



# An evaluation of pediatric burn patients over a 15-year period

## On beş yıllık çocuk yanık hastalarının değerlendirilmesi

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### BACKGROUND

Burn injuries are a huge public health issue for children. The aim of this study was to determine the demographic and etiological features, burn wound infections, and clinical trends of 2346 pediatric burns patients over 15 years in the southeast provinces of Turkey and to establish criteria for a pediatric burn prevention program.

### METHODS

Age, gender, degree of burn, demographics, etiology of burn, burn wound infections, length of hospital stay, total body surface area percentage, and outcome data of 2346 children (1064 males, 1282 females; mean age 4.42±3.56 years; range 2 months to 15 years) who admitted to the Burn Center of Dicle University between January 1994 and December 2008 were recorded.

### RESULTS

The male to female ratio was 0.8:1. The highest incidence appeared in the 0-4 years of age group (68.5%). Burn type was scalding burns in 1828 (77.9%), flame burns in 332 (14.2%) and electrical burns in 186 (7.9%). Distribution of the degree of burns was 19 (0.8%) first-degree, 2172 (92.6%) second-degree and 155 (6.6%) third-degree. The mean total body surface area burn was 21.5±12.6%. The mean length of hospitalization was 12.87±10.02 days. The most frequently isolated burn wound infections were *Pseudomonas aeruginosa* (52%, 368), *Acinetobacter spp.* (12%, 83), and *Escherichia coli* (9%, 66). 2241 (95.5%) cases were survivors and 105 (4.5%) were non-survivors.

### CONCLUSION

The epidemiological features of pediatric burns in the southeast region of Turkey differ from those of other regions. Burn prevention education should include training in pediatric burn prevention.

**Key Words:** Burn; burn wound infections; emergency department; epidemiological features; pediatrics.

### AMAÇ

Yanık yaralanmaları çocuklar için büyük bir halk sağlığı sorunudur. Bu çalışmada Güneydoğu Anadolu bölgesinde 15 yıl boyunca takip edilen 2346 çocuk yanık hastasının demografik, etyolojik, yanık yara enfeksiyonu ve klinik gidişleri değerlendirildi ve çocuk hastalar için bir yanık önleme programı geliştirildi.

### GEREÇ VE YÖNTEM

Dicle Üniversitesi yanık ünitesinde Ocak 1994 ile Aralık 2008 tarihleri arasında yatırılarak takip edilen 2346 çocuk hastanın (1064 erkek, 1282 kız; ort. yaş 4,42±3,56; dağılım 2 ay - 15 yıl) yaş, cinsiyet, yanık derecesi, dermografik özellikleri, yanık etyolojisi, yanık yara enfeksiyonu, hastanede kalma süresi, yanık yüzeyi yüzdesi ve hasta sonlanımı verileri geriye dönük olarak değerlendirildi.

### BULGULAR

Erkek kız oranı 0,8:1 idi. En yüksek insidans %68,5 ile 0-4 yaş aralığında görüldü. Yanık tipleri 1828 (%77,9) haşlama yanığı, 332 (%14,2) alev yanığı ve 186 (%7,9) elektrik yanıklarından oluşuyordu. Yanık dereceleri açısından 19 (%0,8) birinci derece, 2172 (%92,6) ikinci derece ve 155 (%6,6) üçüncü derece yanıklardan oluşuyordu. Ortama toplam vücut yanık yüzdesi ortalaması 21,5±12,6 idi. Ortalama hastanede kalış süresi 12,87±10,02 gün idi. En sık izole edilen yanık yara enfeksiyonları (%52, 368) *Pseudomonas aeruginosa*, (%12, 83) *Acinetobacter spp.* ve (%9, 66) *Escherichia coli* idi. Olguların 2241'i (%95,5) hayatta kalırken, 105'i (%4,5) yaşamını yitirdi.

### SONUÇ

Çalışmamızda yanık hastalarının özellikleri diğer bölgelerden farklı idi. Çocuk yanık önleme programı için bölge halkı eğitilmelidir.

**Anahtar Sözcükler:** Yanık; yanık enfeksiyonları; acil bölümü; epidemolojik özellikler; çocuk.

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Burn injuries are an important public health issue and one of the most frequent injuries among pediatric patients in developed and developing countries due to the increased length of stay in both intensive care units and general wards, scar contractures, extremity deformities, extremity functional limitations, and significant financial burden.<sup>[1-5]</sup> In addition, treatment of burn injuries is very difficult and remains a significant source of morbidity and mortality worldwide.<sup>[6-8]</sup> Burn wound infections are one of the most common causes of death after burn injury, because burn injuries suppress the immune system.

The epidemiology, etiology, burn wound infections, and outcomes in pediatric burns may vary depending on the region, culture, and economic situation. It is important that the epidemiology of pediatric burns includes information about the risk factors that predispose to the occurrence of pediatric burns for the development of preventive programs.

The aim of this study was to analyze the epidemiology, etiology and outcome of pediatric burns in the southeast provinces of Turkey and to establish the criteria for a pediatric burn prevention program for this region.

## MATERIALS AND METHODS

Our burn treatment center is located in Diyarbakır, in the southeast Anatolia region of Turkey. It is the only burn unit in that region and is the largest burn unit in Turkey. In addition, it serves approximately 6,000,000 people from Diyarbakır and nearby cities such as Mardin, Siirt, Batman, Şırnak, Hakkari, Van, Şanlıurfa, Elazığ, Bitlis, and Bingöl.

All medical records of pediatric burn patients (aged 2 months-15 years) admitted to the Burn Center of Dicle University over a 15-year period (January 1994 - December 2008) were reviewed retrospectively. Patient's age, gender, degree of burn, demographics, etiology of burn, burn wound infections, length of hospital stay, total body surface area (TBSA) percentage, and outcome data were recorded.

Burn type was divided into three groups as follows: first-degree burn group: cases with serious first-degree burn with or without non-serious second- or third-degree burn; second-degree burn group: cases

with serious second-degree burn with or without non-serious first- or third-degree burn; and third-degree burn group: cases with serious third-degree burn with or without non-serious first- or second-degree burn.

The treatment protocol of burn was established in accordance with the main international standards of treatment, including antibiotherapy, wound care, fluid resuscitation, nutritional support, resuscitative regimens, and surgical operations.

## Statistical analysis

The data were presented as number and percentage. The mean age of the patients was presented as mean±standard deviation (SD). For independent samples, the continuous variables with normal distribution were expressed as means ±2 SD and were compared using Student's t test, whereas continuous variables with an asymmetric distribution were expressed as median and the respective range interval and were compared using Mann-Whitney U-test. In the case of categorical variables, Pearson's chi-square test was used to analyze differences in proportions. The significance level was established at  $p < 0.05$  for all tests. Data entry and analysis were made using the Statistical Package for the Social Sciences version 17.0 (SPSS, Inc., Chicago, IL, USA).

## RESULTS

### Age and gender

A total of 2346 pediatric burn patients were admitted during the study period. The average age was  $4.42 \pm 3.56$  years (range, 2 months-15 years). There were 1064 (45.3%) males and 1282 (54.7%) females. The male to female ratio was 0.8:1. With respect to gender distribution, the number of females was significantly larger ( $p < 0.000$ , Table 1). There was a statistical difference among the age groups ( $p < 0.000$ ). The highest incidence (68.5%) appeared in the 0-4 years of age group (Table 2).

### Burn type

Burn type was scalding burns in 1828 (77.9%), flame burns in 332 (14.2%) and electrical burns in 186 (7.9%). Scalding burns and flame burns were seen significantly more in the youngest age group. Electrical burns were seen significantly more in the 11-15 age

**Table 1.** The distribution of the population according to age groups and gender

Age group	Female n (%)	Male n (%)	Total n (%)
2 months - 4 years	889 (37.9)	718 (30.6)	1607 (68.5)
5-10 years	285 (12.1)	217 (9.3)	502 (21.4)
11-15 years	108 (4.6)	129 (5.5)	237 (10.1)
Total	1282 (54.7)	1064 (45.3)	2346 (100)

**Table 2.** The distribution of gender according to time periods

Age group	Female n (%)	Male n (%)	Total n (%)
1994-1998	236 (10.0)	404 (17.2)	640 (27)
1999-2003	404 (17.2)	273 (11.6)	677 (29)
2004-2008	642 (27.3)	387 (16.4)	1029 (44)
Total	1282 (54.7)	1064 (45.3)	2346 (100)

group cases ( $p<0.000$ , Fig. 1). Burn TBSA was significantly larger in flame burns than other types of burns ( $p<0.000$ ).

**Burn degree**

Distribution of the degree of burns was 19 (0.8%) first-degree, 2172 (92.6%) second-degree and 155 (6.6%) third-degree. Second-degree burns were seen significantly more ( $p<0.000$ ). Second-degree burns were observed more frequently in the 2 months - 4 years of age group, and third-degree burns were observed more frequently in the 11-15 years of age group ( $p<0.000$ ).

**Severity (extent and depth) of burns**

The mean TBSA burn was  $21.5\pm 12.6\%$  (range, 1-90%). TBSA (%) of 1505 (64.2%) cases was  $<20\%$ , TBSA (%) of 705 (30.1%) cases was 21-40%, TBSA (%) of 112 (4.8%) cases was 41-60%, and TBSA (%) of 24 (1%) cases was  $>61\%$  (Table 3). Severity of burn was significantly greater in flame and electrical burns than in scalding burns ( $p<0.000$ ).

**Length of hospitalization**

The mean length of hospitalization was  $12.87\pm 10.02$  days (range, 1-104 days). Severe burns and large burns required longer hospitalization. Length of hospitalization was significantly longer in flame burns ( $p<0.017$ ).

**Culture and antimicrobial susceptibility**

Cultures were performed on wound, blood, urine, and tracheal aspirate samples taken from 3820 inpatients, and 710 pathogens were isolated. The most frequently isolated microorganisms were *Pseudomonas aeruginosa* (52%, 368), *Acinetobacter spp.* (12%, 83), *Escherichia coli* (9%, 66), and *Staphylococcus aureus* (7%, 51) (Table 4). Amikacin, cefoperazone-sulbac-

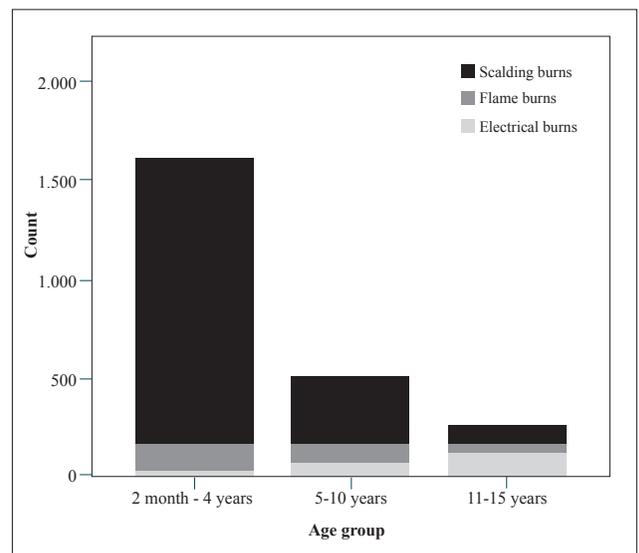
**Table 4.** Distribution of isolated microorganisms

Microorganism	Number	(%)
<i>Pseudomonas aeruginosa</i>	368	(52)
<i>Acinetobacter spp.</i>	83	(12)
<i>Escherichia coli</i>	66	(9)
<i>Staphylococcus aureus</i>	51	(7)
Coagulase-negative <i>Staphylococci</i>	28	(4)
<i>Klebsiella spp.</i>	18	(3)
<i>Proteus spp.</i>	11	(2)
<i>Enterobacter spp.</i>	10	(1)
<i>Stenotrophomonas spp.</i>	8	(1)
Other	67	(9)
Total	710	(100)

tam, piperacillin/tazobactam, imipenem, meropenem, and colistin were the most effective agents against Gram-negative bacteria.

**Outcome**

2241 (95.5%) cases were survivors and 105 (4.5%) were non-survivors. There was no significant relationship between age and mortality. There was a significant relationship between degree of burns, TBSA (%) and length of hospitalization and mortality (Table 3). Mortality was significantly higher in flame burns and electrical burns than in scalding burns ( $p=0.021$ ).



**Fig. 1.** The distribution of burn type according to age groups.

**Table 3.** The distribution of age, degree of burns, TBSA (%) and length of hospitalization according to outcome

Outcome	n	Age Mean±SD	Degree of burns Mean±SD	TBSA (%) Mean±SD	Length of hospitalization (day) Mean±SD
Survivor	2241	4.42±3.56	2.05±0.25	20.59±11.37	12.80±9.82
Non-survivor	105	4.20±3.76	2.20±0.40	42.02±19.98	14.36±13.54
<i>p</i>		0.886	0.000	0.000	0.000

## DISCUSSION

Epidemiology, etiology, risk factors, and outcome of pediatric burns may vary according to region, lifestyle, gender, living conditions, and socioeconomic status. Epidemiological studies that determine the risk factors are very important for the development of prevention programs for pediatric burns. In Turkey, females usually work in the kitchen, while males usually work outside. As a result, the burn rate and burn type may vary between genders. In our study, female prevalence was 54.7%, and this finding correlates with some reported studies,<sup>[9-11]</sup> though contradicting findings have been published.<sup>[12-14]</sup>

Children are exposed to burns more often because they are unaware of their danger. Thus, parents should be aware of the risk factors for pediatric burns and be more careful in preventing them. In our study, young age was the most striking risk factor for burns, with 68.5% of cases under 4 years old. These data were similar to other studies.<sup>[1,15-17]</sup> In our country, small children are prone to exposure to hot liquids and foods, while school-aged children are commonly exposed to fire and electrical burn. Scalding burn was the most frequent cause of burns in many studies from other countries.<sup>[14,18-21]</sup> Similarly, scalding burns were seen significantly more often (77.9%) in our study. It was reported that the rate of electrical burn ranged between 2.1% and 16.8% in the pediatric age group.<sup>[14,22]</sup> In our study, the rate of electrical burns was 7.9%. Akcay et al.<sup>[22]</sup> reported the average length of hospital stay in their study as 31.64 days. The average length of hospital stay was 12.87±10.02 days in our study. The patients with the longest hospitalization were those with severe burns or large burns.

Burn wound infections due to burns may change over time. Previously, *Pseudomonas* infections were frequently seen, while today, *Acinetobacter* infections are becoming more widespread, and due to the high antibiotic resistance, *Acinetobacter* infections are a serious problem. In our burns unit, in 2000, Aldemir et al.<sup>[22]</sup> found that the most frequently isolated microorganisms from their patients were *Pseudomonas spp.* (58%) and *Escherichia spp.* (22%). In our study, the most frequently isolated microorganisms were *P. aeruginosa* (55%), *Acinetobacter spp.* (13%), *E. coli* (8%), and *S. aureus* (7%). It is very clear that if measures against *Acinetobacter* infections are not taken, it will become an important problem for burn units in the future.

The burn mortality rate may change due to type of burn, age, TBSA (%), burn wound infections, and the quality and features of the burn unit. The mortality rates vary widely between burn centers, ranging from 4.4% to 33.5%.<sup>[14,22-25]</sup> Our mortality rate was 4.5% among 2346 cases. Severe degree of burns, burn

wound infections, large TBSA (%), long length of hospitalization, and flame and electrical burns were associated with high mortality rates. In burn units, development of burn wound infections will decrease with the application of effective topical antimicrobial therapy, early excision of burn injury, effective wound care, follow-up of the burn wound, increased hand hygiene compliance, and development of surveillance programs. The survival rate among burn patients will also increase.

In conclusion, in the southeast Anatolia region of Turkey, the epidemiological features of pediatric burns are different from other parts of Turkey and others countries due to the culture, lifestyle, young population, living conditions, and socioeconomic status. We found that especially children aged 0-4 years and females are at greater risk for scalding burns. Burn prevention education should train individuals living in these areas about the safe handling of hot water and other domestic hazards for pediatric burn prevention. The mortality rate may be reduced in advanced burn units.

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