral factors (such as risky activities or lack of supervision).<sup>[8]</sup> By identifying these risk factors, healthcare professionals can develop targeted interventions to address them and prevent future injuries.<sup>[9]</sup> Overall, pediatric trauma epidemiology and etiology play a critical role in informing injury prevention efforts, improving treatment outcomes, and reducing the impact of trauma on children's health and well-being.<sup>[10]</sup> By understanding the patterns and causes of pediatric injuries, healthcare providers can work towards creating safer environments for children and reducing the incidence of preventable injuries.<sup>[7]</sup> The epidemiology and etiology differ in regions and depends on the geographical and cultural characteristics of countries.<sup>[6-9]</sup> Evaluating the etiology of trauma based on population characteristics, especially in children, could help to prevent or alleviate the unpleasant outcomes of trauma.<sup>[5,10,11]</sup>

## Objectives

In the current study, we assessed the epidemiology and etiology of non-intentional trauma in individuals below fifteen years old.

## Methods

### Study design

This cross-sectional study was performed all trauma patients referred to Hashemi Nejad trauma Center, Mashhad, Iran. The medical records of all trauma cases who had been referred from 2017 to 2018 and were under the age of 15 years old were evaluated. The study protocol was approved by the Research Ethics Committee of Mashhad University of Medical Sciences. Confidentiality of patients' information was maintained throughout the study. Hashemi Nejad Hospital is an academic level-1 trauma center and one of the referral trauma centers in the east of Iran.

### Study Protocol

All patients under 15 years old who had been admitted due to trauma from 2017 to 2018 were selected; 299 cases were assessed in total. Patients were excluded based on the incomplete file data. Patients' information was extracted using a checklist which included the following data: demographic characteristics, anatomical site of injury, and mechanism of trauma, time from accident scene to hospital, time from admission to visit by physician, final medical intervention and the time of day in which the trauma had happened. Patients were categorized into the age groups of 0-2, 3-6 and 7-15 years old. Trauma related findings were also compared between genders.

### Statistical analysis

Continuous variables were presented as mean  $\pm$  standard deviation (SD). Qualitative variables were described using absolute frequencies and percentages and were compared with the chi-square test or Fisher's exact test. Quantitative data were presented as mean  $\pm$  standard deviation or median (interquartile range), and compared using Mann-Whitney U and student-t tests. Statistical analyses were performed using SPSS software version 26 (SPSS Inc., Chicago, Illinois, USA). Statistical significance was considered at the P-value less than 0.05.

### Ethical Consideration

The study protocol was approved by the Research Ethics Committee of Mashhad University of Medical Sciences (code: IR.MUMS.MEDICAL.REC.1399.063) according to Helsinki ethical standards.

## Results

In total, 299 children were enrolled in this study. The mean age was 6.32 ( $\pm 3$ , SD) years. 66.2% were males. Traffic-related accidents were the commonest cause of trauma (51.8%) in both genders. The most frequent anatomical sites of injury in children were upper & lower limbs, and head and neck (45.3% and 36.3%), respectively. Evaluating the outcome demonstrated that the majority of the traumas had led to the hospital division (37.8%). The highest numbers of accidents had occurred in the afternoon, especially between 13 to 19 (43.8%).

Regarding the gender of children, there was no significant difference in the site of injury ( $p=0.41$ ). In addition, no significant differences were found between males and females regarding the mechanism of trauma ( $p=0.54$ ). Moreover, there was no statistically significant difference between two genders in final intervention at trauma emergency room, and time of injury ( $p = 0.32$  and  $p = 0.75$ , respectively) [Table 1].

Table 1. Trauma related characteristics among male and female patients

Variables		Overall N (%)	Female N (%)	Male N (%)	P value*
Site of injury	Head and Neck	108 (36.2)	41 (40.6)	67 (34)	0.41
	Limbs	135 (45.3)	41 (40.6)	94 (47.7)	
	Multiple trauma	45 (15.1)	14 (13.9)	31 (15.7)	
	Trunk	10 (3.4)	5 (5)	5 (2.5)	
Mechanism	Road traffic accidents	155 (51.8)	57 (56.4)	98 (49.5)	0.54
	Falling	94 (31.4)	28 (27.7)	66 (33.3)	
	Penetrating trauma (except road traffic accidents and falling)	3 (1)	0 (0)	3 (1.5)	
	Blunt trauma (except road traffic accidents and falling)	21 (7)	8 (7.9)	13 (6.6)	
	Other	26 (8.7)	8 (7.9)	13 (6.6)	
Outcome	Hospital division	113 (37.8)	33 (32.7)	80 (40.4)	0.325
	Wound care	52 (17.4)	20 (19.8)	32 (16.2)	
	Reduction dislocation	5 (1.7)	0 (0)	5 (2.5)	
	Suture	56 (18.7)	23 (22.8)	33 (16.7)	
	Splint	50 (16.7)	16 (15.8)	34 (17.2)	
	others	23 (7.7)	9 (8.9)	14 (7.1)	
	Time of day (Minutes)	7-13	81 (27.1)	27 (26.7)	
	13-19	131 (43.8)	46 (45.5)	85 (42.9)	
	19-24	76 (25.4)	23 (22.8)	53 (26.8)	
	24-7	11 (3.7)	5 (5)	6 (3)	

\* Chi-square test.

Comparison of the rates of accidents between different age groups showed that children in the age group of 3-6 had the highest rates of accidents groups (54%, 25% and 21% for children in the ages of 3-6, 7-15 and 0-2, respectively). Children in the age group of 0-2 years showed the highest rate of trauma to the head and neck area (67.9%), which was less common in older age groups (26.2% in children between 7 and 15). On the other hand, injuries to the extremities were more common in older children. Overall, a significant relationship existed between the age groups of our cases and the anatomical sites of injury ( $p=0.001$ ). According to the etiology of trauma, no meaningful differences in the mechanism of trauma existed between the three age groups ( $p=0.060$ ). Regarding final intervention at ER, hospital division had the highest rate of patients in all age groups. Generally, the types of injury were significantly different among the three age groups ( $p=0.001$ ). The patients' age groups did not relate to the time of trauma ( $p=0.13$ ) [Table 2].

In regards to medical services, there were significant differences in the time delay from trauma scene to hospital admission among different times of the day ( $p=0.016$ ). The time delay was higher between 19 – 24 and 7-13 O' clock,

but the medical services at hospital did not significantly differ at different times of the day [Table 3].

## Discussion

The etiology of pediatric trauma is a complex and multifaceted topic that encompasses a wide range of factors that contribute to injuries in children.<sup>[9]</sup> One of the primary factors contributing to pediatric trauma is accidents, which can occur in various settings such as the home, school, playground, or while traveling.<sup>[8]</sup> Accidents such as falls, burns, drowning, and motor vehicle collisions are common causes of pediatric trauma.<sup>[2]</sup> Children are particularly vulnerable to accidents due to their developing motor skills, lack of awareness of potential dangers, and tendency to engage in risky behaviors.<sup>[5]</sup>

Sports-related injuries are another significant contributor to pediatric trauma. Participation in sports and recreational activities can lead to a range of injuries, including fractures, concussions, sprains, and strains.<sup>[6]</sup> Factors such as inadequate supervision, improper equipment, and lack of proper training can increase the risk of sports-related injuries in children.<sup>[7]</sup>

Table 2. Trauma related characteristics among different age groups

Age (years)		0-2	3-6	7-15	P-value*
Site of injury	Head and Neck	19 (67.9)	56 (38.9)	33 (26.2)	0.001
	Limbs	7 (25)	62 (45.9)	66 (52.4)	
	Multiple trauma	2 (7.1)	24 (16.7)	19 (15.1)	
	Trunk	0 (0)	2 (1.4)	8 (6.3)	
Mechanism	Road traffic accidents	7 (25)	79 (54.5)	69 (54.8)	0.060
	Falling	14 (50)	45 (31)	35 (27.8)	
	Penetrating trauma (except road traffic accidents and falling)	0 (0)	0 (0)	3 (2.4)	
	Blunt trauma (except road traffic accidents and falling)	4 (14.3)	10 (6.9)	7 (5.6)	
	Other	3 (10.7)	11 (7.6)	12 (9.5)	
Outcome	hospital division	11 (39.3)	37 (25.5)	65 (51.6)	0.001
	Wound care	5 (17.9)	35 (24.1)	12 (9.5)	
	Reduction dislocation	0 (0)	4 (2.8)	1 (0.8)	
	Suture	6 (21.4)	34 (23.4)	16 (12.7)	
	Splint	2 (7.1)	27 (18.6)	21 (16.7)	
Time of day (Hour)	7-13	7 (25)	42 (29)	32 (25.4)	0.130
	13-19	12 (49.2)	56 (38.6)	63 (50)	
	19-24	6 (21.4)	44 (30.3)	26 (20.6)	
	24-7	3 (10.7)	3 (2.1)	5 (4)	

\* Chi-square test.

Table 3. Trauma-related medical services at different times of day

Time interval		7-13	13-19	19-24	24-7	P value*
Scene to hospital	Less than an hour	47 (58)	83 (63.4)	59 (77.6)	6 (54.5)	0.016
	1-4 hours	26 (32.1)	42 (32.1)	9 (11.8)	3 (27.3)	
	More than 4 hours	8 (9.9)	6 (4.6)	8 (10.5)	2 (18.2)	
Admission to visit by physician	Less than 10 minutes	35 (43.2)	44 (33.6)	29 (38.2)	4 (36.4)	0.401
	10-30 minutes	36 (44.4)	68 (51.9)	32 (42.1)	4 (36.4)	
	30-60 minutes	6 (7.4)	17 (13)	12 (15.8)	3 (27.3)	
	more than 60 minutes	6 (4.9)	2 (1.5)	3 (3.9)	0 (0)	

\* Chi-square test.

In the present study, 299 children were evaluated. Although pediatric trauma was more common in males, but the difference was not significant. In a similar study conducted by Zia et al.,<sup>[12]</sup> in 2012, 66% of the injured children (below 12 years old), were boys. Furthermore, Mutto et al.,<sup>[13]</sup> performed a study with the aim of evaluating the odds and pattern of trauma in 566 children below the age of 13. They found that nearly 60% of patients were boys. This finding has also been reported in other studies.<sup>[14,15]</sup>

In the aspect of the etiology of pediatric trauma, our results demonstrated that traffic accidents are the main cause of trauma in both genders and falling from heights was the second common cause of trauma. In a study conducted by Jalalvandi et al.,<sup>[15]</sup> with the aim of assessing

the pediatric injuries in western Iran, authors reported that the most frequent cause of trauma was road traffic injuries.

In our study, trauma to the extremities accounted for the most prevalent anatomic site of injury in both genders. Although in the Simon et al.,<sup>[4]</sup> study which was conducted in Tanzania, injuries to the head and neck were the most common type of trauma in pediatrics below the age of ten (32.7%); but, the Jalalvandi et al.,<sup>[15]</sup> study reported that the extremities were the commonest site of injury in children between the ages of 0-10 years old (53.6%). This controversy could be related to the cultural factors and warrants further research. According to another study assessing traffic accidents in paediatrics,<sup>[16]</sup> injuries to the head and face were the most observed type of injury. Our

results also showed a significant relationship between age and anatomical site of injury ( $p=0.001$ ). Other studies have also reported a similar relationship.<sup>[16,17]</sup>

In our study, the majority of the accidents had happened between the 13 to 19 hours. Similarly, in the Simon et al.,<sup>[4]</sup> study, 83.3% of the traumas had happened during day time. The results of our study were in line with Jalalvandi et al.,<sup>[15]</sup> study, which reported that as children age, the pattern of injury changes, and the rates of injuries to the head decreases while injuries to the extremities become more common.

In the studied age groups, hospital division was the most final intervention in ER, thus, regarding the management of pediatric trauma, we suggest that hospital wards should receive the most resources and training.

We also assessed the adequacy of medical services by evaluating the time delay from trauma scene to hospital, and hospital admission. Our results revealed that most of the patients had been visited by a physician less than ten minutes after admission and there was no significant difference during day times ( $p=0.401$ ). Although transportation of patients from scene to hospital were done in less than an hour, but this took a significantly longer time between 19 – 24 and 7-13 O' clock. We know in many urban areas, the morning rush hour typically peaks between 7:00 Am and 9:00 Am as people commute to work or school. The evening rush hour often occurs between 4:00 PM and 6:00PM as individuals return home from work or other activities. However, these times can vary significantly based on specific local condition, such as the presence of major employers, public transportation schedules, and the layout of road networks. Our study hospital is located in a high-traffic area with many stores and high population, which has a lot of shopping between 18:00 and 22:00.

This study had various limitations. Most importantly, due to the retrospective nature of our study, there was not a complete control over the variables. On the other hand, this was a pioneer study in epidemiologic evaluation of pediatric trauma in the region.

## Conclusions

In conclusion, the etiology of pediatric trauma is a complex and multifaceted issue. Understanding the various factors contributing to childhood injuries is essential for developing effective prevention strategies and promoting the well-being of children.

Prevention is one of the main interventions to decrease the morbidity and mortality related to pediatric trauma. By raising awareness, implementing safety measures, and

providing support to at-risk children and families, we can work towards reducing the incidence of pediatric trauma and ensuring the health and safety of our youngest population. It is crucial for healthcare providers, parents, caregivers, and communities to collaborate in creating a safe environment for children to thrive and grow without the burden of preventable injuries. In addition, evaluating the etiologies of trauma and assessing the medical providing facilities could help find the Achilles Heel and try to improve them. By addressing the root causes of pediatric trauma and implementing preventive measures, we can strive towards a future where children can live healthy and active, and they can have injury-free lives.

In the present study traffic accidents are the main cause of trauma in both genders and falling from heights was the second common cause of trauma. Furthermore, trauma to the extremities accounted for the most prevalent anatomic sites of injury in both genders.

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## Competing interests

The authors declare that they have no competing interests.

## Abbreviations

Disability Adjusted Life Years: DALYs.

## Authors' contributions

EVM and SMS: conception and design of study, acquisition of data, analysis data, drafting the manuscript. EVM and SMM: conception and design of study, revising the manuscript critically for important intellectual content. All authors: acquisition of data, drafting the manuscript. All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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None.

## Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The Medical Ethics Committee of Mashhad University of Medical Sciences has approved the study (IR.MUMS.MEDICAL.1399.211). The present study did not interfere with the process of diagnosis and treatment



of patients and all participants signed an informed consent form.

### Availability of data and materials

The data used in this study are available from the corresponding author on request.

### Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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