Childhood injuries in Tehran: a review of 1281 cases

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SUMMARY: Karbakhsh M, Zargar M, Zarei MR, Khaji A. Childhood injuries in Tehran: a review of 1281 cases. Turk J Pediatr 2008; 50: 317-325.

Childhood injuries cause significant mortality and morbidity in Iran, like in other developing countries. This study was undertaken to describe the pattern of pediatric trauma in a multi-center hospital-based study. Pre-hospital and hospital data were prospectively gathered on all hospitalized trauma patients admitted to six major trauma hospitals in Tehran from August 1999 to September 2000. Data from patients 12 years of age and younger were analyzed for this article. About 15.1% of the hospitalized trauma cases belonged to children. Mean age was 7.35±3.25 years and 69.1% of cases were male. Most of the cases were injured accidentally. More than half of the cases were injured due to falls, followed by road traffic accidents. Injuries in streets were the most common, followed by injuries at home. Recently, several injury prevention strategies have been designed and developed in Iran, and it is hoped these may contribute to decreasing the burden of childhood injuries in Iran.

Key words: pediatric, injuries, childhood, trauma, Tehran, Iran.

Injury is a major cause of death and disability throughout the world[1,2]. It ranks first among the causes of death in children from early childhood through adolescence[3,4]. About one-quarter of all children experience a medically attended injury each year[2,5,6]. The more serious injuries that lead to hospitalization comprise 5-10% of all pediatric injuries[6,7]. These injuries, along with the fatal accidents, cause major suffering for the children and are also a large economic burden for society[8,9].

In the United States, an estimated 600,000 children are hospitalized annually because of injuries and more than 15 million are seen in emergency departments[10]. In the European region, injuries account for 23% of deaths from all causes and 19% of disability-adjusted life years (DALYs) from all causes in the age group 0-19 years[11]. Despite the declining rates of child injury-related death in developed countries[12], the burden of disease attributable to child injuries is increasing in developing countries[13-15]. Furthermore, mortality is often described as the 'tip of the injury iceberg', because for every child who dies many more will suffer non-fatal injuries; a proportion of these will be left with varying degrees of disability. Hazardous living conditions; heavy traffic with scarce separation of vehicles from pedestrians; and lack of safe play spaces, childcare options and health care facilities compound the problem for many children in these settings[16].

Injuries in Iran, similar to other developing countries[17-19], cause significant mortality and morbidity[20,21]. Nevertheless, data on childhood trauma in these countries are rather scarce and limited. Some studies have been published on the epidemiology of pediatric injuries in Iran. Some of these articles focus on specific aspects [e.g. cycling-related injuries[22], fatal pediatric injuries[23] and burns[24]].

Regional collection and analysis of injury-related data is vital for design and implementation of injury prevention initiatives. In fact, knowledge of the epidemiology of pediatric injury must be grounded in an understanding of the mechanism and pattern of injures encountered by various age groups[25]. This study was undertaken to describe the patterns of pediatric trauma in a multi-center hospital-based study in Tehran.

Material and Methods

Pre-hospital and hospital data were prospectively gathered on all hospitalized trauma patients (for at least 24 hours) admitted to six major trauma hospitals in Tehran from August

1999 to September 2000. Data from patients 12 years of age and younger were analyzed for this article. In our country, cases of pediatric trauma are not admitted to general pediatric hospitals but are referred to trauma centers. Our data set does not include poisoning and burn patients, as these are admitted in other specialized centers. Structured, closed-ended questionnaires designed and developed based on National Trauma Databank of American College of Surgeons Committee on Trauma[26] were used for data collection. Demographic data, patterns of injuries [intentionality, mechanism, place of injuries, external cause of injury code (E code) from the International Classification of Diseases, 10th Revision (ICD 10), and Injury Severity Score (ISS) using the Abbreviated Injury Scale (AIS) 1990 revision[27]] were recorded by trained physicians through these questionnaires. ISS below 7 was grouped as mild, 7 to 12 as moderate, and higher than 12 as severe. SPSS version 11.5 was used for statistical analysis.

Results

From 8,453 hospitalized trauma patients, 1,281 cases (15.1%) belonged to children.

Distribution of Injuries by Age and Sex

Mean age was 7.35±3.25 years (median=8.0 years) and 69.1% (n=885) of cases were male. In fact, boys were affected 2.2 times as often as girls. 1.6% of cases were younger than 1 year of age, 13% between 1 and 3 years, 24.4% between 4 and 6 years, 30.3% between 7 and 9 years, and 30.6% between 10 and 12 years of age.

Pre-Hospital Information

Only 72 cases had been transported to hospital by emergency service ambulances (5.6%). Twenty-four percent of cases had received pre-hospital care before reaching the hospital (n=307).

Intentionality of Injuries

Most of the cases (98.6%) were injured accidentally. There were 18 cases of violence (1.5%). Of these cases of violence-related injuries, 10 (55.6%) were injured by hitting with bodily force and 3 were stabbed with knife (16.7%).

Mechanism of Injury

Overall, blunt mechanism accounted for 97.7% of our trauma cases (n=1251). Penetrating injuries were uncommon, occurring in 2.3% (n=30), including 15 cases with accidental injury with sharp glass, 4 injuries with knife, 4 injuries with foreign body entering into skin, 3 injuries by assault with sharp objects, 2 injuries due to contact with hand tools (like scissors) and 2 other cases with unspecified penetrating injuries. More than half of our cases (50.6%) were injured due to falls (n=648), followed by 40.6% injured in road traffic accidents (n=520). A remarkable proportion of fall-related injuries (33.2%) were due to accidental stumbling or slipping to the ground. For the purpose of comparison, mechanisms were divided into motor vehicle and non-motor vehicle-related injuries.

Motor Vehicle-Related Injuries

Mean age of these 520 cases was 7.57 with a standard deviation (SD) of 2.95. Children 7-9 years of age comprised a considerable proportion (32.1%), followed by 10-12 years (30.2%) and 4-6 years (28.5%); 68.7% of these cases were male (n=357) and 31.3% were female (n=163). Details of mechanisms of motor vehicle-related injuries are demonstrated in Table I.

Non-motor Vehicle-Related Injuries

Mean age of these 761 cases was 7.2 with a SD of 3.44. Children 10-12 years of age predominated (30.9%), followed by those 7-9 years (29%). In fact, falls were the predominant mechanism of injuries in all age groups, except for those 7-9 years of age, in whom falls followed road traffic accidents as the leading cause. Of these cases, 69.4% were male (n=528) and 30.6% were female (n=233). More than 85% of these cases were injured due to falls (n=648). Details of mechanisms of fall-related injuries are demonstrated in Table II.

Location of Occurrence of Injury

Injuries in streets were the most common (45%), followed by injuries at home (38%). The most common mechanism of trauma in houses was falls (83.9%), especially falls from heights of less than 4 meters (46%). Males

Table I. Patterns of Motor Vehicle-Related Injuries in Children

Mechanism	Number (%)
Pedestrians	**346 (66.53)**
Collision with a car	259 (49.81)
Collision with a motorcycle	65 (12.5)
Collision with a bus or other heavy vehicle	12 (2.31)
Collision with a bicycle	6 (1.15)
Collision with a train	1 (0.19)
Collision with an unspecified object	3 (0.58)
Car passenger	**56 (10.77)**
Collision with another car	23 (4.23)
Car overturning	11 (2.11)
Collision with a fixed object	7 (1.35)
Collision with a heavy vehicle	5 (0.96)
Occupant of van/truck	4 (0.77)
Unspecified	6 (1.15)
Motorcycle rider	**47 (9.04)**
Collision with a car/van	21 (4.03)
Overturning	10 (1.92)
Collision with a heavy transport vehicle	1 (0.19)
Collision with a fixed object	1 (0.19)
Collision with an unspecified vehicle	14 (2.69)
Bicycle rider	**67 (12.88)**
Overturning	34 (6.54)
Collision a with car/van	21 (4.04)
Collision with a motorcycle	4 (0.77)
Collision with an unspecified vehicle	6 (1.15)
Collision with a heavy transport vehicle	2 (0.38)
Others	**4 (0.77)**
Total	520 (100)

Table II. Patterns of Fall-Related Injuries in Children

Mechanism	Number (%)
Slipping, tripping, stumbling	215 (33.18)
Fall from stairs and steps	114 (17.59)
Fall from buildings	80 (12.34)
Fall into cavities, holes	50 (7.72)
Fall from playground equipment	27 (4.17)
Fall while being carried	21 (3.24)
Fall from furniture (except chairs)	21 (3.24)
Fall on collision with another person	14 (2.16)
Fall from trees	13 (2.01)
Fall from chairs	13 (2.01)
Fall from beds	12 (1.85)
Fall from ladders	10 (1.54)
Fall from scaffoldings	6 (0.92)
Assault by bodily force	4 (0.61)
Assault by pushing from high place	1 (0.15)
Others/unspecified	47 (7.25)
Total	648 (100)

were more commonly injured in streets/roads (51% of males); while females were more commonly injured at home (46.5% of females). A significant relationship was observed between place of injuries and sex ($p<0.001$).

Hourly and Seasonal Peaks

Approximately 31.6% of injuries were sustained in summer. Approximately 34% of injuries occurred from 4 to 8 p.m. followed by 12 noon to 4 p.m. (21.7%).

Anatomical Sites and Types of Injuries

A total of 2,739 injuries were observed in 1,281 cases. Lower extremities were the most common anatomical site harboring 912 injuries, followed by head with 899 and upper extremities with 745 injuries. The frequency distribution of injuries according to anatomical sites and mechanism is demonstrated in Table III. Figure 1 demonstrates the distribution of injuries according to anatomical site and external cause (fall related, road traffic accidents and others).

Number of Injuries

As is evident from the total number of injuries (n=2,739) - which is well above the number of cases (n=1,281) - many cases sustained more than one injury. In fact, only 627 cases (48.9%) had one injury, while the rest of the patients suffered from multiple injuries (Table IV).

Injury Severity Score (ISS)

Most of cases had mild ISS (80.2%), followed by moderate severity of injuries (10.3%). Only 9.3% were categorized as high ISS. Mean ISS in cases of road traffic accidents was significantly higher than that of ISS due to falls (7.7 vs. 4.9) ($p<0.001$).

Mortality

Twenty-nine cases died (2.26%), and the mechanism of trauma in 22 of them (76%) was road traffic accidents. Twenty-two of these cases died in the emergency department, 5 died in the intensive care unit, 1 died in the operating room and the last died in the surgery ward. Of 29 cases of death, 26 had a high ISS score (89.7%). The underlying cause of death (according to ICD 10) was skull fracture in 8 (27.6%) and intracranial injuries in 15 (51.7%). In the remaining cases, other etiologies like injury to blood vessels and traumatic shock were implicated.

Discussion

This article deals with the problem of childhood injuries in Iran according to a hospital-based study.

Like similar studies, boys were more commonly hospitalized than girls due to injuries[19,28,29]. Boys are often given greater freedom to roam, and are more likely to be injured than girls[29-35]. The 2.2:1 male to female ratio in our setting is similar to the 1.5:1 to 3:1 ratio reported by others[1,2,18,19,28,30]. As adolescents, again males predominate because of their high activity levels and participation in high-risk activities[36].

The mean age of hospitalized cases in our study was 7.35 with a median of 8. This is also in accord with results from other studies conducted in developing countries[28,29]. In our study, falls were the leading cause of hospitalizations in all age groups followed by road traffic accidents (except in 7-9 years in whom falls were the second after road traffic crashes). Predominance of falls as the major cause of childhood trauma has also been reported by some other reports from the United States[37] and Spain[38]. Slipping and falling from stairs comprised most of the fall-related injuries. In a study from Singapore, falls due to slipping were the commonest among children, followed by fall from beds[29].

The preponderance of falls among the mechanisms of trauma leading to hospitalizations, especially falling to the same level due to stumbling and slipping, might be attributed to low levels of physical standards of housing (unsafe placement of carpets, low lighting in corridors and playground, stairs without safety bars, etc.). Some authors believe that physicians must be involved actively in developing strategies to decrease the occurrence of falls by counseling parents of small infants to increase supervision during play activities and to restrain children from playing unsupervised on stairs, balconies, or near open windows. Mandatory insertion of window bars, regular verifications by building owners and city officials, and legislative measures to enforce safety standards could lead to long-term benefits in decreasing

Table III. Frequency Distribution of All Sustained Injuries (n=2739) According to Anatomical Site and Type of Injuries

Type of injuries Anatomical site	Superficial injury	Open wound	Fracture	Dislocation	Nerve injury	Vascular injury	Muscle and tendon injury	Crush injury	Traumatic amputation	Internal organ injury	Unspecified	Total (n/%)
Head	426	160	162	1	5	0	143	2	0	0	0	899 (32.8)
Neck	9	2	5	0	1	1	0	0	0	0	0	18 (0.7)
Thorax	61	5	9	0	0	0	0	4	0	0	0	79 (2.9)
Abdomen and pelvis	79	11	23	0	0	1	16	9	1	0	0	140 (5.1)
Shoulder and upper arm	38	5	215	3	2	1	1	0	0	0	0	265 (9.7)
Elbow and forearm	98	26	235	15	0	0	1	0	0	1	0	374 (13.7)
Wrist and hand	59	20	17	1	0	0	5	2	2	0	0	106 (3.9)
Hip and thigh	100	8	223	2	0	3	0	1	0	0	0	337 (12.3)
Knee and lower leg	194	52	140	0	1	1	4	0	0	3	0	395 (14.4)
Ankle and foot	41	44	20	3	0	0	3	5	2	2	0	120 (4.4)
Unspecified	0	0	0	0	0	0	0	0	0	0	6	6 (0.2)

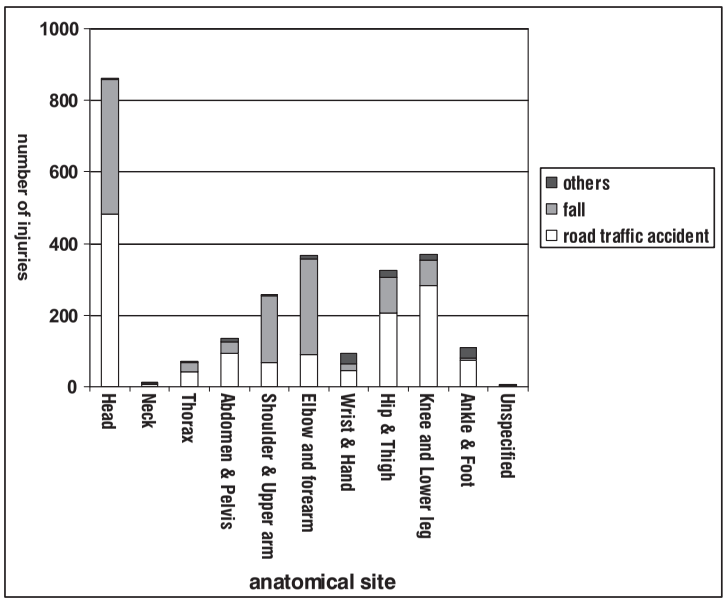

Fig. 1. Distribution of injuries according to anatomical site and external cause.

Table IV. Frequency Distribution of Pediatric Trauma Cases According to Number of Sustained Injuries

	Injury mechanism			
Number of injuries	Road traffic accident (n=520)	Fall (n=648)	Others (n=113)	Total (n=1281)
One	151	415	62	628
Two	130	124	33	287
Three	89	58	12	159
Four	57	26	3	86
Five	41	10	2	53
Six	25	6	0	31
Seven or more	27	9	0	36

injuries caused by falls from heights[39]. On the other hand, in some cases of fall from stairs and heights, child abuse might be implicated. One large series reported that about one-fourth of the falls were "not accidents"; some children jumped to avoid beatings or fires, some were pushed by siblings or parents, and some attempted suicide (all the suicide attempts were adolescents)[40]. According to Reece and colleagues[41], a substantial percentage of head injuries requiring hospitalization in children younger than 6.5 years is attributable to inflicted injury. In our study, only 18 cases of child abuse were recorded, of which 5 were categorized as fall-related. Intentional injuries are likely to have been under-reported due to social stigma and criminal implications[42], like in some other developing countries[43-45]. In some developed countries like the United States, child abuse is prone to both under- and over-reporting due to mandatory reporting regulations[46].

Road traffic accidents were the most common mechanism of pediatric injuries in a report from Canada, followed by falls[47], while another study in the United States in an urban setting showed the predominance of falls over road traffic accidents[48]. In that study, most of the victims of road traffic accidents were the car occupants followed by pedestrians, while in our study pedestrians predominated.

In a study from Ghana (sub-Saharan Africa), the most common injuries in children that resulted in loss of days of normal activity were reported to be pedestrian injuries, burns and falls[17].

Pedestrian injuries sustained in collision with motor vehicles, which occurred in 259 of our cases, remain a major cause of pediatric morbidity and mortality throughout the world, especially in economically disadvantaged communities[28,49,50]. A child's risk of pedestrian injury is likely related to his overall exposure to traffic. However, urban children participate in other activities in addition to street crossing that expose them to traffic and therefore place them at risk for traffic-related injuries[49]. These activities include playing football, etc. in streets/alleys in our country.

Regarding the anatomical site of injuries - like some other reports - extremities (especially lower limbs) were the most commonly affected region, followed by the head[28].

Although we only included cases admitted for more than 24 hours and all these hospitals were referral, most of our cases had low ISS. This is probably due to lack of triage or justified system for patient referral in our trauma system.

The main reason for death in our cases was head trauma, especially intracranial injuries. Most of these cases had ISS higher than 12; thus, it can be concluded that severity of injuries, especially in those sustaining head injuries, was responsible for death in most of our fatal cases. In developed countries, many studies have shown that head injuries are the most common cause of death among trauma victims[51-54], followed by gunshot injuries[55,56]. In the developing nations, head injuries and burns are the leading causes of death from trauma[57-59].

One of the limitations of our study is that burns and poisoning cases are not represented as they are admitted to specialized centers in our country. In addition, our data set just demonstrates the pattern of injuries in hospitalized pediatric trauma cases. In our country, as in other developing countries, many victims are dying in the field and never reach the hospital[28]. In Iran, like in many other developing countries, developments in

motorization and industrialization occurred much faster than in industrialized countries[21] without the accompanying improvements in the knowledge and practice of road safety. This can contribute to the high prevalence of death and disabilities due to injuries in Iran. In recent years, the rate of increase in traffic accidents in Iran was very high, with traffic accidents increasing by 55% between 1994-1996[60].

Recently, several injury prevention strategies have been designed and developed in Iran (like educating children on safe road crossing through television clips, etc.), and it is hoped these may contribute to decreasing the burden of childhood injuries in Iran. For example, legislations mandating helmet use have been put into practice recently in Iran, but you frequently see children without helmets riding on motorcycles with their parents. Bicycling in public places is not popular in Tehran, even among children and adolescents, and the use of protective devices such as helmets in this group is even less than that of motorcyclists[61].

In a study on community health workers' knowledge of risk factors of childhood injuries in Iran, more than 96% of respondents believed that injury prevention programs should be identified as a regular health service in rural health centers. They also strongly agreed that injury prevention must be taught to mothers of young children and that a national program on childhood injury prevention should be implemented[62].

Progress in injury control requires concerted community action[63]. Physical separation of pedestrians from vehicles, pedestrian crossing signs and zebra crossings, improvement in the roadway lighting especially at night, and education of children in obeying the traffic rules are recognized as the most important strategies that can lessen the magnitude of the pedestrian-related injuries in Iran.

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