

## Burn injuries among children aged up to seven years

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We investigated characteristics of burns in children aged up to seven years and hospitalized at our Burn Unit between 1 January 2000 and 31 December 2007 in order to detect risk factors and prepare a program for prevention of burn injuries in children. There were 119 boys and 81 girls (ratio 1:0.67) and the mean total body surface area burned was  $16.6 \pm 12.5\%$ . Sixty-nine percent (n =138) of the burn-injured children were under three years old. Scalds accounted for more than 60% of the pediatric burns occurring in all age groups. The anterior trunk was the most frequently affected body part (51.5%). The overall mortality rate was 4% (8 deaths). The children included in this study were younger than seven years and they were supposed to be under the care of their parents. Parental neglect might have played a role in burn injuries in these children. In developing countries like Turkey, parents should be offered education about prevention of burn injuries in childhood.

*Key words: pediatric burns, children, prevention, etiology, neglect.*

It has been reported that burns are one of the most important causes of child injury in that they can lead to severe functional, social and psychological impairment<sup>1-3</sup>. Pediatric burns can be more severe than injuries in adults. Nevertheless, neither children nor their parents are usually aware of the serious outcomes of burn injuries. In fact, most are not aware that burns may result in death. Even in cases that are not life-threatening, burns may have severe physical and psychological effects due to the resultant scarring and contractures<sup>4</sup>.

Several studies have revealed that burns are important causes of injury, morbidity, disability and death in developing countries<sup>5,6</sup>. Burns are also considered a serious health problem in Turkey.

A sufficient knowledge of the epidemiological characteristics and risk factors for burns is necessary for their prevention. Sustained research on the epidemiology and risk factors of burns in many developed and high-income countries such as the United States has made a great contribution to primary and secondary prevention of fires and burns. However, this is not true for many developing or low- and middle-income countries<sup>7,8</sup>.

Epidemiological studies on burn injuries have revealed risk factors for burns and led to the development of effective preventive programs<sup>9</sup>. There are not enough statistical data about burns, burn facilities and burn care for young people in Turkey<sup>10</sup>, and only a few studies on childhood burns have been conducted. Therefore, we investigated characteristics of burns in children aged up to seven years and hospitalized at our Burn Unit to determine risk factors and to develop a prevention program for childhood burns. We selected this age group especially since infants cannot move around freely and need their parents' or caregivers' assistance for daily routines and since children aged up to seven years do not have the autonomy for self-directed activity. However, they are curious about and want to touch things around them without being aware of the potential dangers. Adults should, therefore, take care of them and keep them under supervision<sup>11</sup>.

This population-based survey provides evidence on the magnitude of and risk factors for burns among children less than seven years of age and provides a basis for burn prevention programs in the country. In addition, since most of the burns in this age group were due to parental neglect, the results will guide attempts to increase awareness among parents.

## Material and Methods

This is a retrospective study conducted on burn patients aged younger than seven years who were admitted to the Hacettepe University Burn Center, which is the third most frequently utilized referral center, between 1 January 2000 and 31 December 2007 inclusive. We retrospectively evaluated 200 children with burn injuries. Data about age, sex, burn size (% total body surface area [TBSA]), depth of injuries, and etiology of burns were obtained in all cases from the medical records and the burn treatment registry.

The patients were stratified by age, sex, burn size (% TBSA), depth of injuries, and etiology of burns. Burns were categorized into three degrees: First-degree burns corresponding to red, but intact skin, second-degree corresponding to blisters, and third-degree corresponding to the indication for partial removal of the skin for recovery. Children were divided into four groups based on their ages as: <1, 1-2 years, 3-4 years, and 5-6 years. Injuries were classified as scalds, flame, contact, electrical or explosion. Outcome was recorded as patient survival or death based on their etiology.

The study was approved by the Ethics Committee of Hacettepe University.

## Statistical Analysis

Kruskal-Wallis one-way ANOVA on ranks was used when the distributions were not normal. Mann-Whitney U test was used for all pairwise multiple comparisons. Chi-squared analysis was used for qualitative data.  $P < 0.05$  was considered significant. Bonferroni correction was used for pairwise multiple comparisons. The statistical analyses were performed with SPSS for Windows 11.5.

## Results

Two-hundred and thirty-seven burn patients aged under 18 years were admitted to the burn unit between 1 January 2000 and 31 December 2007 inclusive and 200 patients were under seven years.

### Age and Sex

In the study period, 119 male and 81 female patients were hospitalized (ratio M: F: 1: 0.67). Male predominance was present in all age groups. The average age of the children was 2.12 years (range: 4 weeks to 6 years). The 1-2 years of age group had the highest proportion of patients. Seventy-five percent of the children aged 5-6 years were female, but the number of boys was higher in the other age groups. There was a significant difference in the number of patients between genders ( $p = 0.026$ ) (Table I).

### Extent of Injury

The median TBSA burned determined based on the medical records was 13.5% with a range of 2-70% (mean: 16.6; SD: 12.57).

### Anatomical Sites of Burns

Two hundred children with burns had 502 distinct anatomical sites of injury. The anterior trunk was affected in 103 children (51.5%), the face in 81 children (40.1%), the neck in 50 children (20%), the posterior trunk in 40 children (20%), one arm in 49 children (24.5%), both arms in 42 children (21%), one hand in 21 children (10.5%), both hands in 12 children (6%), the perineum in 15 children (7.5%), one leg in 24 children (12%), both legs in 48 children (24%), one foot in 4 children (2%), and both feet in 13 children (6.51%).

**Table I.** Distribution of Burns by Sex and Age

Age	Boys	Girls	Total	p
	n (%)	n (%)	n (%)	
<1	23 (67.6)	11 (32.4)	34 (100)	
1-2	65 (62.5)	39 (32.5)	104 (100)	
3-4	27 (58.7)	19 (41.3)	46 (100)	
5-6	4 (25)	12 (75)	16 (100)	
Total	119	81	200	0.026

The distribution of burns for the total sample is shown in Figure 1.

### Causes of Burns

The most frequent burn injuries were scalds, accounting for 82% (164) of all injuries and followed by flame burns at 8.5% (17), contact burns at 4.5% (9), electrical burns at 3% (6), and burns due to explosions at 2% (4).

Of all scald injuries, 81.7% (134), 12.1% (20), 1.2% (2) and 4.8% (8) were due to hot water, hot milk, hot oil, and hot soup/food, respectively.

Descriptive statistics about the distribution of causes of burns by age group, mean and median age, gender, mortality, degree of burns, and mean and median TBSA are presented in Table II. The most frequent cause of burn in all age groups was scalds. None of the children aged 3-4 years and 5-6 years had contact burns. The children aged less than one year did not have electric or explosion burns, but electric burns were seen in the remaining groups, though rarely. The children aged 5-6 years did not have explosion burns.

There was a significant difference in causes of burns between age groups and a significant difference in age between children with contact-

flame, electric-scalds and contact-electric burns ( $p < 0.001$ ) (Table II). The difference in TBSA was also significant between the children with different causes of burns ( $p < 0.001$ ). However, there was no significant relation between causes of burns and gender and between causes of burns and degree of burns.

### Length of Hospital Stay

The mean hospital stay was 25.35 days (median: 16.50 days; range: 1-255 days). Eleven percent of the patients received care in the intensive care unit and the mean duration of intensive care was 11.1 days (median: 7 days; range: 1-77 days).

### Seasonal Variations

A higher rate of burns occurred in winter than in other seasons. In fact, of all burns, 27% occurred in spring, 25% in summer, 10.5% in autumn, and 37.5% in winter. Scalds were more frequent in all seasons and the most frequent cause of burn injury in winter. Table III shows the distribution of burns by age, seasons and causes.

### Mortality

Eight patients died in the study period. All of them had scald burns; one was three years old and the others were younger than three years old.

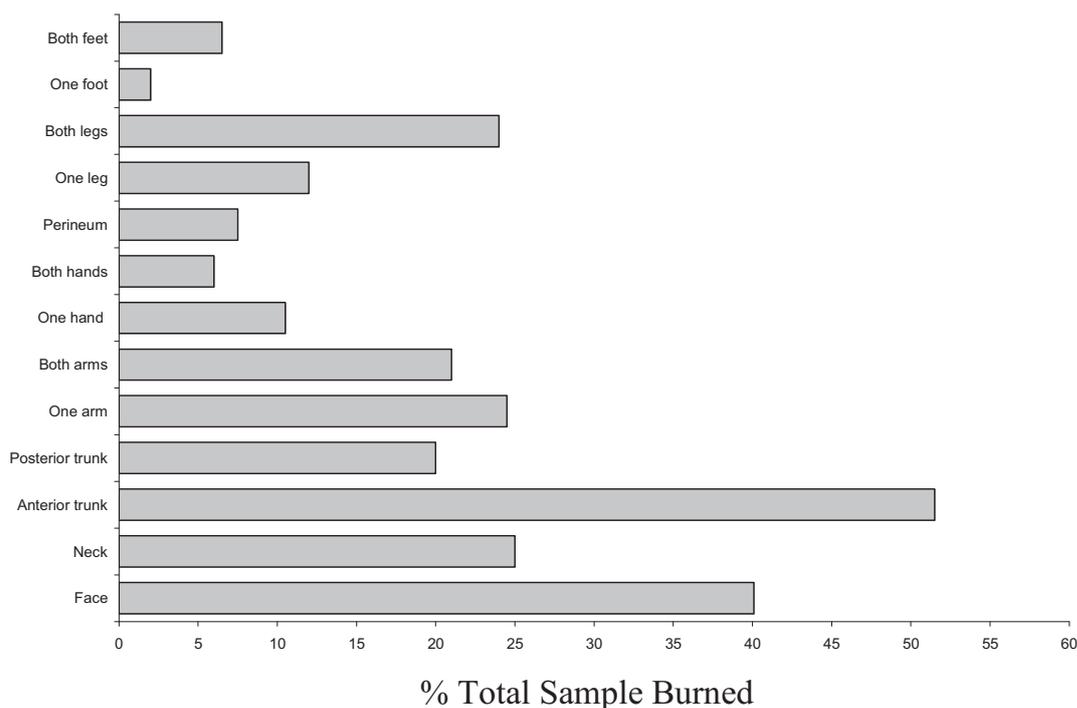


Fig 1. Distribution of burns by body parts.

**Table II.** Demographic Factors and Causes of Burns

Demographic factors		Causes of burns N (%)					P
Age group (years)	Total cases N	Scald	Flame	Contact	Electric	Explosion	
<1	34	27 (79.4)	2 (5.9)	5 (14.7)	0 (0)	0 (0)	
1-2	104	92 (88.5)	6 (5.8)	4 (3.8)	1 (1)	1 (1)	
3-4	46	35 (76.1)	7 (15.2)	0 (0)	1 (2.2)	3 (6.5)	
5-6	16	10 (62.5)	2 (12.5)	0 (0)	4 (25)	0 (0)	
Total cases N (%)	200	164 (82)	17 (8.5)	9 (4.5)	6 (3)	4 (2)	
Mean age + S.D.	2.12±1.39	2.03±1.30	2.70±1.47	0.98±0.68	4.33±1.75	3±1.41	
Median age (min-max)	2 (0.08-6)	2 (0.08-6)	3 (0.5-5)	0.91 (0.08-2)	5 (1-6)	3.5 (1-4)	P<0.001
Male	119	100 (84)	6 (5)	5 (4.2)	5 (4.2)	3 (2.5)	
Female	81	64 (79)	11 (13.6)	4 (4.9)	1 (1.2)	1 (1.2)	P=0.180
Mortality	-	-	-	-	-	8	
Second-degree	160	137 (85.6)	12 (7.5)	5 (3.1)	4 (2.5)	2 (1.3)	
Third-degree	40	27 (67.5)	5 (12.5)	4 (10)	2 (5)	2 (5)	P=0.12
TBSA mean		16.99±12.42	20.35±11.11	5.56±3.71	3.17±1.47	29.5±19.00	
TBSA median (min-max)		15 (2-70)	20 (5-40)	5 (2-15)	2.5 (2-5)	30 (8-50)	P<0.001

TBSA: Total body surface area.

**Table III.** The Distribution of Burns by Age, Seasons and Causes of Burns

	Spring	Summer	Autumn	Winter	Total
	n (%)	n (%)	n (%)	n (%)	
<1	6 (17.6%)	7 (20.6%)	7 (20.6%)	14 (41.2%)	34 (100%)
1-2	29 (27.9%)	29 (27.9%)	11(10.6%)	35 (33.7%)	104 (100%)
3-4	14 (30.4%)	12 (26.1%)	3 (6.5%)	17 (37.0%)	46 (100%)
5-6	5 (31.3%)	2 (12.5%)	0 (0%)	9 (56.3%)	16 (100%)
Total	54 (27%)	50 (25%)	21 (10.5%)	75 (37.5%)	200 (100%)
Scald	49 (29.9%)	43 (26.2%)	15 (10.4%)	55 (33.5%)	164 (100%)
Flame	4 (23.5%)	4 (23.5%)	2 (11.8%)	7 (41.2%)	17 (100%)
Contact	0 (0%)	0 (0%)	2 (22.2%)	7 (77.8%)	9 (100%)
Explosion	0 (0%)	2 (50%)	0 (0%)	2 (50%)	4 (100%)
Electric	1 (16.7%)	1 (16.7%)	0 (0%)	4 (66.7%)	6 (100%)

**Geographical Distribution and Residence**

Of the 200 patients, 149 (74.5%) lived in urban areas, 33 (16.5%) in rural areas and 18 (9%) in semi-urban areas. Our center is located in Central Anatolia; however, 36% of the patients were referred by health centers in other regions of Turkey.

**Degree of Burns**

Of the 200 patients, 80% had second-degree burns and 20% third-degree burns. None of the patients had first-degree burns. It may be that most patients with severe burns are treated in the burn unit and that those without severe burns are treated in the outpatient clinic on a day care basis. Grafts were applied in 46.5% of the patients.

## Discussion

In Turkey, the number and quality of specialized burn centers and units are not sufficient and therefore, most severe burns are treated in surgical units of state hospitals. Emergency resuscitation is not performed properly in many cases, which occasionally leads to early major complications. Delayed transportation and admission to specialized burn centers is responsible for most of the deaths in cases of critical burns<sup>12</sup>.

Our center is located in central Anatolia, but 36% of the patients were referred by health centers in other regions of Turkey. This can be explained by a relative lack of organized burn facilities in our country.

There have been many studies on epidemiological features of burns in Turkey<sup>12-15</sup>. This is the first study to evaluate burn injuries in children aged up to seven years in Turkey.

In this study, 69% (n=138) of the burn-injured children were under three years old. This age group has also been reported in other studies to be the most vulnerable to burn injuries<sup>16-21,22</sup>. Consistent with the studies from Egypt, China, India, Kuwait and Ireland, we found that most of the burn patients were male<sup>23-27</sup>.

Unlike older children and adults, most young children present to burn centers with scald injuries. Older children and adults mostly suffer from flame injuries<sup>19,28-30</sup>. Similarly, in the present study, the most frequent cause of burn injuries was scalds.

Most of the childhood burn injuries have been shown to be due to hot liquids<sup>4,21,22,31-33</sup>. Scald injuries are frequently caused by hot coffee, soup or hot water from pots and saucepans. In this study, scalds were commonly caused by hot water. These injuries may also be due to some traditional habits such as preparing tea with two pots (one placed on the top of the other), pots used for cooking on low stoves, and eating breakfast while seated on the floor in rural areas<sup>12</sup>. In addition, hot milk causes burns in children in our country because people prefer to boil milk for sterilization instead of pasteurization, especially in rural areas<sup>14</sup>.

We had a few cases of flame injuries at our Burn Center (8.5%). Actually, it is the second most frequent burn injury and occurs in childhood, usually outdoors, and is often caused by the

ignition of flammable liquids. Therefore, sales of flammable liquids to children must be banned<sup>14</sup>. It is also essential to make legislations that force the manufacturers of these liquids to improve safety measures. These flammable liquids should have labels that warn people about their dangers and they should be stored appropriately and kept away from children<sup>22</sup>.

In the present study, only nine children had burns caused by hot solid objects. These hot solid objects were usually those placed on the coal burning stoves, which are used for heating, especially in rural areas in Turkey. Likewise, Fukunishi et al.<sup>4</sup> reported that burns due to hot solid objects might affect large body areas, but that they usually caused burns over small areas. This may also explain why few cases of burns due to hot solid objects presented to our center, which mainly treats severe burns.

In this study, 3% and 2% of the children had electrical burns and burns due to explosions, respectively. Electrical burns frequently occur in late childhood. Consistent with the literature<sup>14,4</sup>, there were few electrical and explosion burns in this study.

El-Badawy et al.<sup>23</sup> revealed an increase in burn accidents in Cairo, Egypt in winter and they attributed this to increased needs for boiled water in cold weather and to the use of traditional kerosene stoves, especially in slum areas, with no safety measures. They noted that children accidentally touched these stoves, which led to flame burns.

As in Egypt, the rates of severe burn injury in Turkey were higher in winter than in other seasons. This may be explained by increased heating accidents in colder seasons due to the use of traditional methods for heating. In fact, people need more heating especially in the bathroom and for bath water, for which they utilize stoves, indoor liquid-petroleum gas heaters and open fires in the winter. They also use traditional tea pots, open fires and grills for everyday cooking. This equipment, frequently used with no safety precautions, is responsible for most of the flame and scald burns in Turkey<sup>13</sup>.

In Turkey, especially in the eastern and south-eastern regions, people use a special kind of oven called tandir for baking bread. It looks like a large hole drilled underground, and is full of embers and surrounded with a sheet iron.

Mostly young children and women are affected by tandır burns. They fall into these ovens and may not be rescued immediately<sup>34,35</sup>.

Arslan et al.<sup>11</sup> from Turkey reported that children younger than one year had scalds. Similarly, we found that 79.4% of the children aged less than one year had scalds. These children could not walk. For this reason, they cannot have caused the burn trauma themselves. It is very likely that the parents were responsible for the scalds in infants. Parent should be offered training programs and their awareness of the proper care of infants should be increased<sup>11</sup>.

The leading causes of burns are hot water, milk, oil, and soup. Such burns are preventable. Children should not be allowed in the kitchen and they should be kept in their beds or in their rooms while their mothers are doing housework chores. Crawling children are especially at risk of burns since they move around the house. They should not be left unattended<sup>11</sup>.

A high rate of childhood burns requires hospital admissions and prolonged hospital stays. Therefore, burns in childhood cause huge financial and social burdens on individuals, families, society and the nation. To reduce this burden, a burn prevention strategy and prevention program for the country should be developed<sup>5</sup>.

Simple preventive measures can help to eliminate burn injuries. The most effective way is public education. Especially parents with preschool children should be offered education about preventive measures against burns<sup>14</sup>. Broadcasts showing risk situations, presenting epidemiological data about burn accidents and drawing attention to preventive measures against burns can be useful. Illustration showing hypothetical accidents may also be helpful<sup>22</sup>. Appropriate solutions should be provided. Education programs that inform and warn people about the causes of all types of burn injury should be offered by the government and health care personnel<sup>13,14</sup>.

Peleg et al.<sup>36</sup> reported a statistically significant reduction in the rate of hospitalizations because of burns in infants and toddlers in places where intervention programs were implemented. This illustrates that intervention programs reduce injuries among children. These programs can

be modified in accordance with the cultural features of the target population and their effectiveness can be increased.

The children included in this study were younger than seven years and they were supposed to be under the care of their parents. It should be remembered that parental abuse and neglect may play a role in burn injuries in these children.

It is known that some childhood burns result from neglect. However, it is not easy to distinguish deliberate actions from neglect and accidents. In cases of repeated burns, examination may help to make a distinction between neglect and deliberate actions and accidents. In fact, one study on non-accidental burns revealed that a higher proportion of burns were due to neglect<sup>37</sup> and it was emphasized that both neglect and deliberate abuse might cause non-accidental burns in children<sup>38</sup>. It has also been shown that neglect can precede abuse in some cases<sup>39</sup>. Therefore, pediatric forensic examination should be performed if a child is likely to suffer from abuse, neglect or intentional injury<sup>40</sup>; detection of neglect may prevent abuse and neglectful episodes likely to appear subsequently<sup>41</sup>.

In the present study, 69% of the children were younger than three years. They should be under the strict supervision of their parents. The fact that their injuries were preventable suggests parental neglect. Forensic investigations should be carried out in all childhood burns, especially burns in children aged under seven years. Parental abuse and neglect should be ruled out and forensic specialists should cooperate with social workers when necessary. Early detection of neglect is essential to prevent further harm to children. It is essential that government and health care personnel seek appropriate solutions and carry out education programs to increase awareness about burn injury.

To conclude, an expert and experienced team should determine whether childhood burns are due to accidents, neglect or deliberate actions. In developing countries, parents should be offered education about the prevention of burn injuries in childhood. In cases of burns caused by neglect and deliberate actions, children should be examined by pediatric psychiatrists and provided psychological counselling, and social care workers should also be contacted when necessary.

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