

# Review of Pediatric Burn Injuries in Egypt

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## ABSTRACT

**OBJECTIVES:** Most childhood burns can be avoided if proper preventive measures, public education, and continuing medical education are applied. These actions are especially important in general hospitals, which are the first lines of management to provide good burn care facilities as near to the place of injury as possible. Here, we described the first aid and initial management of patients at our center, which are still far from ideal and which could explain the high mortality rate.

**MATERIALS AND METHODS:** This study included 507 acutely burned pediatric patients admitted to the Burn Unit of Ain Shams University (Cairo, Egypt) from January 1, 2008, to December 31, 2020. Our objective was to analyze risk factors and demographic and epidemiological features of patients in our area, which could be used to define preventive measures that can be implemented to minimize burns in children and provide better quality of patient care.

**RESULTS:** Of 7450 patients with burns patients who presented to our unit during the study period, 2831 were children between 2 months and 14 years (representing 38.0% of the total number). There were 1678 total admissions for all age groups during this period, and 507 were children, representing 30.2% of total admissions. Male-to-female ratio was 1.38:1. Four age groups were distinguished, according to children's main activities and behavior, with 130 children (25.5%) <1 year of age, 242 children (47.8%) from 2 to 3 years of age, 109 children (21.5%) from 4 to 7 years of

age, and 26 children (5.3%) from 8 to 14 years of age. Average age was 4.09 years. The burns occurred predominantly during the winter.

**CONCLUSIONS:** Our analysis showed that most pediatric burns were avoidable.

**KEY WORDS:** *Children, Hospitalization, Scalding injury*

## INTRODUCTION

Most burns in children can be avoided if the proper preventive measures, public education, and continuing medical education are applied. These actions are especially important in general hospitals, which are the first lines of management to provide burn care as near to the place of injury as possible.

This study included 507 pediatric patients with acute burns who were admitted to the Burn Unit of Ain Shams University (Cairo, Egypt) from January 1, 2008, to December 31, 2020. Our objective was to analyze risk factors and demographic and epidemiological features of pediatric patients in our area.

## MATERIALS AND METHODS

Pediatric patients were grouped into 4 age categories: (1) infants ( $\leq 1$  year), (2) toddlers (2 to 3 years), (3) preschoolers (4 to 7 years), and (4) school age kids (8 to 14 years). Patients were treated according to standards of care for pediatric burns formulated by the Chinese Burn Association.<sup>1</sup> Severity of burns in pediatric patients was graded as follows: mild (<5% of total body surface area [TBSA] and no third-degree burns), moderate (between 5% and 15% of TBSA or third-degree burn <5% of TBSA), extensive (between 15% and 25% of TBSA or third-degree burns between 5% and 10% of TBSA), and critical (>25% of TBSA or third-degree burns >10% of TBSA). The burn area was estimated by 2 attending physicians at admission to our burn unit, according to the Rule of Nines and Rule of Palm.<sup>1</sup>

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We collected and analyzed data on burn etiology, age, sex, place of burn, type and severity of burn, anatomical regions involved, and length of hospital stay. Details of treatment, first aid, and initial management (in referred patients), medical care, follow-up results, and mortality rate were also recorded.

The Burns Unit of Ain Shams University Hospitals is a major regional referral center for pediatric burn injuries in Cairo and the surrounding districts. Of the total 7450 patients with burn injuries who presented to our unit from January 1, 2008, to December 31, 2020, there were 2831 children below 14 years of age. This constituted 38.0% of total patients.

The policy of our burn unit is to admit any child with burn injuries with any of the following criteria: (1) TBSA >10%; (2) localized deep burn of 2% TBSA or greater; (3) children below 2 years of age with burns; (4) children with facial burns; (5) children with suspected inhalation injury; (6) children with burns of the hand, feet, and perineum; (7) children with chemical or electrical burns; and (8) children with associated fractures or chronic illness.

All patients were managed by our strict protocol, which we have followed in our unit for the past 12 years.<sup>2</sup> All children received first aid in the reception room of the burn unit. This consisted of cooling the burned area and dressing the wound using silver sulfadiazine. Patients who needed admission were managed first in the resuscitation room where an intravenous line was established and respiration was secured.

Although management principles are similar to those for adults, children have unique pathophysiologic responses to burn injury.

Thermal injury uniquely results in plasma loss from injured tissues, thereby affecting not only the integumentary system but also the cardiovascular, renal, gastrointestinal, and pulmonary systems.<sup>3</sup> In addition to loss of the evaporative protection of the skin, burns >15% TBSA activate a systemic inflammatory response that results in diffuse capillary leak and massive fluid shifts.<sup>3-5</sup>

Resultant intravascular fluid depletion may rapidly lead to hypovolemia and shock.<sup>6,7</sup> Furthermore, delayed fluid administration to the volume-contracted patient may contribute to a perfusion-reperfusion injury when they are finally resuscitated, resulting in the release of free radicals, which in turn potentiates the systemic inflammatory response.<sup>4</sup> Because of smaller circulating blood volume in children, delays in initiating adequate volume resuscitation must be avoided.<sup>3</sup> Postponing proper resuscitation in children for as little as 30 minutes is associated with the development of acute renal failure, increased hospital length of stay, and increased mortality.<sup>6-8</sup>

## RESULTS

### Demographics

During the study period, 7450 patients with burn injuries presented to our unit; of these, 2831 were children between 2 months and 14 years of (representing 38.0% of the total number). The total number of admissions was 1678; of these, 507 were children, representing 30.2% of total admissions. Male-to-female ratio was 1.38:1.

Four age groups were distinguished, according to children's main activities and behavior, with 130 children (25.5%) <1 year of age, 242 children (47.8%) from 2 to 3 years of age, 109 children (21.5%) from 4 to 7 years of age, and 26 children (5.3%) from 8 to 14 years of age. Average age was 4.09 years, and burns occurred predominantly during the winter.

### Place of injury

The home was the most common site (n = 386; 76.1%), with most occurring in the kitchen, followed by the bathroom and living room. Another 121 pediatric burn injuries (23.9%) occurred outside the home. Twenty-four children above 10 years of age (from poor families) were burned in the workplace.

### Burn etiology

The most common etiology was scalding (450/507; 88.8%), followed by flame (43/507; 8.5%), electricity (6/507; 1.3%), chemicals (4/507; 0.8%), and other (4/507; 0.8%) (Table 1).

**TABLE 1.** Distribution of Burns by Etiology and Age

Age, years	Number (N = 507)	Etiology				
		Scald (n = 450)	Flame (n = 43)	Electric (n = 6)	Chemical (n = 4)	Other (n = 4)
0-1	130	118 (90.7%)	10 (7.6%)	1 (0.7%)	1 (0.7%)	0
2-3	242	220 (91%)	16 (6.6%)	3 (1.2%)	0	3 (1.2%)
4-7	109	95 (87%)	9 (8.2%)	2 (1.8%)	2 (1.8%)	1 (0.9%)
8-11	26	19 (67.8%)	7 (26.9%)	0	0	0

### Extent of burns

Mild injuries were the most common (n = 239; 47.0%), followed by moderate (n = 177; 35%), severe (n = 56; 11.0%), and extremely severe (n = 35; 7.0%) burn injuries (Figure 1).

### Anatomical regions involved

The most frequently injured anatomical area was head and neck (n = 271; 53.5%), followed by lower (n = 265; 52.3%) and upper (n = 243; 48.0%) extremities (Figure 2). Some patients had multiple anatomic areas involved and were counted more than once.

### First aid measures at burn site

Among 507 patients, only 131 (25.8%) had cooling by tap water on the burn wound surface. In 148 children, (29.2%) household remedies were applied as first aid, including toothpaste, raw eggs, animal ointment, and other. The remaining 228 children (45.0%) did not receive any first aid measures.

### Initial management at peripheral hospitals and during transfer

Of 507 pediatric patients, 223 were referred from other general hospitals or nonspecialized burn centers and 284 were brought directly by their relatives without ambulance and medical staff. Among the 223 patients transferred to our unit, 122 children (54.7%) received basic burn wound care; the other patients did not receive any wound care. Ninety-one children (40.8%) were given fluid resuscitation, of whom only 14 (15.4%) had medical records with volume and category documented for the given fluid. From these 14 patients with full documentation, only 11 patients were resuscitated throughout the way to the unit. Pain relief was given in 47.1% of patients. Patients transferred directly were managed according to the protocol of the unit.

### Medical care and follow-up results

Most pediatric patients (n = 351; 69.2%) underwent no surgery; however, 156 children (30.8%) required surgery in the form of excision and skin grafting. Early excision and grafting were conducted in 70 patients (13.8%) who had deep burns on admission. The higher the extent and severity of the burns, the more frequently skin grafting procedures were done.

### Length of hospital stay

The average hospital stay was  $16 \pm 10.7$  days, and the range of stay was from 1 to 60 days. Children between 0 and 2 years of age had the shortest hospital stay (median of 8 days; range, 1-40 days).

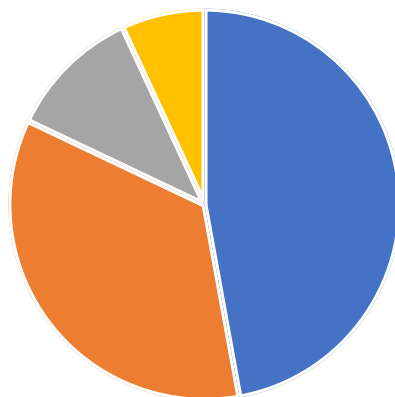
### Morbidity and mortality

During the study period, there were 66 patients who died (13% of total admissions). Of these, 36 children were from the group who had been referred to our unit (n = 223 patients) and 30 children were from the group who presented directly to our unit (n = 284 patients). More than 80% of the burn-related deaths were in children with a TBSA of 40% or more. Flame-related burns accounted for about 70% of deaths either because of the high TBSA or because of associated inhalation injury. About 30% of deaths were due to scalds. Most patients (n = 365; 72.0%) developed pigmentation and scarring after wound healing.

## DISCUSSION

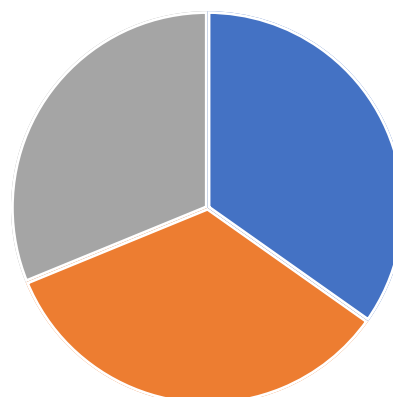
This prospective study included 507 pediatric patients with acute burn injuries who were admitted to the Burn Unit of Ain Shams University (Cairo, Egypt) from January 1, 2008, to December 31, 2020. Our objective was to analyze risk factors and demographic and epidemiological features of patients in our area, so that we could define preventive

**FIGURE 1.** Burn Severity in Pediatric Patients



● Mild ● Moderate ● severe ● Extremely severe

**FIGURE 2.** Burn Distribution by Region in Pediatric Patients



● Head and neck ● lower Extremities ● Upper Extremities

measures that could be implemented to minimize burns in children, which would allow a better quality of patient care.

The percentage of childhood burns in relation to the total number of patients with burns at our center was 38.0%, whereas the total rate of admissions to the unit for pediatric patients was 30.2%, which is relatively higher than other studies in developed and developing countries.<sup>9-13</sup> We considered this high number an indicator of a risk, possibly related to the low socioeconomic status in our population, which forces both parents to work, thus leaving children unattended for long periods of time. Also, in the 5- to 14-year-old age group, there was an increase in the number of school dropouts and children entering the labor force, putting them at risk of industrial accidents.

We found that most patients in our study group were between 2 and 5 years of age, which is similar to a previous study in our unit<sup>2,14</sup> but different from other published reports.<sup>15-19</sup> These studies stressed the increasing incidence of burns in children below the age of 3 years. Our study showed a different incidence. Children between 0 and 2 years constituted the group with the least number of burns; this was perhaps because this is the time when the child is being nursed by their mother and attached to her most of the time.

However, from age 2 to 5 years, the situation changes as the mother is usually preoccupied with a newborn baby, making this age group responsible for their own protection in perhaps the overcrowded areas where they live and exposing them to burn accidents.<sup>2</sup> Unlike other studies that excluded the hazards of industrial burns due to child labor, this study included 24 admitted pediatric patients who had industrial accidents.

The overall male predominance in this study agrees with another report and conforms to a previous study from our unit.<sup>2,14</sup> Boys are more likely to be involved with behavior that may expose them to burns, and the male preponderance among pediatric burns is recognized generally throughout the burn literature.<sup>20-25</sup>

Results due to seasonal variations were the same in developing and developed countries.<sup>26-28</sup> During wintertime, burns increase significantly due to the need for boiling water. The traditional kerosene stove, which is used extensively in slum areas in Cairo, for boiling water and cooking lacks any safety measures. Children stumble on the kerosene stoves that are usually placed on the ground, leading to flame burns.<sup>2,14</sup>

Scald burns predominated over other types of burn accidents in our study, which is consistent with earlier reports.<sup>24-28</sup>

When we compared the results of this study with a previous study<sup>14</sup> from our unit from 2009, we observed almost the same incidence of pediatric burns (38% vs 39.05% in 2009); this denotes unsuccessful prevention programs in our local community. We did observe a decrease in length of hospital stay ( $16 \pm 10.7$  days vs  $18 \pm 11.7$  days in 2009). Also, mortality rate decreased from 14.39% in the admitted group in 2009 to 13% of the admitted group in the present study. These 2 factors denote improvement in burn care standards.

The overall mortality rate was 13%, which is similar to previous findings.<sup>28,29</sup> Mortality rate was higher with flame burns (70%), followed by scalds (30%). More than 80% of deaths occurred in children with large burn size ( $>40\%$  TBSA), and TBSA is a strong predictor of mortality. This indicates the need for advanced technology to reach the international standards and the need for specialized pediatric burn units with dedicated staff.

## CONCLUSIONS

Most childhood burns can be avoided if the proper preventive measures are undertaken. Further public education and continuing medical education should be applied, especially in general hospitals, which are often the first lines to providing care as near to the place of injury as possible. This study showed that first aid and initial management practices were still far from ideal, which could explain the high mortality rate.

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