

Epidemiology of Trauma in Children and Adolescents Based on Emergency Medical Services (EMS 115) in Shiraz, 2017

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Abstract

Background: Trauma, the most common cause of mortality in children and adolescents, imposes high costs on the community. This study aimed to investigate the epidemiology of trauma in children and adolescents and the risk factors associated with death to provide a clinical model of traumas in terms of the type of injury and to adopt effective preventive interventions.

Methods: This cross-sectional study was conducted on 12522 children and adolescents based on the data recorded in the Emergency Medical Services (EMS 115) in 2017. The study population consisted of trauma patients who had contacted EMS 115. Then, demographic and clinical variables were analyzed using the Chi-square test and logistic regression model.

Results: The results showed that 3448 out of the 12522 participants (27.5%) were female, and 9072 (72.5%) were male. The mean age of the injured people was 11.82±5.33 years. The highest and lowest injuries frequencies were accidents (71.8%) and drowning (22%), respectively. Additionally, the highest frequency of death was related to drowning (25.93%). Furthermore, accidents, combats, falls, and drowning significantly correlated with mortality ($P<0.001$).

Conclusion: Considering the relationship between accidents, combats, falls, drowning, and mortality, it can be concluded that the identification of at-risk groups, development of training courses, and adoption of protective measures can help take an effective step toward preventing these types of injuries and declining the frequency of mortality among trauma patients.

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Introduction

Trauma is one of the leading causes of premature death and disability worldwide.¹ Children and adolescents are the most vulnerable groups at risk of illnesses and injuries,² resulting in the death of millions of children annually³ and causing permanent disability in a large number of them.⁴ As predicted by the World Health Organization (WHO) (2020), injuries caused by accidents alone will be the second leading cause of

Years of Life Lost (YLL) around the world.⁵ Childhood injuries are a growing public health problem worldwide, and millions of children suffer from diseases caused by accidents.⁶ Trauma remains a major reason for death and morbidity in children in the United States. Approximately 4% of injured children require hospital admission at an estimated cost of \$ 674 million per year.⁷ Studies conducted in the United States have shown that the prevalence of trauma was 40.1% among girls.⁸

The prevalence of childhood trauma in Western

countries is about 15 to 25%.⁹ Generally, more than 90% of all deaths affected by injuries among children occur in low-income countries. Communicable diseases are the leading cause of death in low-income Middle Eastern countries, while non-communicable diseases and traumas are the leading causes of disease burden in rich countries around the Persian Gulf. A study in Oman showed that traffic accidents followed by falls were the major causes of injury among children under the age of 15 years. Besides, injuries resulting from exposure to heat and contact with hot objects were the third leading cause of trauma among girls.¹⁰

In Iran, the mortality rate due to trauma is 58 cases per 100,000 people¹¹ and it is the second leading cause of mortality among children under the age of five.^{12, 13} Iran is a country with a large population of children. This part of the community is always exposed to various events. Hence, trauma is one of the most important reasons for referral to the emergency department and is also the most common cause of disability and mortality in this age group.¹⁴⁻¹⁶ The budget required for preventing such accidents is much lower than the costs spent for the treatments of patients, their families, the community, and the health system.¹⁷ Given the increasing incidence of accidents in Iran, it is of great importance to study trauma mechanisms associated with culture, road safety, and the facilities available in the community.¹⁸ Providing accurate national statistics regarding the incidence of trauma in children, both intentional and unintentional, and assessing these injuries and calculating their incidence and prevalence can help design effective plans for controlling and preventing such events.^{14, 19} Emergency Medical Services has a very effective role in managing trauma and reducing patient mortality. Pre-hospital care begins at the patient bedside and ends in the hospital emergency. Although pre-hospital care for children differs from that for adults, children's needs can be assessed and resolved.²⁰

Trauma is the first or second cause of death in developed and developing countries.²¹ Additionally, children and adolescents comprise a large proportion of the population in Iran. These two facts highlight the need to pay special attention to trauma among children. Since there are limited epidemiological studies on trauma in children,⁶ the present study aims at investigating the epidemiology of trauma among children and adolescents, identifying the risk factors associated with mortality, and developing a clinical model for trauma patients based on the type of injury to implement effective preventive interventions.

Methods

This cross-sectional study was conducted in 2017. The study population was all injured people who had contacted Emergency Medical Services (EMS 115) in

2017. After cleaning and removing the missing data, which were about 2 percent (250 cases), a total of 12522 cases were enrolled in the analysis. The inclusion criteria were based on ICD10 codes, including S.00 to Y09 codes. Accordingly, all cases aged 18 years and younger who had contacted an EMS center were entered into the study. However, patients whose demographic and clinical variables were not fully recorded in the EMS center were excluded from the study.

The data were collected using the information registered in the EMS centers, including demographic characteristics such as age (the following age groups: under one year, 1-4 years, 5-9 years, 10-14 years, and 15-18 years), gender, information about the accident (address, date and time of report, type of accident, and emergency case), assessments (level of consciousness (GCS), history of illnesses, patient status, and actions taken by the technician), and other information related to the accident and damage. The causes of injury were also investigated, including traffic factors, combat, poisoning, burn, poisoning, drowning, electric shock, fall, fever, seizure, heat and cold attacks, insect bite, and animal bite. For ethical considerations, the study was approved by the Ethics Committee of Shiraz University of Medical Sciences with No. 201 in 2019. Participation was voluntary and the confidentiality of the information gathered during the study was guaranteed.

The study data were described and analyzed using Stata14 software. The Chi-square test was used to describe and analyze univariate variables and a logistic regression model was used for multivariate analysis. Accordingly, Odds Ratio (OR), P value, and 95% Confidence Interval (CI) were reported. The level of significance was set at 0.05.

Results

Of the 12522 cases, 3448 (27.5%) were female and 9072 (72.5%) were male. The mean age of the injured people was 11.82 ± 5.33 years. The highest and lowest frequencies of injuries were related to accidents (71.8%) and drowning (22%), respectively. Ranked the second after accidents, falls had the second highest frequency among trauma cases and were the most frequent cause of trauma among the 10-14-years age group. In all cases, except for self-harm and bites by animals and insects, the frequency of injuries was higher in males than in females. Furthermore, 57 cases of injuries resulted in death and the highest frequency of mortality was due to drowning (25.93%). In addition, the 5-9-years age group had the largest number of cases died of drowning (37.04%). Medical and treatment measures were adopted for 8954 trauma cases, and the highest rate of treatment activities were performed for the cases injured due to self-harm (82.44%). Moreover, 5.28% of traffic accidents among children and adolescents were associated with cycling.

The majority of cases with burns were observed in the 1-4-years age group (40.24%), while the largest number of cases of accidents (44.13%) and electric shock (45.71) were observed in the 15-18-years age group. The level of consciousness was 3-8 in 0.49% of the cases and 13-15 in 98.92%. The descriptive results are presented in Table 1.

The results showed that the prevalence of self-harm was 3.9%. Besides, the highest rate of self-harm among children and adolescents was related to

poisoning with pills and self-injury, with a prevalence of 80.13% and 15.27%, respectively. Figure 1 depicts the frequency of self-herm.

The results indicated that oxygen therapy (59.68%), venipuncture (43.24%), and the use of splint and fixation (29.77%) were the most common pre-hospital measures adopted for injured children and adolescents. Figure 2 presents the frequency of pre-hospital procedures.

Table 1: Descriptive analysis of the demographic information related to accidents among children and adolescents in Shiraz, Iran, in 2017

Variable	Grouping	Number of accidents leading to an injury in children and adolescents (%)								
		Total n=12522	Accident n=8988 (71.79%)	Fall n=2116 (16.9%)	Combat n=695 (5.5%)	Self-harm n=484 (3.9%)	Burn n=82 (65%)	Electric shock n=35 (28%)	Drowning n=27 (22%)	Bites of animals and insects n=95 (76%)
Age	Under one year	51 (4%)	33 (0.37)	17 (0.80)	-	-	-	-	-	1 (1.05)
	1-4 years	1634 (13.04%)	1168 (13)	393 (18.57)	7 (0.43)	1 (0.21)	33 (40.24)	5 (14.29)	9 (33.33)	18 (18.95)
	5-9 years	2620 (20.92%)	1984 (22.07)	549 (25.95)	27 (3.88)	1 (0.21)	20 (24.39)	5 (14.29)	10 (37.04)	24 (25.26)
	10-14 years	2692 (21.13%)	1837 (20.44)	609 (28.78)	127 (18.27)	62 (12.81)	16 (19.51)	9 (25.71)	6 (22.22)	26 (27.37)
	15-18 years	5525 (44.51%)	3966 (44.13)	548 (25.90)	534 (76.83)	420 (86.78)	13 (15.85)	16 (45.71)	2 (7.41)	26 (27.37)
Gender	Female	3450 (27.5%)	2375 (26.43)	659 (31.14)	76 (10.94)	284 (58.80)	24 (29.27)	10 (22.86)	4 (14.81)	18 (18.95)
	Male	9072 (72.5%)	6612 (73.57)	1457 (68.86)	619 (89.06)	199 (41.20)	58 (70.73)	27 (77.14)	23 (85.19)	77 (81.05)
Therapeutic intervention	Applied	8954 (71.5%)	6412 (71.34)	1490 (70.42)	494 (71.08)	399 (82.44)	54 (65.85)	20 (57.14)	22 (81.48)	63 (66.32)
	Not applied	3568 (28.5%)	2576 (28.66)	626 (29.58)	201 (28.92)	85 (17.56)	28 (34.15)	15 (42.86)	5 (18.52)	32 (33.68)
The outcome of the accident	Death	57 (52%)	31 (0.34)	3 (0.14)	2 (0.29)	10 (2.07)	1 (1.22)	2 (5.71)	7 (25.93)	1 (1.05)
	Survival	12456 (99.47%)	8957 (99.66)	2113 (99.86)	693 (99.71)	474 (97.93)	81 (98.78)	33 (94.29)	20 (74.07)	94 (98.95)
Level of consciousness	3-8	60 (49%)	12 (0.13)	14 (0.01)	3 (0.43)	31 (6.40)	0	0	0	0
	9-12	74 (59%)	6 (0.07)	19 (0.01)	6 (0.86)	30 (6.20)	0	3 (8.57)	7 (25.93)	3 (3.16)
	13-15	12388 (98.92%)	8970 (98)	2083 (98.92)	686 (98.71)	423 (87.39)	82	32 (91.43)	20 (74.07)	92 (96.84)

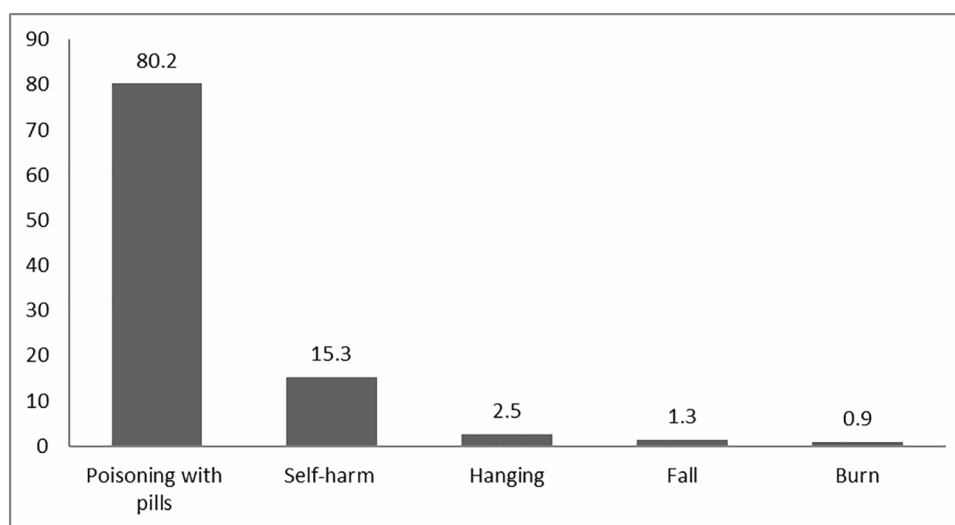


Figure 1: The frequency of self-harm among children and adolescents in Shiraz, Iran, in 2017

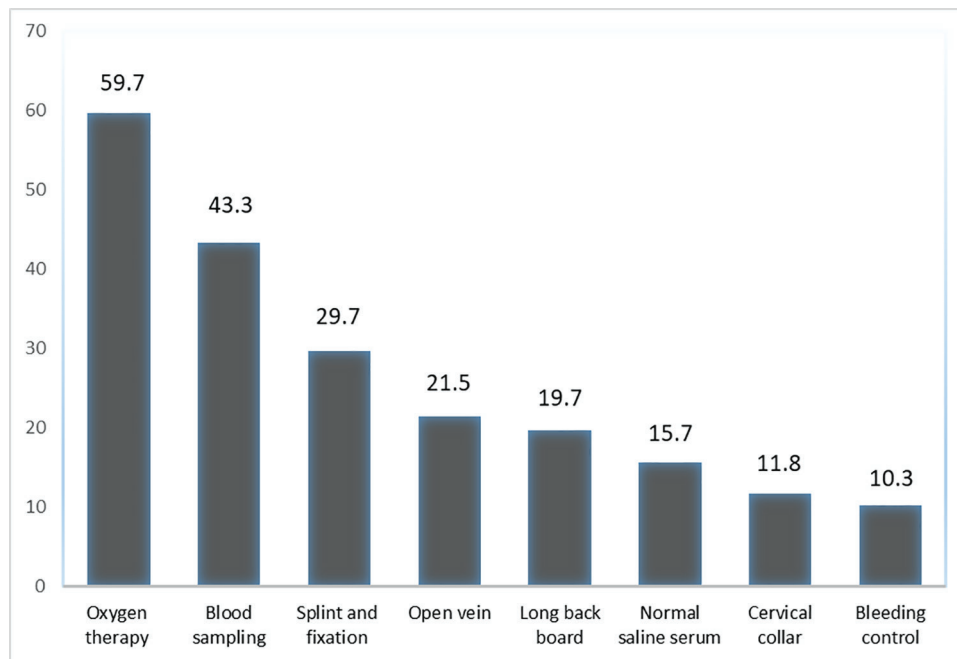


Figure 2: The frequency of pre-hospital procedures performed for injured children and adolescents in Shiraz, Iran, in 2017

Table 2: The estimated adjusted ORs of the factors associated with mortality in children and adolescents in Shiraz, Iran, in 2017

	Mortality	
	OR (95% CI)	P value
Age		
Under one year	Reference	Reference
1-4 years	0.76 (0.33-1.27)	0.51
5-9 years	0.61 (0.29-1.28)	0.19
10-14 years	0.66 (0.32-1.34)	0.25
15-18 years	0.65 (0.35-1.29)	0.24
Type of injury		
Self-harm	Reference	Reference
Accident	2.15 (0.06-0.33)	>0.001
Combat	3.09 (0.02-0.45)	>0.001
Electric shock	1.96 (0.38-10.07)	0.421
Fall	2.06 (0.02-0.26)	>0.001
Burn	1.57 (1.07-4.86)	0.041
Drowning	23.77 (6.66-84.83)	>0.001
Insect bite	0.41 (0.05-3.53)	0.422
History of diseases		
No	Reference	Reference
Yes	0.71 (0.24-2.13)	0.55

The results of multivariate analysis of mortality showed that accident ($P<0.001$, 95% CI: 0.06-0.33, OR=2.15), combat ($P<0.001$, 95% CI: 0.02-0.45, OR=3.09), fall ($P<0.001$, 95% CI: 0.02-0.26, OR=2.06), and drowning ($P<0.001$, 95% CI: 6.66-84.83, OR=23.77) had a significant relationship with mortality. Table 2 shows the results of the multivariate analysis of mortality.

Discussion

This study aimed to investigate the epidemiology of trauma among children and adolescents, identify the risk factors associated with mortality, and develop

a clinical model for trauma patients to identify fundamental strategies for preventing and reducing traumas. Based on the results, the gender distribution of trauma patients showed that most of the patients were male (72.5%), which was in line with the findings of the studies performed by Ebrahimipour¹⁸ and Mubaleghi.²² This finding might be attributed to a larger number of males in high-risk places. On the other hand, the lowest rate of trauma (0.4%) belonged to the under-one-year age group, which was consistent with the results of a study carried out by Dolatabadi et al.¹⁷ The low level of trauma in this age group might be due to the higher level of care received at this age as well as the inability to walk.

The majority of studies around the world have revealed that accidents are the most common cause of trauma.²³ The current study also showed that the most common causes of trauma were accidents and falls, which was in agreement with the results reported by Dolatabadi et al.¹⁷ Given the high rate of accidents and falls that can be prevented and controlled, it seems necessary to design training programs and observe standards and safety measures.

Heat injuries are one of the public health problems in developing and industrialized countries, which lead to high mortality among children.²⁴ In the present study, the highest incidence of burns and electric shocks occurred in males, and 40.24% of burn cases belonged to the 1-4-years age group. Moreover, 28% of the injuries were related to electric shocks, which was consistent with the results of the study performed by Tegtmeyer et al.²⁴ In general, younger children are more vulnerable since they lack enough knowledge and experience to overcome events and cannot defend themselves when faced with risk.²⁵

Drowning is the leading cause of unintentional injury-related mortalities worldwide.²⁶ In the present study, the highest mortality rate was related to drowning (25.93%). Additionally, it was more prevalent among males and the 5-9-years age group, which was in line with the results of the research carried out by Miller et al.²⁶ Existing documents and evidence have suggested that lack of child monitoring and lack of safety barriers were among the main causes of high rates of drowning among children.²⁷ Given the high incidence of death in drowning cases, it is essential to identify the risk factors and determine drowning patterns to adopt the required measures and precautions.

Poisoning is one of the most common causes of referral to emergency centers and is a leading cause of increased morbidity and mortality among children.²⁸ In the current study, the frequency of poisoning with pills was 80.13%. Since poisoning in children is unintentional and they put objects in their mouths curiously, pharmaceuticals should be kept in proper packages far from children.

The present study findings indicated that oxygen therapy, venipuncture, and splint and fixation were the most common pre-hospital measures for children and adolescents affected by traumas. Hence, medical staff must be trained about the performance of these procedures, and the necessary facilities must be provided.

Based on the analysis of age subgroups, the highest and lowest incidence rates of traffic accidents were observed among children aged 15-18 years (9.79%) and those under five years of age (2.77%), respectively. However, given the high incidence of traffic accidents in the 15-18-year age group that imposes a great deal of social and economic burden on the country, it is

necessary to identify the risk factors and to develop preventive and educational measures for this age group.

The present study results demonstrated that accident, combat, fall, and drowning significantly related to mortality. Hence, it is necessary to identify the people at risk of such injuries, determine the relevant risk factors for these injuries, and provide necessary training and control measures. As previously mentioned, there is limited epidemiological research on trauma among children.⁶ Hence, a similar study was not found in some cases to compare the results.

Study Strengths and Weaknesses

Most studies on trauma among children are based on hospital data, but the present study was conducted based on the data of 12522 affected people obtained from pre-hospital EMS 115. However, a study limitation was that some of the required information had not been registered in EMS 115 centers.

Conclusion

Iran is a country with a very young population where children make up a large part of the population. According to the findings, most injuries occurred due to traffic accidents and falls. On the other hand, death was more common in the cases of drowning, electric shock, and self-harm. Considering other types of recorded injuries, it is possible to design a clinical model, identify high-risk groups, and formulate training and care programs to take an effective step toward preventing the occurrence of these types of injuries and reducing the number of deaths among children and the active and productive generation of the community. The higher the safety education, the lower the mortality rate among children and adolescents. Given the fact that traffic accidents are one of the main causes of injury among children, future studies are suggested to investigate the type and location of accidents, promote safety considerations such as the utilization of pedestrian bridges and observing traffic rules, and identify the risk factors that lead to traffic accidents.

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Ethical Issues

This study has been confirmed by the Ethics Committee at Shiraz University Medical of Science. (IR.SUMS.REC.No.20 in 2019)

Authors' Contributions

Authors contributed equally to this work.

Conflicts of interest: None declared.

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