

Incidence and patterns of traumatic death among children and adolescents, crowded city, Iran

Abstract

Introduction: We aim to evaluate the epidemiology and pattern of pediatric traumatic deaths in an Iranian city, during the period 2011-2020, in light of the importance of information on pediatric trauma and mortality.

Materials & Methods: Present study is a retrospective cross-sectional study including children and adolescents admitted to our tertiary trauma hospital between 2011 and 2020. Information from the clinical profiles of 16413 children was gathered and analyzed, including demographics, injury type and mechanism, referral method, and site of injuries.

Results & Discussion: 151 (0.92%) deaths related to trauma were identified, 128 (84.7%) were boys and 23 (15.3%) were girls ($P = 0.033$). The mean age of children with and without mortality was 10.0 ± 6.1 and 11.0 ± 5.6 years, respectively ($P = 0.07$). 51 (33.8%) deaths occurred in children 15-18 years old ($P = 0.004$). The highest mortality was in summer with 48 people (31.8%) ($P = 0.96$). Traffic accidents with 130 (86%) cases were the most common mechanism ($P < 0.001$). The most common traumas leading to death were head and neck traumas, with 64 (42.4%) deaths. Regarding the transfer to the hospital, 123 (81.4%) deaths were referred by ambulance, while 28 (18.6%) deaths were referred by personal vehicle ($P < 0.001$).

Conclusion: Most trauma-related deaths in pediatric and adolescent children in our city were boys between 16-18 years of age, had head and neck or chest trauma, referred by ambulance, and caused by traffic accidents on streets, mainly with the car. 0.92% of trauma led to mortality, and the most common cause was head and neck injuries. Traffic accidents, the leading cause of trauma, requires social, legal, and environmental interventions.

Keywords: Epidemiology, Mortality, Child, Trauma.

Accepted: 39 days before printing

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Introduction

Injuries in children are the leading cause of death and disability globally. In the industrialized world, unintentional injuries in children account for approximately 40% of all deaths⁽¹⁾. Transportation and unintentional injuries were estimated to be responsible for 25% of deaths and 14% of Disability-adjusted life years (DALYs) among adolescents in 2019. These statistics show little improvement since 1990, when such injuries were responsible for 26% of adolescent deaths and 17% of DALYs⁽²⁾. Trauma is the third leading cause of death in the United States among 1 to 44 year old^(3,4), and More than 620,000 children worldwide died from unintentional injuries in 2010⁽⁴⁾. It is estimated that the mortality rate associated with trauma is twice as high as that associated with cancer⁽³⁾. Surviving victims also suffered from varying functional and cognitive impairments^(5,6). Disabilities sometimes were permanent, affecting the quality of life and development⁽⁶⁾. Various studies and clinical observations indicate that trauma survivors (mainly under 18) are often disabled and face high economic costs^(7,8). Over 90% of injuries and deaths from trauma occur in low- and middle-income countries, causing a financial burden on the injured person and society and indirect costs on individuals and society due to lost years of functional capacity. According to studies, this loss of years is approximately 30% for individuals under 65^(9,10). Numerous studies have shown that the most prevalent trauma among children is falls from heights, sports injuries, drownings, burns, and traffic accidents⁽¹¹⁻²⁰⁾.

Nevertheless, based on the study of different regions at various times points, as and also well as the occurrence of unpredictable events, violence, self-harm, and war are described as the most common mechanisms of trauma and accordingly accounted for half of all deaths resulting from trauma in 2000, which was equivalent to 1.6 million deaths⁽³⁾. Pediatric trauma has always been a concern for most communities and organizations due to its essential role in causing pediatric mortality^(3,15,21,22). This information is necessary for the macro-national and local planning processes and health programs, which vary according to geographical region, culture, religion, and ethnicity. However, there are no specific reports and statistics on Iran and our neighboring countries in the middle east, and research conducted in different areas indicates different and variable prevalence^(14,23).

Transport and unintentional injury continue to cause death and DALYs in children and adolescents, supporting the need to prioritize new strategies for preventing injuries⁽²⁴⁾. Most pediatric injuries can be predicted and prevented⁽²⁵⁾. Although it would be ideal to prevent all injuries, additional studies focusing on critical injuries that result in mortality are necessary because of the significant loss of life. We studied epidemiology and pattern of pediatric traumatic deaths in our city in a developing middle eastern country, Iran, classified by WHO age classification in view of the importance of pediatric trauma information and mortality in our developing communities.

Materials & Methods

Study design and setting

The present study was approved by the institutional review board (IRB) of our university of medical sciences. All patients' rights and ethical laws were observed, and the patient's personal information was kept confidential.

This study is a retrospective cohort study based on databases of the city trauma center, investigating children and adolescents aged 1-18 years old from 2011 to 2020 who were referred to the surgical triage department of our tertiary hospital, Kashan, Iran. In this study, cases of death that occurred before reaching the emergency department (ED) were excluded from the study. The study included patients who died in the ED and then were removed from the

hospital morgue. All trauma patients were resuscitated and managed by an experienced trauma team and then managed by a pediatric surgeon (in the case of pediatric traumas) and other specialists if needed.

Data collection

Data on demographics, injury type, the time span between the event and referral, referral method, clinical condition of the patient at the time of referral, date of trauma, location of incidence, type of vehicle, and site of injuries were collected.

Statistical analysis

The information was then input into the IBM SPSS version 24 software, and statistical analysis was conducted on the data. Central indices such as mean, frequency, and standard deviation were extracted from the data. Analyses were performed to compare the characteristics of patients who died and survived after admission. Depending on the type of variables and based on the normality of the data according to Shapiro–Wilk test, Chi-square or Student's t-test were used. $P < 0.05$ was considered a significant level.

Results

A total of 16413 patients, consist of 151 (0.92%) deaths and 16262 (99.08%) survived patients were included. The mean age in the mortality and non-mortality groups was 10.0 ± 6.1 and 11.0 ± 5.6 years, respectively, with no significant difference ($P = 0.07$). Among the children and adolescents who died, 84.7% were male (128 cases), and 15.3% were female (23 patients), which showed a significant difference in terms of sex differences ($P = 0.033$) (Table 1).

The highest number of deaths (16.5%) occurred in 2013 ($P = 0.64$) (Figure 1).

The highest number of deaths was in 16-18 years, with 51 people (33.8%). There was a significant difference in the number of deaths according to age group ($P = 0.004$). Regarding the mortality rate in each season, the highest mortality was in summer with 48 people (31.8%), and the lowest mortality in winter was 25 people (16.5%, $P = 0.96$) (Table 1).

The distribution of traumatized children and adolescents according to the place of the accident is presented in Table 2. The highest number of deaths was caused by street trauma with 80 cases (53%), followed by road trauma with 34 patients (22.5%).

Table 1: Distribution of traumatized children and adolescents based on demographic data

	Death	None-death	P-value
Sex			
Male	128 (84.7%)	12605 (77.5%)	0.033*
Female	23 (15.3%)	3657 (22.5%)	
Season			
Spring	43 (28.5%)	4553 (28%)	0.96
Summer	48 (31.8%)	5203 (32%)	
Autumn	35 (23.2%)	3577 (22%)	
Winter	25 (16.5%)	2929 (18%)	
Age Group			
1-5 years (early childhood)	43 (28.5%)	2882 (17.7%)	0.004*
6-10 years (middle childhood)	32 (21.2%)	3362 (20.7%)	
11-15 years (early adolescents)	25 (16.5%)	3610 (22.2%)	
16-18 years (late adolescents)	51 (33.8%)	6408 (39.4%)	
Total	151 (100%)	16262 (100%)	

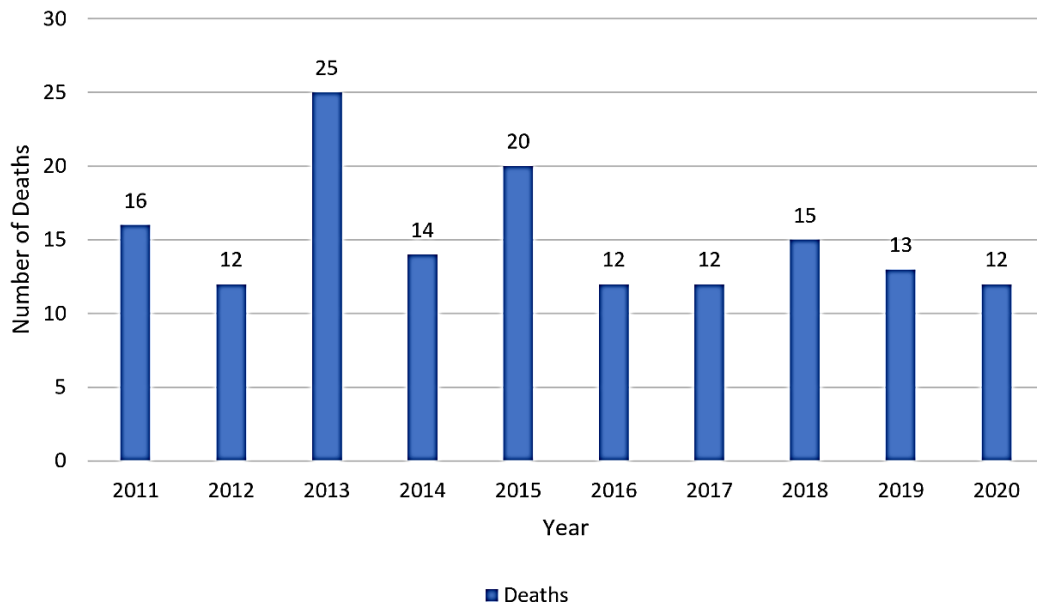


Figure 1: The prevalence of death occurred due to trauma in children and adolescents per year.

Table 2: The frequency distribution of traumatized children and adolescents separated based on the place of the accident.

Place of accident	Death	None-death	P-value
Street	80 (53%)	7755 (47.7%)	<0.001
Road	34 (22.5%)	914 (5.6%)	
Freeway	15 (9.9%)	339 (2.1%)	
House and School	11 (7.3%)	5354 (32.9%)	
Gym	3 (2%)	854 (5.2%)	
Village	3 (2%)	831 (5.1%)	
Other	5 (3.3%)	215 (1.4%)	
Total	151 (100%)	16262 (100%)	

The frequency distribution of injury sites in traumatized children and adolescents is shown in Table 3. The head and neck area were the most anatomic site of injury that resulted in death ($P < 0.001$).

Also, chest injuries are significantly higher in death cases than in the non-death group ($P < 0.001$). Abdominopelvic and limb trauma is significantly more frequent among the non-death group ($P < 0.001$). Regarding the transfer to the hospital, 123 (81.4%) deaths were referred by ambulance, while 28 (18.6%) deaths were referred by personal vehicle. In the non-death group, 42.3% were referred by ambulance and 57.7% by private vehicle; There was a statistically significant difference ($P < 0.001$).

The damage mechanism is shown in Table 4. The highest mortality in traumas was caused by accidents

and traffic accidents with 130 people (86%, $P < 0.001$). About the used vehicle in case of traffic accidents, the highest mortality was caused by motorcycle traumas with 55 people (42.3%, $P < 0.001$), followed by car accidents (31.5%).

The time interval between injury and referral from the urban area for the death group and non-death was 15.2 ± 4.1 and 15.4 ± 2.2 minutes, respectively, which was not statistically significant ($P = 0.95$). This time in out-of-town injuries for the death group and non-death was 44.5 ± 3.1 and 45.4 ± 2.9 minutes, respectively, which was insignificant ($P = 0.89$).

Regarding the patient's condition at the time of admission, the highest mortality in the clinical condition was the decrease in the level of consciousness in 88 cases (58.3%), which statistically was significant ($P < 0.001$).

Table 3: The frequency distribution of injury sites

Anatomical site of injury		Death	None-death	P-value*
Head and Neck	Yes	64 (42.4%)	4374 (26.9%)	<0.001
	No	87 (57.6%)	11890 (73.1%)	
Chest	Yes	5 (3.3%)	38 (0.2%)	<0.001
	No	146 (96.7%)	16224 (99.8%)	
Abdominopelvic	Yes	11 (7.3%)	101 (66.9%)	<0.001
	No	140 (92.7%)	16161 (33.1%)	
Limbs	Yes	41 (27.1%)	10983 (67.5%)	<0.001
	No	110 (72.9%)	5279 (32.5%)	

Table 4: Mechanism of damage (P-value is calculated with Fisher's exact test.)

Mechanism of injury	Death	None-death	P-value
Driving Accident	130 (86%)	12342 (75.9%)	<0.001
Car	41 (31.5%)	2227 (13.7%)	
Motorcycle	55 (42.3%)	9927 (61%)	
Bicycle	4 (3%)	1128 (6.9%)	
Trunk	4 (3%)	140 (0.9%)	
Pedestrian	26 (20.2%)	2840 (17.5%)	
Falling	6 (3.9%)	487 (3%)	
Burn	4 (2.6%)	325 (2%)	
Drowning	2 (1.3%)	162 (1%)	
Poisoning	2 (1.3%)	585 (3.6%)	
Violence	2 (1.3%)	829 (5.1%)	
Other	5 (3.6%)	1532 (9.4%)	
Total	151 (100%)	16262 (100%)	

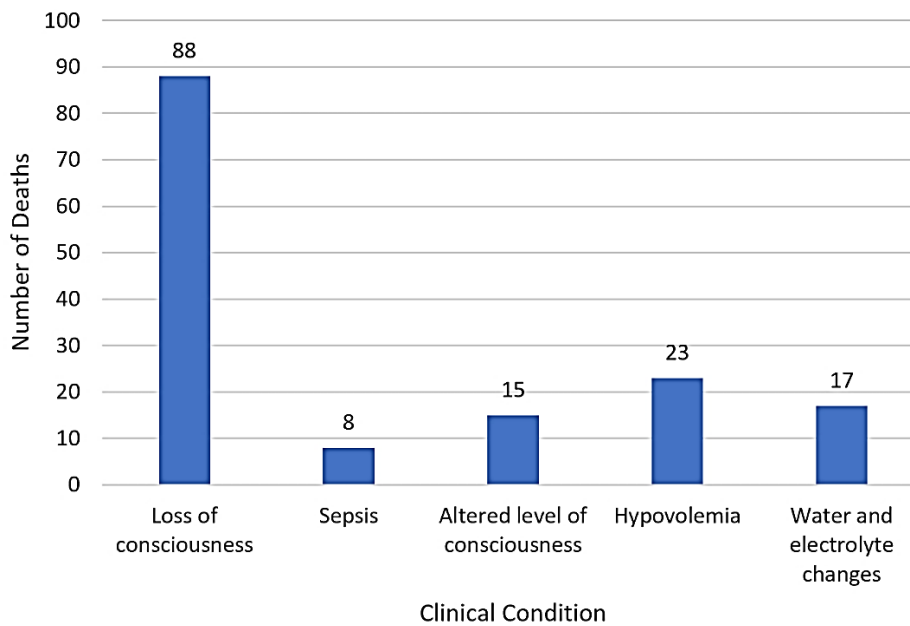


Figure 2: Patient's clinical condition at referral with mortality outcome.

Discussion

According to a study of trends in the transport and unintentional injury mortality of adolescents between 1990 and 2019, these injuries continue to be major causes of harm that remain largely unchanged as a proportion of all causes of death since 1990⁽²⁴⁾. Even though the mortality rates for these injuries are declining globally, variations and inequities exist according to trauma mechanism, time period, sociodemographics, and outcome. While progress in reducing injury rates in high-income countries has stalled, injury is becoming a major cause of death and disability in low-income and middle-income countries⁽²⁶⁾. International donors, governments, and industry must invest to satisfy this challenge, but this investment is often inadequate in low-income countries.

According to this study, most cases of trauma resulting in mortality of children and adolescents were boys, age group 15-18 years, had head and neck or chest trauma, referred by ambulance, and caused by traffic accidents on streets, mainly with the car. A total of 0.92% of trauma cases were associated with mortality, and the most traumatic death was related to head and neck trauma. There was no significant difference between death and non-death groups regarding age, date (year), season, and the time interval between injury and referral.

In a study by Arhami Dolatabadi et al.⁽²⁷⁾ between 2011-2012 in Tehran, Iran, the information of 547

children was examined. According to this study, most referred under 14 years patients to the ED of the hospital were boys, in the summer season, between 16:00 and 24:00, and due to traffic accidents, which complies with our study. Due to the prevailing cultural conditions, it can be said that the use of vehicles by girls is less, and therefore they are less exposed to traffic injuries. In the mentioned study, 1.8% of trauma cases have died. The highest fatality rate due to trauma was related to chest and abdominal trauma. While in our study, this value was 0.92%, and the highest fatality rate due to trauma was related to head and neck trauma.

In our study, the highest mortality was caused by motorcycle trauma with 55^(42.3%) patients. Bowman et al.⁽²⁸⁾ also pointed out that the less strict rules related to motorcycles and their relatively low price and convenience for use in the studied age group effectively raise the resulting accidents. On the other hand, the people in our studied age group have sometimes been the victims of their parents' carelessness, which has led to accidents. As a result of our study, accidents were the leading cause of trauma (50%), and falling from a height was the second most common cause (36%). As high as 32% of children were injured in a bicycle or motorcycle accident.

In our study, due to limiting laws for using weapons in Iran, firearms and subsequent deaths are the least common cases, and in this study, trauma due to firearms wasn't found. However, in a survey

conducted by Kayani et al.⁽²⁹⁾ in 2001-2005, in Missouri, 1358 patients died from traumatic brain injury. Motorcycles and firearms accounted for 88% of the total causes. According to a study by Cavalcanti et al.⁽³⁰⁾, which was the result of the autopsy of the bodies of children who died 0-4 years old due to external causes, the leading causes of death were drowning (34%) and vehicle accidents (22%). Among the dead, 56% were male, and about 27% were under one year old. Head and face injuries were seen in 34% of the bodies. According to this study, there was a solid and significant relationship between vehicle accidents and the incidence of head injuries. The findings of this study showed that head and neck traumas are the most common anatomical location of trauma in the death group. Anatomically, children have a larger head-to-toe ratio, and their skull bones are thinner than adults, so this might explain the higher risk of head and neck trauma^(31,32). Another important finding of this study is transporting the injured patient to the hospital. According to the present study results (81.4%), 123 deaths were referred by ambulance, while (18.6%) 28 deaths were transferred by personal vehicle.

There were several limitations to this study. This study did not include the death mechanism, so it was not possible to determine an accurate mechanism of mortality. Furthermore, sending children through the emergency system requires staff training and familiarity with the differences between sending children and adolescents at all stages, including vascular access, resuscitation, etc. Unfortunately, this level of expertise is absent in this study, which makes the study prone to bias. Another important limitation of this study was the inability to determine the severity of the traumas based on existing classification systems. Last but not least, despite suspected cases of child abuse resulting in death and trauma in our study, the necessary evidence was unavailable.

Conclusion

Different causes of children's trauma have been implicated based on different environmental conditions, laws, and various times, which is why epidemiological studies are important for resolving these problems. Our studies showed that most trauma-related deaths in pediatric and adolescent children during 2011-2020 in Kashan, Iran, were boys, between 15-18 years of age, had head and neck or

chest trauma, referred by ambulance, and caused by traffic accidents on streets, mainly with the car. 0.92% of trauma led to mortality, and the most common cause was head and neck injuries. It also seems that due to strict rules regarding using firearms, no cases of trauma caused by firearms. However, in our city, traffic accidents were the leading cause of trauma in children and adolescents, which requires social, legal, and environmental interventions.

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