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Outcome and Risk Factors Associated with Burn Injuries in Children

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Abstract

Background: *Burn injuries and their complications are still considered major threats to society's health standards. The aim of this study was to describe the epidemiological profile, outcome, and factors associated with children's burn injuries in Shahroud (northeastern Iran).*

Methods: *This cross-sectional study was performed over a three-year period (2013–2015) on children 12 years and under who were admitted to Imam Hossein Hospital in Shahroud with burn injuries. In this study, we reviewed medical records of hospitalized burn patients, and an analysis was performed using SPSS software.*

Results: *Of the 195 patients, 111 cases (56.9%) were male and the rest were female. The mean age was 6.34±5.32 years (0–12 years). The highest proportion of burn injuries were in the 5- to 8-year-old group (47.2%), and the most common environment in which burn injuries occurred was the home (72.3%). The most common cause of burns was a hot liquid (56.9%). The mean TBSA was 20.11±10.5% and the mean LHS was 9.81±3.85 days. The most frequent burn areas were the upper limbs (46.6%), and second-degree burns were the most common type (48.2%). The mortality rate was 10.8%.*

Conclusions: *The results of this study show that burn injuries in the pediatric population most commonly occur at home from a hot liquid, resulting in second-degree burns on upper-limb areas. So a large percentage of them are preventable with a little attention.*

Keywords: Epidemiology, Burn injury, Children, Shahroud.
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Introduction

Contemporary understanding of burn management for the pediatric population is underscored by several decades of advancing care in resuscitation, reconstruction, and rehabilitation. Burns, however, remain a common and potentially devastating cause of injury in childhood.[1] Children may sustain a burn injury through a variety of different energy sources, such as thermal, electrical, and chemical. These will be discussed in turn, as well as the important case of intentional injury, an omnipresent consideration in presentations of pediatric injury.[2]Burns are the third most frequent cause of childhood injury resulting in death, after motor vehicle accidents and drowning. Although non-fatal burns vastly outnumber fatal burn injuries, significant repercussions are possible from all burns, not only for the child but also for the family, who may need to invest significant time and finances during long recovery periods.[3]

Burns account for the greatest length of stay of all pediatric hospital admissions for injuries and costs are substantial, with many hours of wound care and follow-up visits necessary, sometimes lasting months or years. The incidence of burns in various age groups has a bimodal distribution, with children 0–4 years accounting for approximately half the number of burn accidents and the number rising again as adolescents sustain activity- and work-related injuries. Boys are also more likely to incur an injury than girls, and the majority of these occur in the home. Scalds resulting from hot liquids are most common (80%), occurring five times more frequently in the first three years of life than those that result from a flame. Scalds also result in injuries of greater severity, as reflected by one study where nearly 25% of scald cases required hospital admission in contrast to less than 1% of other thermal burns following initial treatment.[4-6]

Other causes of injury include contact with hot surfaces such as oven doors, fireplace screens, irons, and hair care products. In developed countries, scalds and contact burns are the most common mechanisms, whereas in developing countries, cooking fires gain primacy. Exposure to electricity is a less common cause of burn injury, accounting for 2%–10% of burn center admissions, but these injuries may often result in amputation and thus are a significant injury modality.[7]In relation to the home environment, most burns occur in the kitchen and involve food preparation and mealtimes. There is also a seasonal variance that indicates the winter months as a time of increased risk.

A child may incur an injury while under the supervision of one or both parents. Factors that increase the severity of a burn include the type of burn, such as scalding, a younger age, an increased burn size, and the presence of inhalation injury. Indeed, inhalation injury is cited by some reporters as the most important predictor of mortality in burn victims, and it occurs in 50% of children less than nine years old involved in home fires.[8-9]Another important predictor of death is a deficiency or delay in resuscitation, which has been measured as the length of time to intravenous access. Children aged 0–4 are reported in some studies as having a higher risk of death independent of burn size, possibly owing to immature immune systems and increased fluid requirements, which place young children at risk of sepsis and hypovolemia.[10]Respiratory failure and sepsis are the leading causes of death in children with severe burns, with acute lung injury and acute respiratory distress syndrome (ARDS) accounting for 40%–50% of all deaths.[11-12]Owing to the lack of accurate statistics regarding children with burn injuries, this study aimed to describe the epidemiological profile and risk factors related to children's burn injuries in Shahroud.

Materials and Methods

This cross-sectional study was conducted from March 2013 to March 2015 on 195 children 12 years and under who were admitted to Imam Hossain Hospital in Shahroud (northeastern

Iran) with burn injuries. It includes but is not limited to sociodemographic variables, the type of burn injury, the total body surface area (TBSA), the burn degree, and the length of hospital stay (LHS). The TBSA was estimated by surgeons using the rule of nines. A total of 195 admissions were registered, and the children were divided into three groups based on their ages: 0–4 years, 5–8 years, and 9–12 years. Furthermore, three groups were created on the basis of the burn causes: flame, hot liquid (water, milk, etc.), and other (electricity and explosion). Demographic data were also obtained from each patient's medical record.

The study variables were age, gender, location of injury, TBSA, LHS, and clinical outcome including recovery and discharge or mortality. Data input, analysis, and tabulation were performed using SPSS for windows, version 16. The chi-square test and t-test were used where applicable to determine statistical differences, and a $P \leq 0.05$ was considered statistically significant.

Results

Of the study sample (195 children 12 years and under who were hospitalized with burn injuries at Imam Hossain Hospital during a three year period), 111 cases (56.9%) were male and the rest were female. The mean age was 6.34 ± 5.32 years, and the ages ranged from less than 1 year to 12 years. There was not a significant difference between the mean ages of the boys and the girls (P = 0.175). Of note, the 5- to 8-year-old group had the highest proportion of patients (47.2%). For a distribution of patient by age and gender, see Table 1.

Table 1: Distribution (N(%))of age and gender of pediatric burn in Shahroud city

Age	Male	Female	Total
0-4 years	29 (26.1)	23 (27.4)	52 (23.7)
5-8 years	52 (46.8)	40 (47.6)	92 (47.2)
9-12 years	30 (27.1)	21 (25)	51 (26.1)
Total	111(56.9)	84(43.1)	195(100)

The current study showed that hot liquid is the most common cause of burns and accounted for 111 cases (56.9 %) of all the burn injuries, followed by 49 cases (25.1%) of flame injuries and 35 cases (17.9%) related to other causes (such as electricity and explosions). A significant association was found between the causes of burns and age group (P = 0.03).

The mean LHS and TBSA were 9.81 ± 3.85 days and 20.11% ± 10.5%, respectively. There was a significant difference between LHS in terms of age group (P = 0.002) and also between the extent of the burn means in terms of age group (P = 0.001). In all age groups, hot liquid was the most common cause of burns. For a distribution of patients by age group, TBSA, LHS, and cause of burn, see Table 2.

In total, 94 patients (48.2%) had second-degree burns, which was the most common burn degree in all age groups. There was not a significant association between the degree of burn and age (P = 0.068). During the study period, 10.8% of the patients passed away, revealing a significant association between patient outcomes and age group (P = 0.001). For a distribution of the study sample by burn degree and result of treatment, see Table 3.

Table 2: Distribution (n(%)) of pediatric burns by age groups, LHS, TBSA%, and cause of burn in Shahroud city

Age	LHS(days)*	Extent Burns%*	Cause of burns**		
			Flame	Hot Liquids	Others
0-4 years	12.17±4.25	14.5±3.5	16 (8.2)	31 (15.9)	5 (2.6)
5-8 years	9.54±3.41	19.5±5.3	25 (12.8)	56 (28.7)	11 (5.6)
9-12 years	7.62±3.12	24.35±6.9	8 (4.1)	24 (12.3)	19 (9.7)
Total	9.81±3.85	20.11±10.5	49 (25.1)	111 (56.9)	35 (17.9)

*Mean ± SD, **N(%)

For 141 cases (72.3%), the burn injuries occurred at home and the rest were outdoors, revealing a significant association between location of burn and age group (P = 0.001). For 89 cases (46.6%), the most common site of burn injury was the upper extremities, revealing a significant association between the sites of burns and age group (P = 0.085). For a distribution of the study sample by location and sites of burns, see Table 4.

Discussion

Burns are among the most serious and significant health problems worldwide and cause considerable physical, psychological, and economic losses. Epidemiological studies are a prerequisite for effective prevention programs because each population has its own epidemiological characteristics. Burn injuries, especially pediatric burns, impose a high mortality, morbidity, and economic burden on the patients, their families, and society in general. The patients' mean age was 6.34 ± 5.32 years, which is similar to the findings of studies conducted in London, England,[13] Isfahan, Iran,[14] and Pakistan,15 but it is dissimilar to the results of studies conducted in Kuwait[16] and Istanbul, Turkey.[17]The number of male patients was more than that of female patients, but there were no significant differences. In some studies, such as studies conducted in Pakistan,[15] Kuwait,[16] and Istanbul, Turkey,[17]the number of male patients was significantly higher than that of female patients, which is inconsistent with the results of our study, perhaps owing to our smaller sample size.

We found the most common cause of pediatric burns to be a hot liquid. This finding is similar to the results of previous studies.[18-20]This can be attributed to the fact that young children are lively and spend a lot of time inside the home. But it is important and should be mentioned that most of these burns occurred owing to carelessness or a parent's mistake, and nearly all of them were preventable.[21-22] The results of our study show that as a child's age increases, the main cause of a burn injury, especially among males, changes from a hot liquid to flame, which is similar to other studies.[23-25]The overall mean TBSA in our study was 20%. One of the main factors affecting LHS and TBSA% is the cause of the burn. Our study results showed that the mean TBSA of flame burns is higher than that of hot liquid burns, and there was a significant correlation between the cause of burn and TBSA%(P= 0.001). This finding is consistent

Table 3: Distribution (N(%)) of pediatric burns by age group, burn degree, and outcome of burn in Shahroud city

Age	Burn Degree					Outcome of burn	
	1	2	3	1&2	2&3	Survival	Death
0-4 years	4 (2.1)	24 (12.3)	10 (5.1)	5 (2.6)	9 (4.6)	45 (25.9)	7(33.3)
5-8 years	5 (2.6)	43 (22.1)	17 (8.7)	8 (4.1)	19 (9.7)	83 (47.7)	9 (42.9)
9-12 years	2 (1.1)	27 (13.8)	11 (5.6)	4 (2.1)	7 (3.6)	46 (26.4)	5 (23.8)
Total	11 (5.6)	94 (48.2)	38 (19.5)	17 (8.7)	35 (17.9)	174 (89.2)	21 (10.8)

Table 4: Distribution (N(%)) of pediatric burns by age group, place of burn, and site of burn in Shahroud city

Age	Place of burns		Site of burns				
	Indoor	Outdoor	Head and Neck	Upper Limb	Lower Limb	Trunk	Perineum
0-4 years	38 (25.9)	14 (25.9)	8 (29.6)	28 (31.5)	15 (24.6)	21 (28.4)	2 (33.3)
5-8 years	73 (51.8)	22 (40.7)	11 (40.7)	41 (46.1)	29 (47.5)	24 (32.4)	3 (50)
9-12 years	30 (21.3)	21 (38.9)	8 (29.6)	20 (22.5)	17 (27.9)	19 (25.7)	1 (16.7)
Total	141 (72.3)	54 (27.7)	27 (13.8)	89 (46.6)	61 (31.3)	74 (37.9)	6 (3.1)

with the results of other studies.[26-27]We found the mean LHS to be 9.81 days. LHS was significantly associated with the extent of the burn and the burn thickness. The significant association between the cause of a burn and the length of stay was observed in other studies.[27]Usually, length of hospitalization and mortality are used for describing a patient's outcome. Mortality rate reflects patients' burn severities and the level of clinical care they receive.[28]We reported a hospital mortality rate of 10.8%,[21]showing a significant association between the cause of burn and mortality rate (P = 0.001), which is consistent with other studies in Kuwait.[16]Our study subject was a pediatrics population (0- to 12-year-olds), whereas in studies conducted by Ndiritu[29] and Khan,[30]all patients were included and there was no age limit. Also, their studies showed means of TBSA% and LHS for burns similar to other studies.[29-30]

Our study has several limitations. First, it is a cross-sectional study and therefore is subject to all problems related to this type of study. Second, we have not presented the different types of treatments and interventions provided to burn patients, which have a direct influence on mortality rate and LHS. Limitation of the study to admitted children is another problem for external validity of this study.

Burn injuries are important public health issues worldwide. However, most of them are preventable. Since most burn injuries are domestic, preventive and educational programs that emphasize the importance of safety and caution should be developed, with mothers and housewives as the target audience. The current study provides useful information about the characteristics of pediatric burns in Shahroud, Iran. It showed that hot liquid was the main cause of burns in the pediatric population. An important point is that most pediatric burn injuries are preventable, and we hope this study can assist policymakers in eliminating or reducing them.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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