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## Original Article

## Prognosis in children with traumatic injuries referring to the emergency department

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## ABSTRACT

**Purpose:** Trauma may lead to serious complications in children patients. The purpose of this study was to investigate prognosis in children with traumatic injuries.**Methods:** This cross-sectional study was conducted on all of the children (<18 years old) who had suffered traumatic injuries and transferred to the emergency department of Imam Hussein Hospital by emergency medical services. After selecting the children, a checklist including information such as demographic characteristics, trauma type, consciousness level, and final outcome was recorded. Finally, the data were analyzed using *t*-test, Chi-square test and ANOVA.**Results:** In total of 564 children were investigated. Among them, 70% were males, and 33.2% were in the age range of 5–12 years. The mechanism of injuries in 97.9% of the cases was blunt trauma. The most common chief complaint among the affected children was nausea. The majority of them had stable vital signs and normal neurological tests results. However, 1.06% of them died during hospitalization. The results indicated that the final outcome in the children affected by traumatic injuries is significantly related to the type of trauma, the location of traumatic event, the vehicle used to transport them to emergency departments and their Glasgow coma scale score ( $p < 0.05$ ).**Conclusion:** Considering the young age of the child patients and over half of trauma happened at home, it is important to raise parents' awareness about the risky places and activities, which were likely to result in traumatic injuries for children.© 2019 Chinese Medical Association. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Traumatic injury is defined as the injury caused by the sharp transfer of chemical energy, mechanical energy, radiation, heat, or electricity.<sup>1</sup> Traumatic injuries were the main cause of death among the children over 1 year of age.<sup>2,3</sup> Traumatic injury was not only a health risk factor, but also a serious social problem.<sup>4,5</sup>

Unintentional injuries are the second most common cause of death in the world and bring about various kinds of disabilities in the affected people. Each day, about 2300 children and adults die of events such as motor vehicle collisions, suffocation, poisoning, and fall from height. Survived from such events, many of those were

subject to increased risk of various kinds of disabilities.<sup>4</sup> Moreover, such events not just affected the individuals' physical functions, but also brought about financial, mental and psychological consequences, which not only affected the individuals themselves, but also burden their family.<sup>1</sup>

Trauma can lead to severe deformity and disability in the body of the affected children, which can also bring about long-term psychological complications for both the children and their parents.<sup>6,7</sup> Having detailed, comprehensive, and dependable information will make it possible to prevent the occurrence of fatal events and decrease the incidence of relative physical and mental problems in long term.<sup>6</sup> Moreover, providing parents with comprehensive information can promote children's safety at home. Training parents is an effective action that can decrease the incidence of traumatic events in children. In fact, in healthcare systems, training parents is considered as one of the leading activities recommended for primary prevention of trauma.<sup>8</sup> In order to control and decrease the complications mentioned above, first of all, we need to have comprehensive information about the affected children and then

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based on that information determine and implement new health policies. Hence, this study aim to investigate prognosis in children with traumatic injuries referring to the emergency department of Imam Hussein Hospital, Tehran, Iran during 2018.

## Methods

This article is a cross-sectional study in which both descriptive and analytical methods of data analysis were used. After obtaining ethical approval from the Research Committee of Shahid Beheshti University of Medical Sciences, all children under 18 years of age who were diagnosed traumatic injuries and were transported to the emergency department of Imam Hussein Hospital, Tehran, Iran by emergency medical services (EMS) enrolled in the study. The children whose parents did not want them to participate in this investigation were excluded. Using a checklist, the needed information about the children including their demographic characteristics, information about the date, time, location, and mechanism of the traumatic event, type of trauma, comorbidities, use of protective equipment, consciousness level with Glasgow coma scale (GCS) score, trauma severity, and prognosis were gathered and recorded. Trauma severity in this study was calculated using injury severity score (ISS). ISS can take a value between 0 and 75 wherein higher values mean more severe injuries. In order to determine ISS, the patient's information was entered into a website with this address <http://www.trauma.org/archive/scores/iss.html> and the ISS values obtained were recorded in the checklists. Finally, the collected data were all fed into SPSS Software Version 16 and the statistical analysis of data was conducted using Chi-square test.

## Results

This study was conducted on 564 children suffered from traumatic injuries, 395 (70%) of them were males. The mean age of the children was  $4.68 \pm 1.23$  years. After the classification of children based on their age, 187 patients (33.2%) were in the age range of 5–12 years. The results of data analysis indicated that 358 trauma cases (63.5%) happened at home and the most common time of admission to the hospital is afternoon (Table 1). The length of hospitalization for 411 patients (72.9%) was less than 6 h (in the emergency department). Seventy patients were admitted in orthopedic surgery department (75.7%), which was the most common department for hospitalization. The mean ISS of patients in this study was calculated to be  $12.92 \pm 6.82$ . Six of the patients (1.07%) died during hospitalization.

In 552 patients (97.9%), the mechanism of injuries was blunt trauma. Moreover, fall from heights was the most common cause of trauma. The patients in this study had no comorbidities. The needed pre-hospital interventions were conducted on the children. The most common chief complaint upon their admission to the emergency department was nausea, which was observed in 68 patients (12.5%) (Table 2). Breathing in 12 children (2.12%) was supported by a ventilator. Eighty-four patients (14.9%) had tachycardia, 17 patients (3.0%) had hypotension (lower than 90/60), and 3 patients (0.5%) had hypertension (higher than 140/90). In the clinical examinations, 10 patients (1.8%) were diagnosed with focal neurological deficit and 10 patients (1.8%) were found to have GCS scores lower than 12. Head lacerations and scalp fractures were observed in 12 (2.1%) and 8 (1.4%) patients, respectively. Three patients (0.5%) had lower back tenderness and 13 patients (2.3%) had abdominal tenderness. The reason for referral to the hospital was fracture in 119 patients (21.1%), decreased muscle strength in 25 patients (4.4%), and abnormal joint movement in 194 patients (34.39%) (Fig. 1).

**Table 1**

Demographic findings and information on trauma in children.

| Variables                                         | n (%)      |
|---------------------------------------------------|------------|
| Gender                                            |            |
| Boy                                               | 395 (70.0) |
| Girl                                              | 169 (30.0) |
| Age (year)                                        |            |
| < 1 month                                         | 1 (0.2)    |
| 1 month–1 year                                    | 34 (6.0)   |
| 1–3                                               | 84 (14.9)  |
| 3–5                                               | 83 (14.7)  |
| 5–12                                              | 187 (33.2) |
| 12–18                                             | 175 (31.0) |
| Place of trauma occurrence                        |            |
| Home                                              | 358 (63.5) |
| Streets (in city)                                 | 186 (33.0) |
| Highway (out of city)                             | 4 (0.7)    |
| Sport field                                       | 16 (2.8)   |
| Time of injury                                    |            |
| 8:00–12:00                                        | 168 (29.8) |
| 12:00–20:00                                       | 314 (55.7) |
| 20:00–8:00                                        | 82 (14.5)  |
| Injury causes                                     |            |
| Fall from height                                  | 326 (57.8) |
| Motor vehicle accidents                           | 80 (14.2)  |
| Pedestrian-vehicle accidents                      | 72 (12.8)  |
| Injured by heavy objects falling                  | 46 (8.2)   |
| Weapon/knife                                      | 4 (0.7)    |
| Explosion                                         | 20 (3.5)   |
| Assault                                           | 12 (2.1)   |
| Sports trauma                                     | 4 (0.7)    |
| Duration of hospitalization (h)                   |            |
| < 6                                               | 411 (72.9) |
| 6–12                                              | 57 (10.1)  |
| 12–24                                             | 26 (4.6)   |
| > 24                                              | 70 (12.4)  |
| ISS score                                         |            |
| <10                                               | 216 (38.3) |
| 10–20                                             | 296 (52.5) |
| 21–30                                             | 38 (6.7)   |
| 31–40                                             | 7 (1.2)    |
| 41–50                                             | 2 (0.4)    |
| >50                                               | 5 (0.9)    |
| Final situations in ER                            |            |
| Splinting and orthopedic procedures and discharge | 80 (14.2)  |
| Suture the wound and discharge                    | 40 (7.1)   |
| Leaving without any treatment                     | 22 (3.9)   |
| Overall discharge                                 | 352 (62.4) |
| Overall admission                                 | 70 (12.4)  |
| Pediatric outcomes                                |            |
| Alive                                             | 558 (98.9) |
| Expired                                           | 6 (1.1)    |

ER: emergency room. ISS: injury severe score.

The results of the data analysis revealed that the final outcome in patients with trauma is significantly related to the type of trauma ( $p = 0.005$ ), the location of traumatic event ( $p = 0.000$ ), and their GCS score ( $p = 0.000$ ). However, no significant relationship was observed between the final outcome and patients' age, gender, and the time of trauma incidence (Table 3).

## Discussion

Trauma is the most common cause of children's death in the developing countries. In the United States, the cause of children's death in 50% of the cases is trauma.<sup>9</sup> In our study, 564 children under the age of 18 years who had referred to Imam Hussein Hospital, Tehran, Iran due to traumatic injuries were investigated. Of the total number of patients investigated in this study, 70% were male and 33.2% were in the age range of 5–12 years. It was also observed that very few patients were under 1 year of age. The gender distribution of patients in this study is consistent with that

**Table 2**  
Examination and treatment of traumatic children.

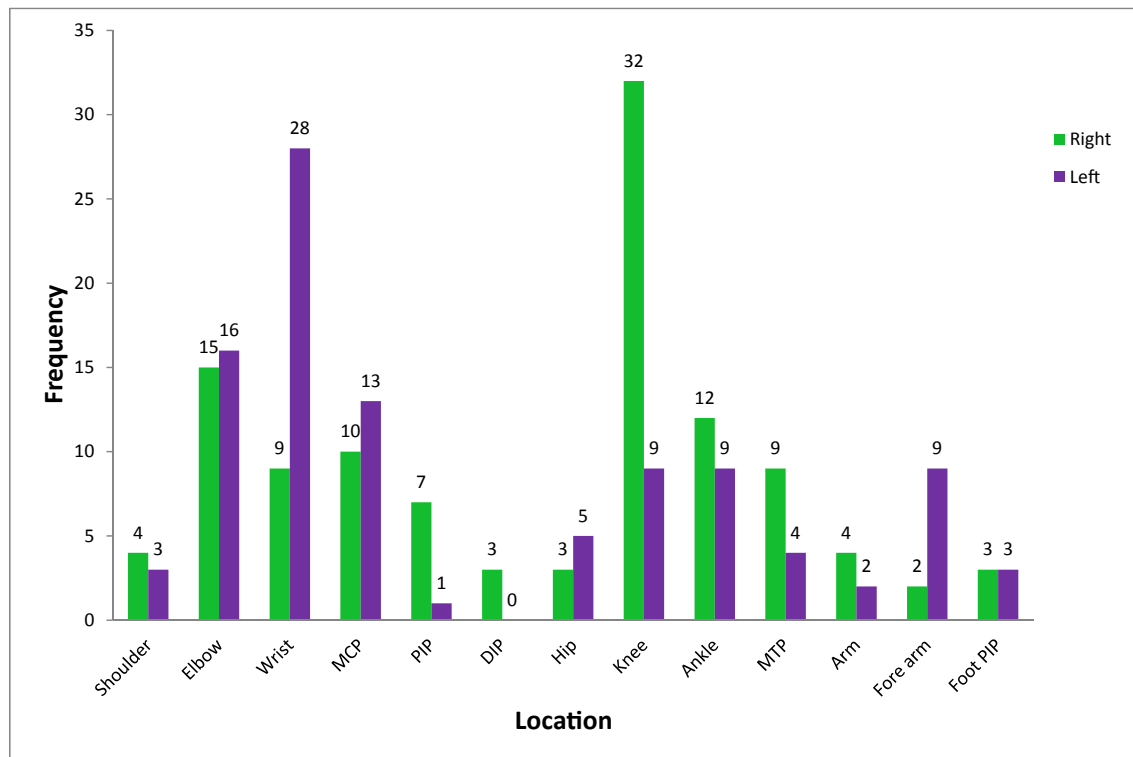
| Variables                          | n (%)      |
|------------------------------------|------------|
| Pre-hospital interventions         |            |
| Intubation                         | 12 (2.1)   |
| Hydration                          | 31 (5.5)   |
| Immobilization                     | 98 (17.4)  |
| Drug prescription                  | 17 (3.0)   |
| Symptoms in ER                     |            |
| Headache                           | 35 (6.2)   |
| Loss of consciousness              | 9 (1.6)    |
| Seizure                            | 5 (0.9)    |
| Amnesia                            | 2 (0.4)    |
| Nausea                             | 68 (12.1)  |
| Agitation                          | 15 (2.7)   |
| Abdominal pain                     | 51 (9.0)   |
| Type of skeletal injury            |            |
| Fracture                           | 119 (21.1) |
| Joint displacement                 | 4 (7.1)    |
| Laceration                         | 65 (11.5)  |
| Abrasion                           | 52 (9.2)   |
| Reduce muscle strength in children |            |
| Right upper extremity              | 8 (1.4)    |
| Left upper extremity               | 12 (2.1)   |
| Right lower extremity              | 7 (1.2)    |
| Left lower extremity               | 6 (1.1)    |

ER: emergency room.

reported in the study of Memarzadeh et al.,<sup>10</sup> In another study, Arhami-Dolatabadi et al.<sup>11</sup> investigated 547 children, of whom 69.3% were male and 50% were in the age range of 1 month–6 years. The higher number of males among the children suffered from traumatic injuries was also reported in various other studies.<sup>4,9,10,12–14</sup> The incidence of trauma in infants is quite low since during the infancy parents take care of them more carefully and also the infants who cannot move independently. As the children

grow up, their mobility increases and as a result the incidence rate of traumatic injuries increased. Furthermore, due to the more active nature of male children both out of doors and at home compared to the female ones, the incidence of trauma in male children is relatively higher. The results of this study indicated that 55.7% of the traumatic events occurred in the afternoon. In the study conducted by Arhami-Dolatabadi et al.,<sup>11</sup> 58.9% of the traumatic events occurred between 16:00 and 24:00. In the study of Jalavandi et al.,<sup>4</sup> the most common time for traumatic events occurrence was 18:00 to 24:00. Moreover, Javid et al.<sup>9</sup> reported that most of the traumatic events occurred at night.

In this study, 63.5% of children trauma cases happened at home. Furthermore, it was found that the mechanism of injury in 97.9% of the affected children is blunt trauma. The most common cause of trauma was also found to be fall from heights, which accounted for 57.8% of the total traumatic events. Javid et al.<sup>9</sup> reported that motor vehicle collisions and fall from heights are the two most common causes of traumatic injuries in children. In another study, Asadi et al.<sup>12</sup> found that 49.6% of the traumatic events occurred at home while 32.9% of them occurred in inner-city streets. They also reported that road accidents and fall from heights were the most common causes of traumatic injuries accounting for 35.1% and 40.4% of the traumatic events, respectively. Alyafei et al.<sup>15</sup> reported that the mechanism of injury in 98.2% of the affected children was blunt trauma. They also found that 35.6% of the traumas were the result of fall from heights and 35% of them occurred as the result of motor vehicle collisions. In another study conducted by Garg et al.,<sup>16</sup> the most common cause of traumatic events in children with lower age was found to be fall from heights while in children with higher age it was found to be motor vehicle collisions. They also reported that home was the most common location where traumatic events occurred. Considering the age range of the children included in their study and the rareness of penetrating and blunt traumas resulting from violent combats as well as non-traffic



**Fig. 1.** Frequency of children by abnormal joints movements.

**Table 3**  
Relationship between children's information and the final outcome.

| Variables                   | Final outcomes, n (%) |           |          | p value |
|-----------------------------|-----------------------|-----------|----------|---------|
|                             | Discharge             | Admitted  | Expired  |         |
| Age range (year)            |                       |           |          | 0.174   |
| <1 month                    | 1 (100.0)             | 0 (0)     | 0 (0)    |         |
| 1 month–1 year              | 31 (91.2)             | 3 (8.8)   | 0 (0)    |         |
| 1–3                         | 75 (89.3)             | 9 (10.7)  | 0 (0)    |         |
| 3–5                         | 68 (82.9)             | 14 (17.1) | 0 (0)    |         |
| 5–12                        | 155 (82.4)            | 28 (14.9) | 5 (2.7)  |         |
| 12–18                       | 137 (78.3)            | 37 (21.1) | 1 (0.6)  |         |
| Gender                      |                       |           |          | 0.417   |
| Male                        | 322 (81.5)            | 69 (17.5) | 4 (1)    |         |
| Female                      | 145 (85.8)            | 22 (13)   | 2 (1.2)  |         |
| Time of injury              |                       |           |          | 0.091   |
| 8:00–12:00                  | 149 (88.7)            | 18 (10.7) | 1 (0.6)  |         |
| 12:00–20:00                 | 249 (79.3)            | 60 (19.1) | 5 (1.6)  |         |
| 20:00–8:00                  | 69 (84.1)             | 13 (15.9) | 0 (0)    |         |
| Type of trauma              |                       |           |          | 0.005   |
| Blunt                       | 461 (83.5)            | 85 (15.4) | 6 (1.1)  |         |
| Penetrating                 | 6 (50)                | 6 (50)    | 0 (0)    |         |
| Places of trauma occurrence |                       |           |          | 0.000   |
| Home                        | 305 (86.6)            | 45 (12.8) | 2 (0.6)  |         |
| Street (in city)            | 144 (75)              | 45 (23.4) | 3 (1.6)  |         |
| Highway (out of city)       | 3 (75)                | 0 (0)     | 1 (25)   |         |
| Sport field                 | 14 (87.5)             | 2 (12.4)  | 0 (0)    |         |
| GCS                         |                       |           |          | 0.000   |
| <9                          | 0 (0)                 | 0 (0)     | 3 (100)  |         |
| 9–12                        | 3 (42.9)              | 1 (14.3)  | 3 (42.9) |         |
| >12                         | 464 (83.8)            | 90 (16.2) | 0 (0)    |         |

GCS: Glasgow coma scale.

and workplace traumas in this age range, this finding seems to be logical.

In this study, the GCS score of 10 children was found to be lower than 12 while for the other patients it was normal. GCS score is one of the most commonly used indices in the assessment of the severity of traumatic brain injuries in both adults and children. This score is also used in the prognosis of the final outcome of traumatic brain injuries. GCS score of lower than 8 means that the injury is quite severe, undesirable outcomes are quite likely, and there is very little chance of recovery. Although quite dependable in adults, the GCS score is less so in children. Considering that the scoring system in GCS is mainly based on patients' understanding and responding to doctors' orders and also bearing in mind the low level of compliance in children, this score is not that much dependable in child patients.<sup>17</sup>

The analysis of the final outcomes revealed that 83.68% of the children were treated and discharged by doctors in the emergency department, 12.4% of them were hospitalized and received the needed treatment, and 1.1% of them died during hospitalization. The results also demonstrated that the final outcome of patients is significantly related to the type of trauma ( $p = 0.005$ ), the location of traumatic event ( $p = 0.000$ ), and the GCS score ( $p = 0.000$ ). In the study conducted by Arhami-Dolatabadi et al.,<sup>11</sup> 98.2% of the patients were discharged with improved and stable conditions from the hospital and 1.8% of them died during hospitalization. In their study, no significant relationship was observed between mortality and trauma mechanism ( $p = 0.845$ ), neither was there any significant relationship between that and the time of trauma ( $p = 0.895$ ). Asadi et al.<sup>12</sup> also reported 1.7% mortality. They also observed that the final outcome of patients is significantly related to the age range of 12–15 years ( $p = 0.04$ ) and the location of traumatic events ( $p = 0.0001$ ). Wegner et al.<sup>18</sup> reported that in their study 85% of the child patients were discharged from emergency departments after receiving conservative non-surgical treatment and only 15% of them needed hospitalization and surgical treatment. In their study, Garg et al.<sup>16</sup> reported that 51% of the children with head trauma

needed hospitalization and surgical treatment mainly to evacuate hematoma and perform de compressive craniotomy. The mortality rate in their study was reported to be 18%. In another study which was conducted by Siram et al.,<sup>19</sup> it was observed that 93% of the children affected by trauma fully recovered from traumatic injuries in trauma centers and the mortality rate was only 7%. In their study, Alyafei et al.<sup>15</sup> reported that 44% of the child patients were hospitalized, 24% in pediatric wards and 20% in trauma intensive care unit. They also observed that only 32.5% of the hospitalized children required surgery. The mortality in their study was also reported to be 1.8%. There is a relationship between trauma severity and the mortality rate among the children affected. For example, mortality was higher among the children with head trauma or among those who had more severe traumatic injuries (determined by their trauma score). In the present study, it was observed that the mortality rate among child patients is lower compared to other patients. The reason for this might be the low severity of trauma, children's early referral to emergency departments, and the faster provision of therapeutic services to them by healthcare professionals in the emergency departments.

In this study, the mean ISS of the patients was 12.92. In the study conducted by Brown et al.,<sup>20</sup> the mean ISS of the children was 17.5. They also found that the ISS of 25 is the cut-off point beyond which the risk of mortality increases among children. In study of Alyafei et al.,<sup>15</sup> the mean ISS was 13.9 (range, 9–38). They also found that patients' ISS is significantly related to their age ( $p < 0.001$ ) and level of consciousness ( $p = 0.002$ ) while no such relationship exists between that and the mechanism of injury, gender, or type of trauma. In the study conducted by Yousefzadeh et al.,<sup>21</sup> the mean ISS of the children affected by trauma was 15.9 (range, 4–48). Their results also revealed that the sensitivity and specificity of predicting mortality among the children with ISSs greater than 16.5 is 92.5% and 62%, respectively. In the study of Palmer et al.,<sup>22</sup> the mean ISS was found to be 15. Their findings also demonstrated that there is a significantly positive correlation between mortality and ISS. Compared to other similar studies, the trauma severity in the present research was lower. Although the hospital from which the patients were selected for this study is a referral hospital, patients with notably lower trauma severity are also admitted there. That is why the mean ISS obtained in this study was relatively lower, which itself can explain the lower level of mortality among the patients investigated.

In this study, it was observed that home is the most common location of traumatic events for children, mainly because they spend much of their time at home due to their lower age. Moreover, due to the lower ISS score of the children in this study, few of them need hospitalization and the mortality rate was also relatively lower.

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## Ethical statement

Ethical approval was obtained from the Research Committee of Shahid Beheshti University of Medical Sciences.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

## Availability of data and materials

Access to data and material can be obtained through the principal investigator.

## Authors' contributions

All authors were involved in obtaining preparing and all have contributed to, read and approved the final version of the paper.

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