

ORIGINAL ARTICLE

An 11-year retrospective study on the epidemiology of paediatric burns in the north of Iran

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Abstract

Burn injuries in children are distressing physical and emotional events with long-term disability. However, there is little research on the epidemiology of paediatric burns. This information is essential for the development of prevention intervention and acute management. This study aimed to describe epidemiologic characteristics and clinical outcomes of paediatric burns in a burn center in the north of Iran. A retrospective, single-center study was conducted of children (<18 years) admitted to the burns center between 2011 and 2021. The data were analysed by SPSS 24.0 software. The chi-squared test and Fisher's exact test were used to assess categorical variables, and Student's t-tests or One-Way ANOVA was used to evaluate continuous variables. 2951 paediatric burns with mean age 5.30 ± 5.27 years, were admitted during the 11 years, with 1777 boys (60.2%) and 1174 girls (39.8%). By age groups, the majority of children (59.7%) were between 0 and 4 years old, followed by 5 to 8 years (15.7%), 13 to 18 years (14.6%), and 9 to 12 years (10.0%), respectively. The most cause of injury was Hot liquids & vapours (1604, 54.4%). The mean age for burns with fire & flames, hot liquids & vapours, contact, chemical, and electrical was 4.46 ± 4.84 , 5.70 ± 5.39 , 5.44 ± 5.42 , 3.93 ± 3.86 , and 3.53 ± 4.06 years, respectively. The total body surface area (TBSA) burned was 14.96 ± 11.94 . The longest length of stay (LOS) related to fire and flame was 5.63 ± 7.57 days. The mortality rate was 1.56%. There were significant differences among aetiology groups for the cost per % TBSA ($F = 15.784$, $P < 0.001$), which correlated with the burn depth, TBSA, aetiology, LOS, and age. The Ministry of Health should establish strategies for burn prevention and incorporate data surveillance for burn injuries. Community education on kitchen and cooking safety could positively impact the prevalence and outcomes of paediatric burns.

KEYWORDS

burns, child, epidemiology, paediatrics, treatment outcome

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Key Messages

- 2951 paediatric burns, mean aged 5.30 ± 5.27 years, were admitted during the 11 years, with 1777 boys (60.2%) and 1174 girls (39.8%)
- by age groups, the majority of children (59.7%) were between 0 and 4 years old
- the most cause of injury was Hot liquids & vapours (1604, 54.4%)
- the mortality rate was 1.56%
- the mean hospital cost was $45\,318\,883.77 \pm 1\,288\,789.96$ IR and $3\,029\,337.15 \pm 146\,453.40$ IR per % TBSA

1 | INTRODUCTION

Burn injuries in children are distressing physical and emotional events with long-term outcomes.^{1,2} More than half a million children worldwide are hospitalised with burn injuries in hospitals annually, most of which occur in developing countries.³ The epidemiology of burns differs between adults and children. According to global research conducted in 103 countries, the mortality rate of children with burns in low- and middle-income countries is eight times higher than in high-income countries.⁴ Recent advances in treatment methods for burn patients have improved survival rates and reduced burn outcomes.⁵⁻⁹ However, children often have a lower quality of life as a result of their distinct physical and psychological characteristics.¹⁰ Also, burn outcomes are not limited to patients' physical health but also affect social and economic domains.^{11,12} Over 90% of burns are preventable.¹³ Burn prevention requires adequate knowledge of its epidemiological features and related risk factors. Adults and children have different burn epidemiology.¹⁴ Also, studies show that the incidence of burns in children is still high, especially in developing countries, and it is considered a challenging condition.^{15,16} Several factors, including the child's characteristics (such as age and ethnicity), the injury mechanism (pull down or spill), the heat source (iron, chemical agent, or hot beverage), and the environment in which the injury occurs (home or school, time of day the injury occurred and levels of social deprivation), directly affect the amount and pattern of burn injury in children.¹⁷ Barcellos et al. reported that most burns in children are caused by hot liquids, followed by contact and flame burns.¹⁴ Another study showed that burn patterns differed significantly between children aged five or older and those under five; for example, chest and face burn rates were significantly higher in children under five.¹⁸ A study in Wuhan found that the majority of paediatric burns were in the age range of 0 to 3 years (81.12%), and 61.8% were male, while 37.03% were females, with a ratio of 1.70:1.¹ Recently, various studies identified risk factors for experiencing burns as a young

child in developing countries. Studies conducted in Guatemala¹⁹ and Mexico²⁰ have shown a significant correlation between the prevalence of burns and low socioeconomic status. Despite the studies conducted on the epidemiology of burns in Iran, few comprehensive studies of paediatric burns have been performed so far. The high burden of burn injuries and lack of adequate epidemiological data makes it challenging for policymakers to implement a proper strategic plan for burn prevention. Hence, epidemiological studies on the prevalence and characteristics of burns are essential to prevent this type of trauma and adopt effective strategies. This study aimed to analyse epidemiological characteristics of paediatric Burns in a Burn Center in the North of Iran to provide better strategies for preventing these injuries.

2 | MATERIALS AND METHODS

2.1 | Data source and design

A retrospective, single-center study was conducted of children (<18 years) admitted to the burns center in the north of Iran between 2011 and 2021. This center is the only burn center in Guilan province, with 55 beds in the burn ward and ten beds in the burn ICU. It has approximately 700 admissions annually, covering all burn patients in the province and some adjacent provinces.

All information was obtained from the hospital information system (HIS). Paediatric records were selected according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) categories for burns and corrosions codes (T20-T32). Inclusion criteria were <18 years of age at the time of the burn and treatment in a referral burn center in Guilan province. We excluded patients who were referred to hospitals for outpatient care and readmission. Patients' information was collected through a researcher-made information registration form. The following data were collected from the hospital information system: (1) demographic data, including age, sex, admission date,

discharge date, and season of injury; (2) injury-related data, including the aetiology of burn injuries and percent total body surface area injury (%TBSA), and (3) treatment situation, including the length of stay (LOS) in hospital (day), and clinical outcomes. The etiologies of burn injuries included fire & flames, hot liquids & vapours, contact burns, chemical burns, and electrical burns. Patients were grouped by TBSA as small area (<10%TBSA), medium area (10%-29%TBSA), large area (30%-49%TBSA), and extra-large area (\geq 50%TBSA).

2.2 | Ethical considerations

This research was approved by the Ethics Committee of Guilan University of Medical Sciences (IR.GUMS.REC.1400.226). Patient informed consent was not acquired as a result of the use of previously gathered data from the hospital information system; nevertheless, the names of patients were not gathered from the database for ethical reasons.

2.3 | Statistical analysis

Statistics analysis was conducted using the SPSS software package (version 24.0, SPSS Inc., Chicago, IL, USA). There was no missing data. Continuous variables are presented as means and standard deviation (SD), and Categorical variables are presented as numbers and percentages. The chi-squared test and Fisher's exact test were used to assess categorical variables, and Student's t-tests or One-Way ANOVA was used to

evaluate continuous variables. A *P*-value less than 0.05 was considered statistically significant for two-tailed tests.

3 | RESULTS

3.1 | Demographics

From 2011 to 2021, 2951 children with burns (under 18 years old) were admitted to the burn center in the north of Iran, constituting 29.1% of all burns (10133). There was no significant increasing trend in the incidence of paediatric burns during the study period (Figure 1). The mean age of children was 5.30 ± 5.27 years. Age distribution indicated that 1-year-old children had the highest number of burn cases (Figure 2). By age groups, the majority of children (59.7%) were between 0 and 4 years old, followed by 5 to 8 years (15.7%), 13 to 18 years (14.6%), and 9 to 12 years (10.0%). Of all cases, 1777 were boys (60.2%) and 1174 girls (39.8%), with the boy: girl ratio of 1.51:1.

3.2 | Aetiology

The most common cause of burns in all age groups was hot liquids & vapours. The leading cause was Hot liquids & vapours (1604, 54.4%), followed by fire & flames burns (746, 25.3%), contact burns (556, 18.8%), electric burns (30, 1.0%), chemical burns (15, 0.5%) (Table 1). There was a significant difference ($F = 8.314$, $P < 0.001$) between age and aetiology. The mean age for burns with

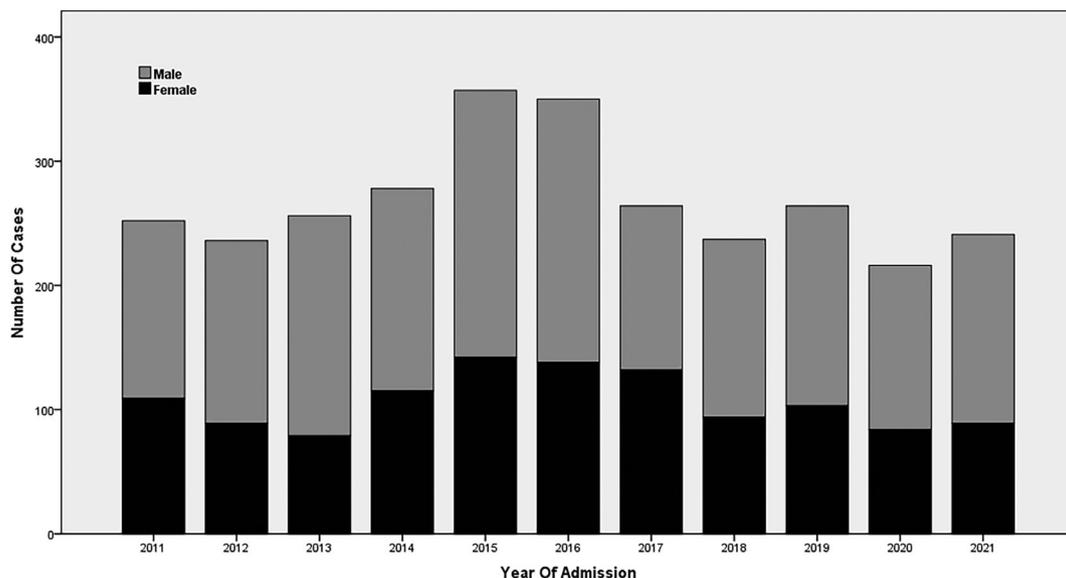


FIGURE 1 The number of paediatric burn patients by year.

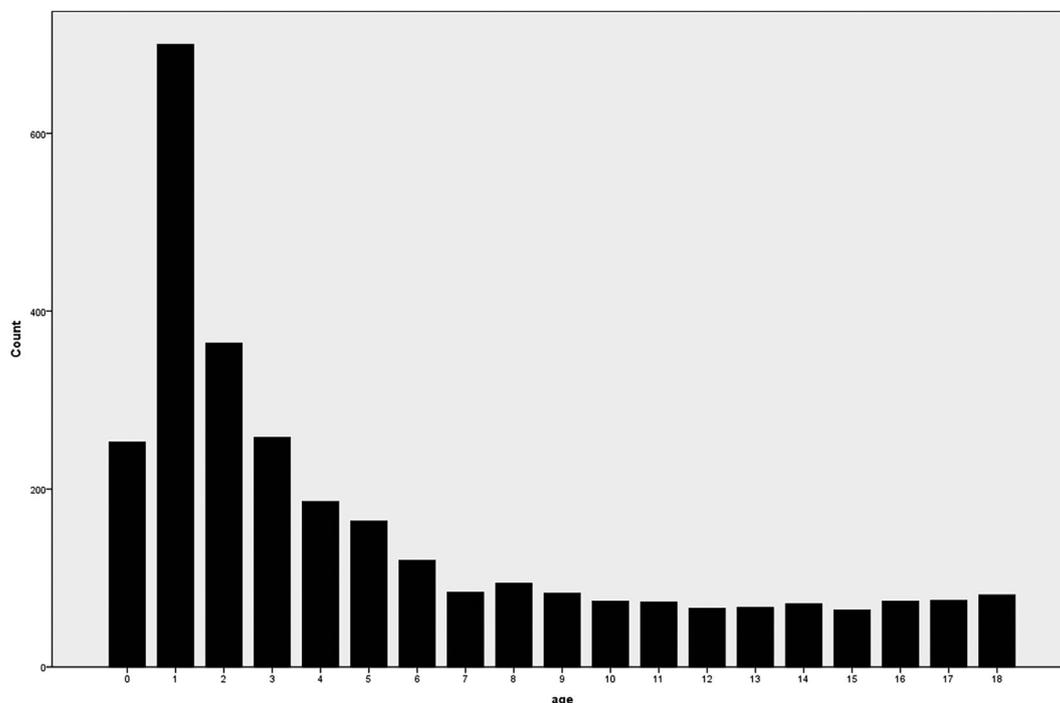


FIGURE 2 Age distribution of paediatric burns.

TABLE 1 Comparison of different etiologies.

Aetiology	N (%)	Boy/girl ratio ^a	Age (y) ^b	TBSA (%) ^c	LOS (day) ^d
Fire & flames	746 (25.3)	2.32	4.46 ± 4.84	18.72 ± 17.35	5.63 ± 7.57
Hot liquids & vapours	1604 (54.4)	1.26	5.70 ± 5.39	14.16 ± 9.41	3.78 ± 4.93
contact	556 (18.8)	1.42	5.44 ± 5.42	12.41 ± 7.73	3.54 ± 4.82
Chemical	15 (0.5)	2.75	3.93 ± 3.86	14.20 ± 14.76	4.27 ± 5.99
Electrical	30 (1.0)	4.00	3.53 ± 4.06	12.47 ± 9.44	4.93 ± 8.06
Total	2951 (100.0)	1.51	5.30 ± 5.27	14.96 ± 11.94	4.22 ± 5.79

Abbreviations: LOS, length of stay; TBSA, total burn surface area.

^a $\chi^2 = 48.467$, $P < 0.001$.

^b $F = 8.314$, $P < 0.001$.

^c $F = 27.93$, $P < 0.001$.

^d $F = 15.57$, $P < 0.001$.

fire & flames, hot liquids & vapours, contact, chemical, and electrical was 4.46 ± 4.84 , 5.70 ± 5.39 , 5.44 ± 5.42 , 3.93 ± 3.86 , and 3.53 ± 4.06 years, respectively. The gender ratios of etiologies were also significantly different ($\chi^2 = 48.467$, $P < 0.001$), with several etiologies having much higher boy/girl ratios than the average, such as electrical burns (4.00:1), chemical burns (2.75:1), and fire & flames (2.32:1) (Table 2).

3.3 | Season of injury

The incidence of burn injuries in spring, winter, summer, and autumn was 27.5%, 27.2%, 23.8%, and 21.5%,

respectively (Figure 3). There was a significant difference ($\chi^2 = 32.367$, $P < 0.001$) between the season of injury and aetiology. The burns incidence with chemicals, electrical, and fire & flame was more in spring (40.00%, 33.33%, and 30.83%, respectively). Also, burns with hot liquids & vapours and contact were more common in winter (27.12% and 27.34%).

3.4 | Total body surface area

The TBSA burned was 14.96 ± 11.94 . Over half of the paediatric (53.2%) were small burns less than 10% total burn surface area, and in the large and extra-large areas,

TABLE 2 Comparison of TBSA groups in different etiologies.

Aetiology ^a	Small area (n, %)	Medium area (n, %)	Large area (n, %)	Extra-large area (n, %)
Fire & flames	360 (48.26)	272 (36.46)	59 (7.91)	55 (7.37)
Hot liquids & vapours	832 (51.87)	670 (41.77)	87 (5.42)	15 (0.94)
Contact	345 (62.05)	193 (34.71)	15 (2.70)	3 (0.54)
Chemical	9 (60.00)	5 (33.33)	0 (0.0)	1 (6.67)
Electrical	23 (76.67)	5 (16.67)	2 (6.67)	0 (0)
Total	1569 (53.17)	1145 (38.80)	163 (5.52)	74 (2.51)

Note: Small area (<10%TBSA), medium area (10%-29%TBSA), large area (30%-49%TBSA), extra-large area (≥50%TBSA).

^a $\chi^2 = 139.640$; $P < 0.001$.

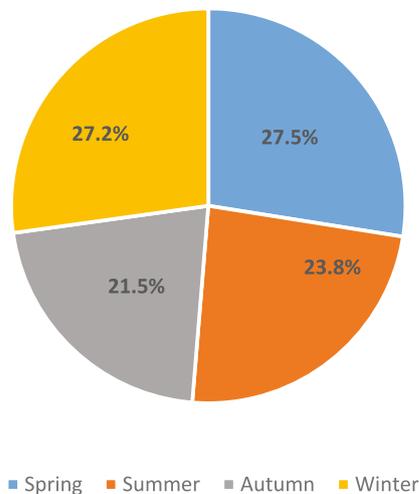


FIGURE 3 The seasonal distribution of paediatric burns.

there were fewer patients (8.0%) (Figure 4). There was a significant difference between TBSA and aetiology ($\chi^2 = 139.640$, $P < 0.001$). Electric burns were nearly all small TBSA (76.67%). Many large and extra-large areas were in hot liquids & vapours, contact, and fire & flames.

3.5 | Treatment outcomes

Of all the patients, after excluding those who did not finish the treatment by transferring to other hospitals, discharged by personal consent, and escaping, 2779 cases were cured (98.44%), and 44 patients (1.56%) died.

3.6 | Length of stay

The mean LOS of children with burns was 4.22 ± 5.796 days. There was a significant difference between aetiology and LOS ($F = 15.57$, $P < 0.001$), with the longest LOS in fire & flames burns of 5.63 ± 7.57 days, followed by electrical injury

4.93 ± 8.06 days, chemical burns 4.27 ± 5.99 days, Hot liquids & vapours 3.78 ± 4.93 days, contact burns 3.54 ± 4.82 days (Table 1). There were significant differences among TBSA groups for LOS ($F = 316.196$, $P < 0.001$), with the extra-large area group 12.85 ± 11.440 days, large area group 12.47 ± 9.261 days, medium area group 5.24 ± 5.809 days, and small area group 2.21 ± 2.870 days.

3.7 | Hospital cost

Of all the cases, the mean hospital cost was $45\,318\,883.77 \pm 1\,288\,789.96$ IR and $3\,029\,337.15 \pm 146\,453.40$ IR per % TBSA. There were significant differences among aetiology groups for the cost per % TBSA ($F = 15.784$, $P < 0.001$), with chemical burns of $3\,615\,753.02 \pm 5\,167\,135.77$ IR, electric burns of $3\,447\,416.51 \pm 3\,933\,821.08$ IR, fire, and flame burns of $3\,284\,592.46 \pm 3\,287\,122.41$ IR, Hot liquids & vapours $2\,526\,390.93 \pm 2\,048\,280.56$ IR and contact burns of $2\,409\,568.81 \pm 1\,943\,053.17$ IR.

4 | DISCUSSION

This study aimed to analyse epidemiological characteristics of paediatric burns in a Burn Center in the North of Iran. This study was the largest population-based survey sample on paediatric burns in Iran. A total of 2951 children with burn injuries were admitted to a Burn Hospital in Guilan, Rasht, from 2011 to 2021. Our findings showed that there were no considerable changes in the burn rate of children during the study period. However, a slight fluctuation in this trend was observed between 2015 and 2016. This finding can indicate a greater need for social and individual learning programs to reduce the rate of burn incidences. One of the main findings of the present study was that most burn cases were one-year-old children and the group of 1 to 4 years old. This is in line with

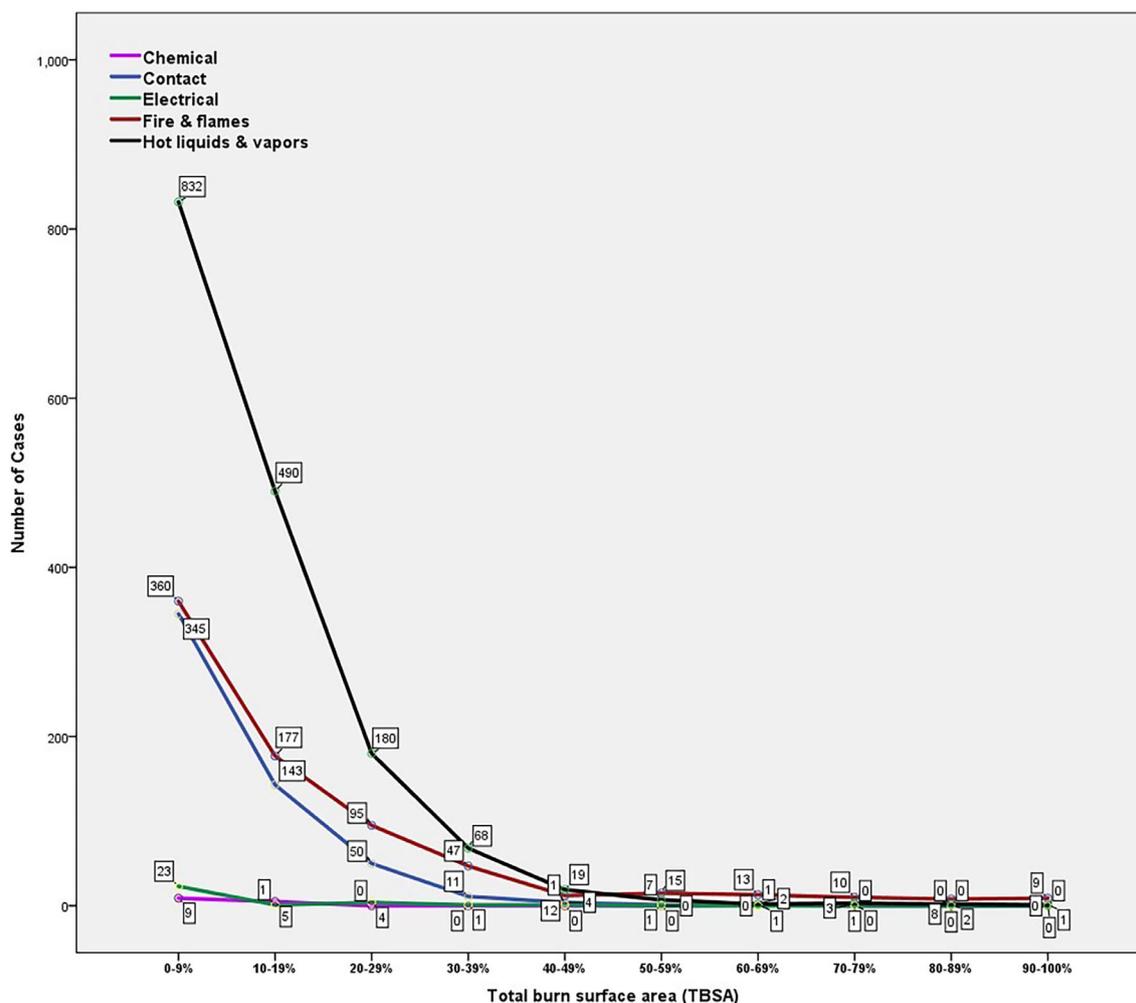


FIGURE 4 Distribution of TBSA in different etiologies of paediatric burn patients.

findings of studies on unintentional burns in Sub-Saharan Africa and South Asia, indicating that the group of Children aged 1 to 5 years were at risk of severe burn injury.^{21,22} Similarly, a study in Guatemala reported that the majority of paediatric burns was under five year.¹⁹ Because paediatrics experience rapid motor and cognitive development during the first five years of life, it is reasonable to assume that both the risk of burn injury and the circumstances associated with such injury would vary during this period. It should be mentioned that most preventive approaches for this age group directly relate to the parents. Also, several studies showed that most paediatric burns occur in household environments, especially the kitchen²³⁻²⁵; therefore, this could be effectively reduced by separating children playing space from the kitchen. Another safety measure to reduce unintentional burns in children could be putting probable causes of burns, such as hot liquids and objects in places far from children's reach. A higher proportion of burning in males was seen in the present study. This is consistent with studies in other parts of the world, like China, Turkey, Australia, and South Africa.²⁶⁻²⁹

The probable explanation could be as a result of more vibrant and daring characteristics in boys.

Among this study's different age groups, hot liquids and vapours were children's most common causes of burning. They were responsible for more than half of burn cases. The second was fire and flames, followed by contact burns. In a study in Ghana, 73.8% of burns were as a result of scalding.³⁰ The same finding was showed in a study in Brazil.¹⁴ Correctly understanding the aetiology of the injury greatly affects determining safety measures. The etiologies can be prevented by properly supervising children and controlling the home environment, such as hot liquids that are more prevalent in little children. In the present study, electrical burns accounted for 1% of paediatric burns. This is less than the prevalence detected in Turkey, where electrical burns accounted for 2.4% of admitted patients.²⁷ Although it is a rare condition, it seems an increase in frequency is occurring.³¹ So it is essential to pay attention to prevent this health-threatening condition.

In the present study, the mean TBSA was 14%, and more than half of the patients had less than 10% TBSA.

In line with our results, the average TBSA in many studies was less than 15%.^{26,29,32} It is important to note that various etiologies of paediatric burns have different means of TBSA. Fire and flames had the most injured body surface, followed by chemical and hot liquids. This is important because higher TBSA has been associated with an increased LOS and mortality.^{33,34} Although electrical burns had the lowest TBSA among patients, they caused severe injuries and a high hospitalisation length.

The mean length of a hospital stay was 4.2 days. The average LOS of children with burns in studies conducted in Palestine,²³ Turkey,²⁷ and the Republic of South Africa²⁹ were 11.45, 19.6, and 17.1, respectively. The plausible explanation is that the difference in mean LOS could be related to the difference in %TBSA. Also, the most prolonged LOS was attributed to fire and flames, followed by electrical, chemical, hot liquid, and contact burns. Similar to our findings, a study in Istanbul, Turkey²⁷ showed that flame and electrical burns needed longer hospitalisation and operative interventions. The mortality rate in the present study was 1.56% which is lower than in similar studies. A systematic review in 2017 showed that the mortality rate of burns in children in Iran varies from 1.7% to 18.5%.³⁵ Also, studies from other low-middle-income countries reported higher mortality rates between 6.1% and 8.8%.^{23,28} The plausible explanation for this low mortality in the present study could be related to the low average TBSA compared with other studies. Although many advances have been made in treating and caring for burn patients, the incidence and mortality rate is still above, and burns are a major cause of disability worldwide. Thus, preventive plans through higher public education are necessary to reduce the incidence and efficient medical approaches to treating patients to reduce disability and mortality, especially in children.

4.1 | Strengths and limitations

The study has several strengths. The data was extracted from the hospital information system in the north of the country, which was extracted with specific inclusion criteria and classified based on standard coding for research. On the other hand, there were some limitations in this study. One of the study's limitations is the retrospective and single-center research environment. So it may not reflect the actual pattern of paediatric burns in the general population of Iran, as it was a single-center study focusing on patients admitted at a tertiary-level center. Also, many patients were transferred from district hospitals, so their clinical findings and management may not accurately represent their acute presentation and care.

4.2 | Implications for future study

Future research on burn injuries should aim to understand the broader epidemiology of paediatric burns in Iran; a multi-center study would provide more complete data. We also propose implementing our study recommendations through community education on avoiding burn injuries. Additionally, future research should assess the quality of life, post-traumatic stress disorder, and long-term functional outcomes in children with burns.

5 | CONCLUSION

From 2011 to 2021, 2951 children with burns were admitted to the burn center in the north of Iran, constituting 29.1% of all burns. The majority of the paediatric burn victims were boys and one-year-old children. The average TBSA was 14.96 ± 11.94 , and the mean LOS was 4.22 ± 5.796 days. The most common cause of burns was hot liquids & vapours, and the mortality rate was 1.56%. The Ministry of Health should create burn prevention strategies and implement data surveillance for burn injuries. Public health measures should focus on preventing burn injuries in children, particularly through educating parents and promoting safety in daily tasks.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This research was approved by the Ethics Committee of Guilan University of Medical Sciences (IR.GUMS.REC.1400.226). Patient informed consent was not acquired as a result of the use of previously gathered data from the hospital information system; nevertheless, the names of patients were not collected from the database for ethical reasons.

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