

RESEARCH ARTICLE

Epidemiology of Hand Injuries in Children Presenting to an Orthopedic Trauma Center in Southeast of Iran

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Abstract

Background: Hand injuries are among the most common childhood injuries. No study has been performed regarding the epidemiology of hand injuries in the pediatric population of Iran.

This study aimed to examine the epidemiology of hand injuries among children in southeast of Iran.

Methods: This cross-sectional study was performed via census sampling on patients, aged 16 years or less, with a final diagnosis of hand injury. Patients presenting to the orthopedic department of Khatam-al-Anbia General Hospital of Zahedan, Iran, were selected from March 2012 to December 2013. Data were analyzed retrospectively, using a chart review.

Results: Two-hundred patients (136 males and 64 females with the mean age of 13 ± 2.8 years) with 205 hand injuries were included in this study. As the results indicated, door-related injuries were the most common type (25%), accounting for 24% and 28% of injuries in male and female patients, respectively ($P=0.016$). Most injuries occurred at home (64%) and the lowest number was reported at school (22%) ($P=0.012$). Compared to boys, girls were more likely to be injured at home (78% vs. 57%) ($P=0.13$). In addition, the dominant hand was mostly injured by doors (28%). The most common type of injury was laceration (81%) and the least common type was finger amputation (7%); also, children with finger amputation were significantly younger than those with other types of hand injuries ($P<0.001$). Thumb alone (20%) and index and middle fingers together with an equal percentage (3.5%) were the most commonly injured digits. Also, the mean hospitalization cost was 297 ± 38 dollars.

Conclusions: Most hand injuries occurred at home and were door-related; they were also more frequent among younger children. Prospective studies in order to identify specific protective door devices could potentially decrease the frequency of these injuries.

Key words: Childhood, Epidemiology, Hand injury

Introduction

Hand injury is among the most common childhood injuries and is the leading cause of morbidity in children (1). During accidents, hand is said to be the part of body most often thrust out to reduce the consequences, resulting in a wide array of soft-tissue and chondro-osseous injuries (2). Fingertip injuries are the most common hand injuries in children, which require medical care at trauma centers (3).

The majority of injuries are treated conservatively and hospitalization is not needed. However, in case of highly severe injuries or patient's young age, surgery

under general anesthesia is often required (2). Health and disease profiles in Iran indicate a transition from the dominance of communicable diseases to that of non-communicable diseases and road traffic injuries (4). Little information exists regarding the relationship between the mechanisms/location of injuries and the resulting outcomes and treatments. Although hand is the most frequently injured organ of a child's body, there is little epidemiological data about pediatric hand fractures (2, 5, 6). This paper highlights the changing pattern and different varieties of hand injuries in different pediatric age groups.

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THE ONLINE VERSION OF THIS ARTICLE
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This study, the first of its kind in Iran, describes the etiology and mechanism of pediatric hand fractures and patients' demographics at the orthopedic department of Khatam-al-Anbia Hospital, affiliated to Zahedan University of Medical Sciences in southeast of Iran. The purpose of this retrospective, clinical study was to identify the epidemiology, pattern and site of hand injuries in different pediatric age groups, attending atrauma center.

Materials and Methods

This observational, cross-sectional, epidemiologic study was performed on patients, aged 16 years or less, with a final diagnosis of hand injury. Our study was performed at Khatam-al-Anbia General Hospital of Zahedan, Iran. All children with a final diagnosis of hand injury, presenting to the orthopedic department, were evaluated from March 2012 to December 2013.

Hand injury is defined as any form of trauma to the hand such as laceration, puncture wound, contusion or fracture, caused by a variety of mechanisms. In this study, census sampling was applied and the inclusion criteria were as follows: 1) ≤ 16 years of age; and 2) blunt, penetrating injuries of hands or fingers including laceration, puncture wound, sprain, fracture, dislocation, soft tissue injuries distal to volar wrist crease, bone injuries and articular injuries distal to radiocarpal and ulnocarpal joints.

The exclusion criteria were as follows: 1) injuries of other parts of the body; 2) hand and finger anomalies

in the affected part; and 3) child abuse. Professional sports are not commonly performed in this age in Southeast regions of Iran. Therefore, considering the low number of sports injuries, they were not considered as a separate cause and were combined in the category of fall-related injuries. According to the inclusion and exclusion criteria, 200 patients were included during the study period.

Information was recorded retrospectively, using a data sheet, completed for each patient; the data sheet was filled by one of the researchers. The following information was included in the sheets: patients' demographic characteristics, fractures, amputations, lacerations, nail bed injuries, soft tissue defects, complications (e.g., infection, pulp avulsion, fracture and amputation), type and number of the affected fingers (involving palms and wrists), dominant and non-dominant hand involvement, time interval between the accident and admission (< 1 hr, < 6 hrs, or > 6 hrs), length of hospital stay, hospital discharge and type of medical procedures (obtained from the charts). The information was entered to a computer. Parametric variables were evaluated using ANOVA and t-test. Non-parametric variables were assessed, using Kruskal-Wallis test and dichotomous variables were evaluated by Chi-square.

Results

During the study period, 200 patients including 136 males and 64 females with the mean age and standard deviation of 13 (2.8) years within the age range of 1-16 years were included in this study. The mean and

Table 1. Epidemiology of the hand injuries among children in Southeast of Iran

	Male	Female	P value*
Accident site, no. (%)			
School	21(15)	7(11)	0.012
Home	78(57)	50(78)	
Street	37(27)	7(11)	
Home location, no. (%)			
Kitchen	71(43)	40(62)	0.13
Bathroom	24(26)	12(19)	
Room	41(31)	12(19)	
Cause of accident, no. (%)			
			0.016
Door	32(24)	18(29)	
Traffic accident	23(17)	5(8)	
Cooking devices	16(12)	16(25)	
Glass	26(19)	17(27)	
Stab wound	15(11)	2(3.1)	
Fall	24(18)	5(8)	
Electric shock	0(0)	1(2)	

* P values are shown to compare between male and female. Analysis was done by Chi-Square

Table 2. Comparing the mean hospitalization day and accident site and causes

Hospitalization Day	Mean \pm SD	95% Confidence Interval for Mean	P value*
School	1.14 \pm 0.44		<0.001 ^a
Home	1.11 \pm 0.32		
Street	1.40 \pm 0.58		
Cause of accident			
Door	1.12 \pm 0.32	0.91-1.53	<0.001 ^b
Traffic accident	1.53 \pm 0.63	1.1-2.17	
Cooking devices	1.09 \pm 0.29	0.89-1.41	
Glass	1.13 \pm 0.41	0.82-1.63	
Stab wound	1.17 \pm 0.39	0.79-1.57	
Fall	1.13 \pm 0.34	0.83-1.49	

^aP values are shown to compare the mean hospitalization day and accident site and causes Analysis was done by The ANOVA test
^aA post hoc analysis between Mean hospitalization at home and street was statistically significant (P Value=0.008)
^bA post hoc analysis between Mean hospitalization at traffic accident and falling was statistically significant (P Value=0.03)

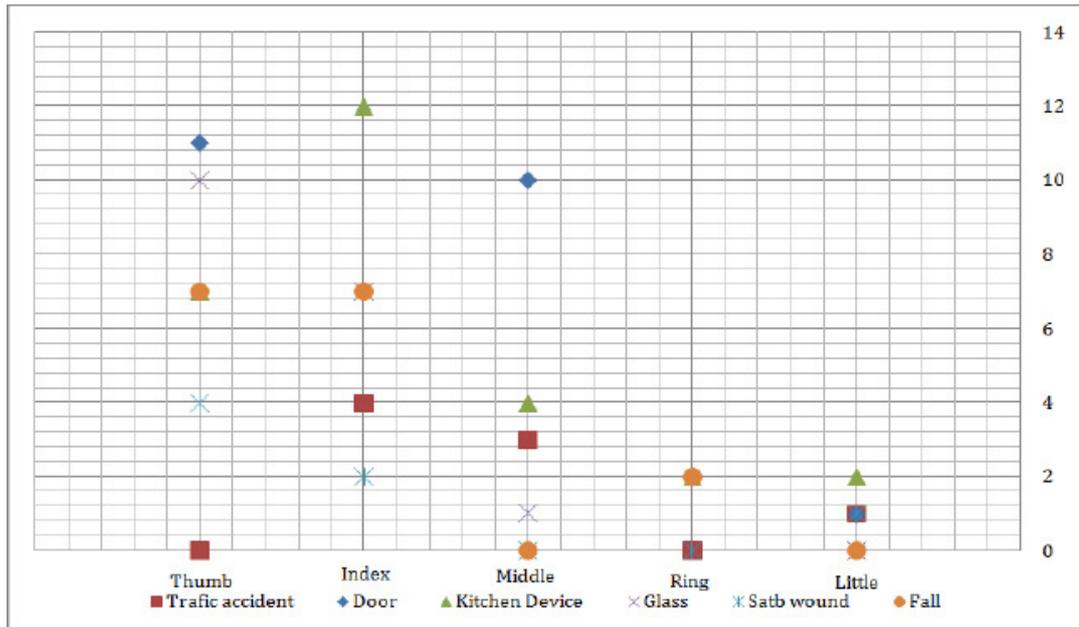


Figure 1. Causes of accident and the number of affected fingers.

standard deviation of the age of male patients was 8.6 (5.5) years and the mean age of female patients was 6.7 (4.3) years, respectively ($P < 0.001$).

A total of 205 hand injuries were evaluated in the current study. Overall, 28 (14%), 128 (64%) and 44 (22%) patients were injured at school, at home and during street fights or traffic accidents, respectively. The mean age of students with injuries at school, at home and on the street was 13 (2.8), 5.7 (4.2) and 11 (4.9) years, respectively ($P < 0.001$). Among 200 patients, 136 (68%) and 64 (32%) patients were boys and girls, respectively.

Overall, in 128 (64%), 22 (44%) and 28 (14%) cases, injuries had occurred at home, on the street and at school, respectively. Home was the most frequent

location of injury for both boys and girls ($P = 0.012$) (Table 1). In addition, kitchen was the most common location of accidents at home for both boys and girls ($P = 0.13$) (Table 1). Palms and wrists were involved in 25% of pediatric injuries. As the results indicated, 109 (55%), 86 (43%) and 5 (2.5%) patients had dominant hand, non-dominant hand and bilateral hand injuries, respectively.

Causes of accidents were as follows: door-related injuries in 50 patients (25%), traffic accidents in 28 patients (14%), injuries by cooking devices in 32 patients (16%), glass wounds in 43 patients (24%), stab wounds in 17 patients (8.5%), fall-related injuries in 30 patients (16%) and electric shock injury in only 1 patient (0.5%). Door-related injuries were the most common type of

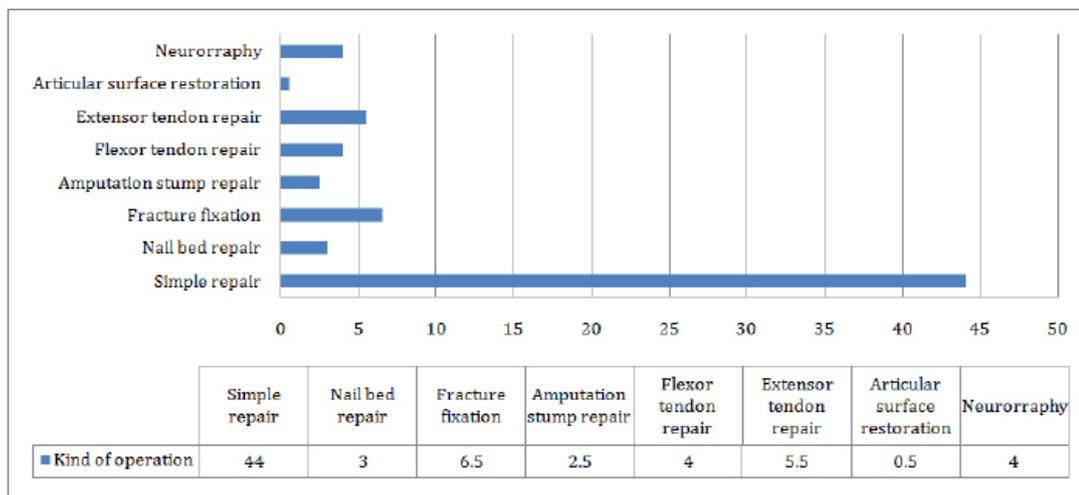


Figure 2. Type of used procedure (in percent).

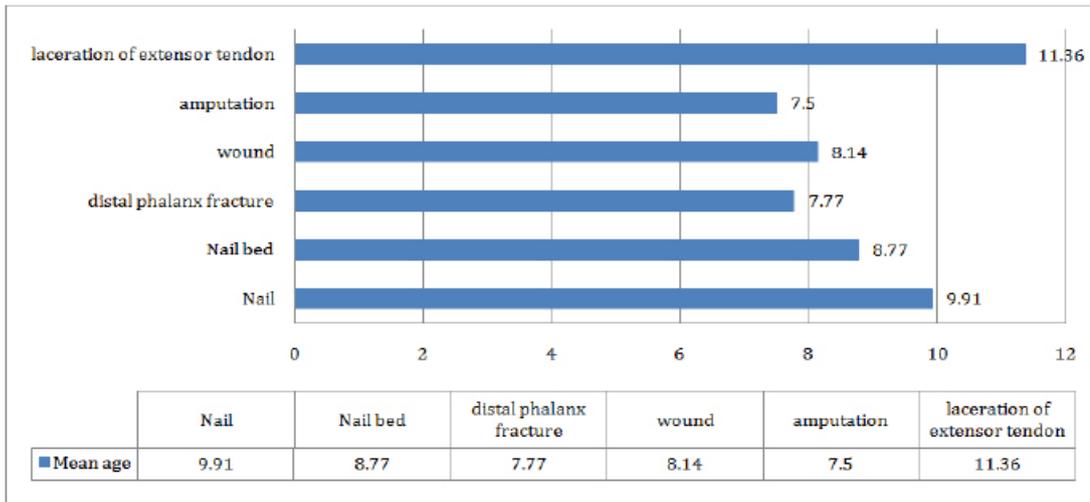


Figure 3. The mean age of all patients in different kind of hand injuries in this study.

accidents in both boys and girls ($P=0.016$) (Table 1). Doors were the most common cause of injury at school (43%) and at home (30%); on the other hand, traffic accident was the most common cause of injury on the street (59%). Also, dominant hand injuries were mostly door-related (28%). Thumb (20%), index finger (17%), middle finger (9%), ring finger (3%) and little finger (2.5%) were the most involved digits, respectively. The index and middle fingers together were the most frequently involved digits with simultaneous injuries; in addition, thumb was the most frequently injured digit by doors (11 cases) (Figure 1).

The most common injuries were as follows: fracture

(18%), amputation (4.5%), pulp laceration (1.5%), infection (1%), and mixed injuries (2.5), respectively; however, 73% of the participants did not present with any complications. Moreover, time interval between the accident and hospital admission was <1 hr in 154 (77%) cases, < 6 hrs in 32 (16%) cases and >6 hrs in 14 (7%) subjects. The most frequent type of procedure alone was a simple repair (44%) and the least common procedure was restoration of articular surfaces (0.5%) (Figure 2). In 161 patients, the most common injuries were laceration (81%) and the least common injuries were amputations (16 cases, 8%). The mean age of patients with different types of injuries is shown in Figure 3. In addition, the

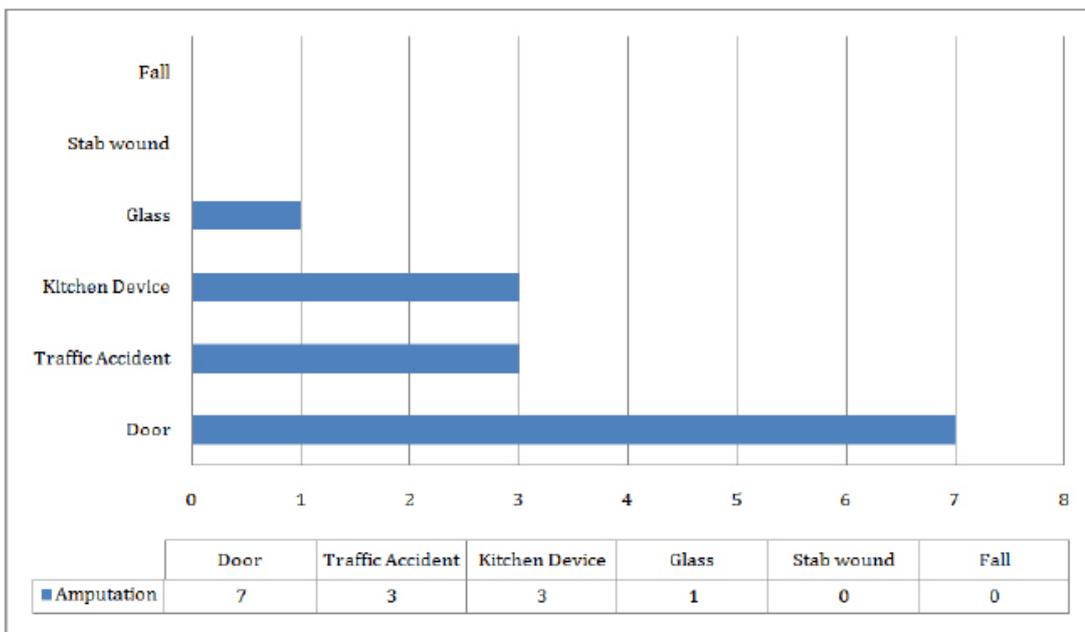


Figure 4. The number of amputees finger in each cause of accidents of this study.

number of patients with finger amputations due to each cause of accidents is shown in Figure 4.

The longest duration of hospitalization was equal to 1.4 (0.58) for the street accidents and equal to 1.5 (0.63) for the traffic accidents ($P<0.001$); the shortest length of hospitalization was equal to 1.1 (0.32) that was associated with home injuries and was equal to 1.1 (0.29) for cooking devices ($P<0.001$) (Tables 2). The average cost of hospitalization equaled to $\$297\pm 38$; the highest and lowest costs were related to street and school injuries, respectively.

Discussion

Hand fractures are the second most common fracture after distal forearm fractures in children (7, 8). This is in contrast with the findings of a study by Landin (1983), who showed that hand fractures were the most common pediatric fractures (9). In our study, hand fracture was the most common hand complication among the studied injuries. A steep rise in frequency after the age of 8 was noted by Hastings in 1984, who also found that fractures were most common among teenagers, aged 12-14 years; they were less frequently reported in older subjects (10).

In this study, hand injuries were mostly reported in subjects aged 6-8 years. Nevertheless, hand fractures are generally a significant cause of morbidity amongst older children. In fact, fingertip injuries are the most frequent hand injury in children seeking medical care at trauma centers (7). The majority of cases are treated conservatively and hospitalization is not needed. However, surgery under general anesthesia is often required on account of high severity of injuries or patient's young age (3).

Higher prevalence of hand injuries in boys, compared to girls, in our pediatric population is consistent with several previous reports (2). In our study, girls were more likely to be injured at home, compared to boys; this might be related to the common cultural belief, which allows boys to spend more time outside the house. It also reflects the fact that hand fractures are more likely to occur during fights, which are popular among boys. This study also showed that most injuries occur at home and are door-related (other causes included falling, stabs, glass, cooking devices and road accidents). This finding is in agreement with previous studies including a report by Frazier et al., in which most hand injuries occurred in or around the house (11). In our studied population, house doors appear to be the most common cause of hand injuries.

Road traffic injuries are a major public health problem, especially in low and middle-income countries. Among middle-income countries, Iran has the highest rate of traffic injuries (4). In our study, street was the second most common location of hand injuries, which were mostly due to traffic accidents; therefore, immediate action should be taken in order to combat this major public health problem.

The Lowest number of injuries (14%) occurred at school, which may indicate the appropriateness of safety measures. However, in our study, 42.9% of 64 school injuries were door-related; this indicates the need

to perform further prospective research to evaluate the safety level of schools. Improved supervision and education about the proper application of protective devices could decrease this sort of injuries.

Although in our study population, no injuries due to domestic violence were reported, it is important to recognize the hand as a target organ for child abuse. In the current research, since abused children suffered from other types of injuries as well and hand injury was not the final diagnosis, they were not included in the study population.

In our study, the established criteria for hand injuries included suspicion of neurovascular injuries, deep lacerations, suspected or definite tendon lacerations, nail bed lacerations, open fractures, amputations and displaced or complex closed fractures. Overall, amputation was more frequent in younger children and older children presented with lacerations of external tendons. This investigation shows that after door-related accidents, trauma (especially due to traffic accidents) is the most common cause of amputation, followed by vascular problems in southeast of Iran (12).

A number of surgical techniques can be used for the management of fingertip injuries of children. These techniques include the adaptation of methods used for adults. In fact, a model for the evaluation of the severity and management of pediatric fingertip injuries should be established (13). Most of the patients in our study presented to the orthopedic department within less than an hour since the accident, in contrast to adult patients, who are typically referred to medical care centers after a longer period (13). This difference probably reflects the importance of children's hand injuries; in addition, many adult hand injuries are work-related and it takes longer to transfer the patient to the hospital.

Our data regarding hand fractures are in consistent with prior studies of pediatric fractures since thumbs and fingers were the most commonly affected digits. On the other hand, in previous reports, most of the fractures resulted from sports-related activities, fist fights or self-inflicted traumas, occurring in the fifth metacarpal/little finger (6).

As a retrospective analysis, the current research had several limitations. We did not have any access to infection rates or poor clinical outcomes. In addition, we might have excluded some patients due to misdiagnosis or coding errors, which might have affected the study results. The strength of this study is the pattern of the mechanism of pediatric hand injuries in different age groups and locations. The observations of this study will hopefully encourage further prospective research including large-scaled cohort studies to develop preventive strategies for pediatric hand injuries. Epidemiological data about hand injuries that affect young patients at their productive age are important to optimize resources and organize health care systems.

There is a critical need for a systematic approach to road injury prevention, considering the integrated organizational coordination and interactions between road users, road infrastructure and vehicles in Iran. Efforts toward public education may help avoid these

preventable injuries. In addition, increased community awareness and equipment safety modifications are required to eliminate this problem. Preventive measures should be concerned with parents' education and training which can help prevent many accidents at home; also, injuries could be reduced by more efficient training of children. However, given the boys' tendency to fight, hand fractures are unlikely to diminish in frequency.

This study illustrates the severity of pediatric hand injuries and the burden they impose on the society. This study can also show the importance of implementing primary care programs in pediatric hand injuries in order to obtain long-term cost-effective outcomes. The Results related to the national burden of these kinds of injuries can be used in health program planning, research, resource allocation, policies and practices.

Most hand injuries occurred at home and were door-related; they were also more frequently reported in younger children. These injuries still remain too frequent among toddlers at home despite their high severity and the functional sequelae; however, they could be often prevented at a reasonable cost, less than hospital charges. Therefore, prospective studies to identify specific protective door devices could potentially decrease the frequency of these injuries.

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