Original Article

Factors Influencing Hospitalization Duration and Mortality in Burn Patients: A 2-Year Analysis of Causes, Age, and Total Body Surface Area

Abdolkhalegh Keshavarzi[1†], Ali Qahremani Arekhloo[2†], Faezeh Bahadornia[2], Marzieh Mansouri[1] , Ilia Keshavarzi[2], Mitra Zardosht[1], Mohammad Dehbozorgi[1,3*], Mohammad Kashkooli[2,4,5]

1. Burn & Wound Healing Research Center, Amir-al-Momenin Hospital, Shiraz University of Medical Sciences, Shiraz, Iran
2. Medical School, Shiraz University of Medical Sciences, Shiraz, Iran
3. Department of Plastic and Reconstructive Surgery, Shiraz University of Medical Sciences, Shiraz, Iran
4. Immortal Dynamical Biotech Network Institute, Shiraz University of Medical Sciences, Shiraz, Iran
5. Visiting Student, Harvard-MIT Health Sciences and Technology, Boston, MA, USA

†Join first authors

***Corresponding Author:**

Mohammad Dehbozorgi

Assistant Professor of Plastic, Reconstructive and Burn Surgery, Shiraz University of Medical Sciences, Burn & Wound Healing Research Center, Amir-al-Momenin Hospital, Shiraz, Iran

Email: mdehbozorgi@hotmail.com

Received: 2/6/2026
Accepted: 7/11/2026

ABSTRACT

Background: We aimed to establish the relationship between hospital stay duration, factors causing burns, total body surface area (TBSA), and patients' age for all individuals admitted to Amir al-Momenin Hospital in Shiraz, Iran.

Methods: This descriptive-analytical investigation was conducted on 1,960 hospitalized patients. The data were evaluated through One-way ANOVA and Tukey HSD tests in addition to a chi-squared test for categorical variables utilizing SPSS version 26 software.

Results: Explosions and fires were the primary causes of burn hospitalizations (n = 635; 32.4% and n = 622; 31.7%). The average hospitalization duration was 12.66 days, with electrical burns leading to the longest stay at 19.91 days. Hospitalized patients had an average total body surface area (TBSA) of around 28%, with burns from fire and explosions resulting in the highest TBSA at 36.59% and 35.74%, respectively. The mean age of admitted patients was 31.51 years, while burns from hot liquids and vapor occurred at an average age of 19.73 years, making this group the youngest.

Conclusion: Burns from explosions and flames are the primary causes of injury, highlighting the need for prevention strategies. Patients with electrical burns experienced longer hospital stays due to specific complications. The severity of burn injuries is closely related to hospitalization duration. Those burned by hot liquids and vapor tend to be younger than those injured by other causes. This risk can be reduced by establishing a designated play area for children away from the kitchen.

KEYWORDS
Burn injuries; Hospitalization duration; Total Body Surface Area (TBSA); Burn causes; Mortality rate; Electrical burns

Please cite this paper as:
Keshavarzi A, Qahremani Arekhloo A, Bahadornia F, Mansouri M, Keshavarzi I, Zardosht M, Dehbozorgi M, Kashkooli M. Factors Influencing Hospitalization Duration and Mortality in Burn Patients: A 2-Year Analysis of Causes, Age, and Total Body Surface Area. World J Plast Surg. 2026;15(2):83-89.
doi: 10.66224/wjps.16.2.83

INTRODUCTION

Burn injuries are a significant global issue, causing economic and social burdens to healthcare systems [1-5]. In Iran, burns are the cause of about one percent of all mortalities and are the source of about 18% of injury-related mortalities [6]. Even though only a small proportion of burn

injuries are lethal, they frequently lead to long-term sequelae such as physical disabilities, scarring, and psychological distress [7, 8]. The global burden from fire-related burns is significant, with an estimated 10 million Disability-Adjusted Life Years (DALYs) lost annually [9].

Medical advances in the last few decades have reduced both the incidence and severity of burn injuries. Improved survival, especially in developing countries, has been aided by advancements in critical care. However, fire-related burns still cause about 300,000 deaths each year, in addition to the loss of millions of DALYs worldwide [10]. Among those presenting to emergency departments with burn injuries, 4% to 22% require intensive care unit (ICU) admission due to the severity of their injuries [11].

The WHO reports that more than 95% of fire-related burns occur in low- and middle-income countries (LMICs), where specialized burn care may be limited [12]. According to the 2017 National Burn Repository Annual Report, the most common causes of burn injuries are fire and scalds, which together account for 76% of reported cases [13]. Burn injuries can result from various sources, including heat, electricity, friction, radiation, and chemicals [14]. The severity of a burn, often determined by the total body surface area (TBSA) affected, directly influences the extent of the injury and the likelihood of survival [15]. Socio-economic factors such as overcrowding, poverty, and inadequate healthcare infrastructure contribute to the challenges of burn prevention and early treatment, particularly in rural and semi-urban communities [16]. Patients with severe burns typically require longer hospital stays, which lead to higher medical costs and significant psychological and financial stress for both patients and their families [17, 18].

Given these complexities, we aimed to examine the relationship between hospital length of stay (LOS) and key factors, including the cause of the burn, patient age, and TBSA, among individuals admitted to Amir al-Momenin Burn Injury Hospital in Shiraz, Iran from January 27, 2021, to July 23, 2023. The results of this study will provide valuable insights for healthcare policymakers and hospital administrators, helping to identify factors that contribute to prolonged hospital stays and guide improvements in burn management and prevention strategies.

MATERIALS AND METHODS

The current research was a descriptive and analytical investigation conducted using data from the Burn Data Registry (ethic code: IR.SUMS.REC.1399.529). The study population comprised all burn patients admitted to Amir al-Momenin Burn Injury Hospital in Shiraz, Iran from 27 January 2021 to 23 July 2023. The hospital is positioned in the southern area of Iran. Throughout the study timeframe, the facility admitted 1,960 patients with burn injuries. The ethical committee of Shiraz University of Medical Sciences approved the study protocol (registration code: IR.SUMS.REC.1402.424). All individuals receiving treatment or their family members completed and endorsed a consent document for the research initiative regarding their information upon entering the hospital.

The statistical population included all Patients referred to Amir al-Momenin Hospital of Shiraz for the first time and patients Consent to participate in the study. We categorized the patients into six groups according to the underlying cause of their burns, and then measured length of stay, patients' age, and TBSA and compared them with each other. We excluded all patient's unwilling to participate in the study, Patients with low burn degree, patients with any use of immunosuppressive drugs during the last month, and all Immunocompromised patients including patients with AIDS, diabetes, vasculitis, inflammatory diseases, and rheumatology diseases (Rheumatoid arthritis, Lupus, Takayasu, Felter, Borger, Polyarthritis). Because we considered that having these types of diseases could increase the length of stay. Based on the inclusion and exclusion criteria, 1,960 patients were incorporated into this study, and their relevant data for the study objectives were retrieved from the Health Information System (HIS).

Theory/Calculation

The relationship between hospital stay duration, burn etiology, Total Body Surface Area (TBSA), and patient age was analyzed using descriptive and inferential statistics. Data was analyzed using correlation and independent samples t-test, including One-Way ANOVA to compare the means of hospitalization durations across different burn causes. The Tukey Honestly Significant Difference

(HSD) test was used as a post-hoc analysis to identify specific differences between groups when the ANOVA indicated statistical significance. The significance threshold was set at $P<0.05$. In addition, chi-squared test was used for categorical variables.

The total body surface area (TBSA) for each patient was calculated based on the extent of the burn injury. The relationship between TBSA and the length of stay was explored, if a greater TBSA correlates with increased severity and therefore longer hospitalization. The data were analyzed using SPSS version 26, with a focus on statistical tests that are appropriate for comparing means between multiple groups.

This approach allows for the identification of key factors influencing hospitalization duration and provides a clearer understanding of burn injury severity in relation to various causative factors.

RESULTS

A total of 1,960 burn patients were enrolled (Table 1). Approximately 71.3% of the patients were male, while 28.6% were female. Explosion and fire were the main causes for burns hospitalization (n = 635; 32.4% and n = 622; 31.7%). Nearly 19.8% of the burnt patients died and the leading cause of death was fire with 196 deaths (*P*-value <0.001, odds_ratio = 2.7). After fire, explosion was the second important cause of death with 168 deaths (*P*-value <0.001, odds ratio = 1.79). The mean duration of hospitalization was 12.66 days.

Hot solids with 9.1 days and electricity with 19.91 days were considered as the shortest and longest length of stay in hospital. The average TBSA of hospitalized patients was around 28% and burns with fire and explosion had the highest TBSA with 36.59% and 35.74%. The mean age of patients admitted to the hospital was 31.51 years. Burns with hot liquids and vapor occurred at an average age of 19.73 years.

Analytic results

The relation between the length of stay and causes of the burn was tested using ANOVA, and the Tukey HSD test is shown in Table 2. The mean duration of hospitalization was 12.66 days, and electric burns had a longer length of stay with 19.91 days in comparison with all other causes of burn (*P*-value = 0.000). Although burning with fire had a shorter length of stay (13.7 days) than burning with electricity, the average length of stay for patients burned by fire was longer compared to burns by hot liquids and vapor (*P*-value = 0.000), as well as burns by hot solids (*P*-value = 0.000). Burns by hot solids had a shorter length of stay in the hospital with 9.1 days compared to burns by electricity (*P*-value = 0.000) fire (*P*-value = 0.000) and explosion (*P*-value = 0.006).

The average TBSA of hospitalized patients was around 28% and burns with fire and explosion had the highest TBSA with 36.59% and 35.74%, compared to the other causes of burn and this relationship was statistically significant (*P*-value = 0.000) (Table 3), however, there was no significant relationship between these two causes of burns in terms of TBSA (*P*-value = 0.986).

The mean age of patients admitted to the hospital was 31.51 years. Burns by hot liquids and vapor occurred at an average age of 19.73 years. Table 4 showed us that there was a significant relationship between the causes of burns and the age of patients, for example, people who were burned by hot liquids

Table 1. Distribution of demographic variables related to burn injuries

Causes of burn	N(% of total)	Length of stay(days)	TBSA (percent)	Age(years)	Death	Male	Female
Hot liquids and vapor	415(21.2%)	10.33	14.63	19.73	10	248	167
Hot solids	110(5.6%)	9.10	6.84	40.21	8	85	25
Fire	622(31.7%)	13.70	36.59	31.73	196	430	192
Explosion	635(32.4%)	12.66	35.74	36.64	168	483	152
Electricity	116(5.9%)	19.91	15.12	33.62	5	110	6
Chemical burn	62(3.2%)	10.43	13.73	33.64	3	43	19
Total	1960(100%)	12.66	28.00	31.51	390	1399	561

Table 2. The association between burn variables and the duration of hospital stay

Dependent variable	Causes of burn	Causes of burn	Standard error	P value
Length of stay in hospital	Hot liquids and vapor	Hot solids Fire Explosion Electricity Chemical burn	1.127 .664 .661 1.099 1.430	.886 .000 .006 .000 1.000
	Hot solids	Hot liquids and vapor Fire Explosion Electricity Chemical burn	1.127 1.087 1.086 1.396 1.669	.886 .000 .014 .000 .969
	Fire	Hot liquids and vapor Hot solids Explosion Electricity Chemical burn	.664 1.087 .592 1.059 1.399	.000 .000 .485 .000 .178
	Explosion	Hot liquids and vapor Hot solids Fire Electricity Chemical burn	.661 1.086 .592 1.057 1.398	.006 .014 .485 .000 .602
	Electricity	Hot liquids and vapor Hot solids Fire Explosion Chemical burn	1.099 1.396 1.059 1.057 1.651	.000 .000 .000 .000 .000
	Chemical burn	Hot liquids and vapor Hot solids Fire Explosion Electricity	1.430 1.669 1.399 1.398 1.651	1.000 .969 .178 .602 .000

The mean difference is statistically significant at the 0.05 level.

Table 3. The relation between burnt variables and total body surface area (TBSA)

Dependent variable	Causes of burn	Causes of burn	Standard error	P value
Total body surface area (TBSA)	Hot liquids and vapor	Hot solids Fire Explosion Electricity Chemical burn	2.454 1.450 1.444 2.403 3.116	.019 .000 .000 1.000 1.000
	Hot solids	Hot liquids and vapor Fire Explosion Electricity Chemical burn	2.454 2.367 2.363 3.045 3.634	.019 .000 .000 .072 .406
	Fire	Hot liquids and vapor Hot solids Explosion Electricity Chemical burn	1.450 2.367 1.291 2.314 3.048	.000 .000 .986 .000 .000
	Explosion	Hot liquids and vapor Hot solids Fire Electricity Chemical burn	1.444 2.363 1.291 2.311 3.045	.000 .000 .986 .000 .000
	Electricity	Hot liquids and vapor Hot solids Fire Explosion Chemical burn	2.403 3.045 2.314 2.311 3.600	1.000 .072 .000 .000 .999
	Chemical burn	Hot liquids and vapor Hot solids Fire Explosion Electricity	3.116 3.634 3.048 3.045 3.600	1.000 .406 .000 .000 .999

The mean difference is statistically significant at the 0.05 level.

Table 4. Relation between burnt variables and patients age

Dependent variable	Causes of burn	Causes of burn	Standard error	P value
Age	Hot liquids and vapor	Hot solids Fire Explosion Electricity Chemical burn	2.160 1.287 1.282 2.116 2.758	.000 .000 .000 .000 .000
	Hot solids	Hot liquids and vapor Fire Explosion Electricity Chemical burn	2.160 2.076 2.073 2.670 3.203`	.000 .001 .519 .134 .314
	Fire	Hot liquids and vapor Hot solids Explosion Electricity Chemical burn	1.287 2.076 1.134 2.030 2.692	.000 .001 .000 .938 .981
	Explosion	Hot liquids and vapor Hot solids Fire Electricity Chemical burn	1.282 2.073 1.134 2.026 2.690	.000 .519 .000 .670 .874
	Electricity	Hot liquids and vapor Hot solids Fire Explosion Chemical burn	2.116 2.670 2.030 2.026 3.173	.000 .134 .938 .670 1.000
	Chemical burn	Hot liquids and vapor Hot solids Fire Explosion Electricity	2.758 3.203 2.692 2.690 3.173	.000 .314 .981 .874 1.000

The mean difference is statistically significant at the 0.05 level.

and vapor are younger than people burned by all other causes of burns (*P*-value = 0.000). Also, burns with fire occurred at an average age of 31 years old, lower than the age of patients who were burned by hot solids (*P*-value = 0.001) and explosions (*P*-value = 0.000).

DISCUSSION

We aimed to analyze the factors related to the length of stay and the causes of burns. Burns due to explosion and fire were the leading cause of hospitalization for burn patients, which aligns with Rachel S. Lundgren et al.'s findings, who also identified fire and flame burns as the most common causes across different age groups [19]. In contrast, in a study, most burn patients suffered injuries from hot liquids and vapor [20]. The larger TBSA observed in our study might explain the longer hospital stays and higher mortality rate compared to the findings of Ghaed Chukamei et al. In our study, the mortality rate was 19.89%, and the average length of stay was 12.66 days, while Ghaed Chukamei et al. reported a mortality rate of 4.7% and an average stay of 3.22 days [20]. The mortality rate at the Rotterdam Burn Centre was 6.9%, and the American National Burn Repository reported 5.6%, both studies showing lower TBSA compared to our findings [21].

Electrical burns affect smaller body surface than other types of burns generally. However, the risk of complications is much higher due to internal injuries. These internal injuries often require longer hospital stays. Our study found that patients with electrical burns had the longest stays, averaging 19.91 days. Electrical burns significantly increased hospital stay durations [22]. Factors influencing prolonged hospitalization and increased mortality included patient age and gender, the cause of the burn, inhalation injuries, affected areas, and the percentage of TBSA burned [23]. For young children, the main causes of burns are hot foods and beverages, steam, and liquids. Common scalds occur from hot items like tea, coffee, soups, and noodles, often from spills or when children pull down hot objects from surfaces. This can result in severe burns to the face, neck, chest, and shoulders.

Our study found that the average age of patients burned by hot liquids and vapor was 19.73 years, making them the youngest group compared to those injured by other causes. Tolouei M et al. reported similar findings [24]. Understanding the etiologies of burn-injuries is crucial for developing effective safety programs. It is clear that ongoing and creative efforts are needed to prevent burns. While the kitchen is often considered a dangerous area for young children, many burns occur unexpectedly, even outside of the kitchen. Only 18% of children were alone at the time of their injury, proving that adult supervision is not always sufficient [25, 26]. Most pediatric burns happen at home, especially in the kitchen [27-29]. Therefore, risks could be greatly reduced by creating separate play areas for children away from the kitchen. Another safety measure would be to keep hot liquids and objects out of children's reach.

In our study, the mean TBSA was 28%, with fire and explosions causing the highest TBSA percentages at 36.59% and 35.74%. A study by Lixia Wen et al. on 48 flame burn patients found a TBSA of 27.6% [30].

The limitations are that this was a single-center study and incomplete data for certain variables, including burn agents and TBSA. The data of these patients were excluded from the study.

CONCLUSION

This study underscores the significant impact of burn etiology on the duration of hospitalization and the severity of burn injuries. Fire and explosion-related burns were found to be the leading causes of both hospitalization and mortality, aligning with global trends. Although electrical burns affect a smaller TBSA, they result in longer hospital stays due to the complexities of internal injuries. Additionally, the study highlighted the younger age of patients burned by hot liquids and vapor, reinforcing the importance of targeted prevention strategies for this demographic. These findings highlight the need for continuous advancements in burn prevention, timely intervention, and post-burn care, especially in regions with high burn incidence. The correlation between TBSA, hospitalization duration, and burn etiologies offers valuable insights for clinicians and policymakers to optimize burn treatment protocols and improve patient outcomes.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Declaration of Competing Interests

None of the authors has any conflicts of interest to declare.

Abbreviations

TBSA: Total Body Surface Area
DALYs: Disability-Adjusted Life Years
ICU: Intensive Care Unit
WHO: World Health Organization
LMICs: low- and Middle-Income Countries
LOS: Length of Stay
HIS: Health Information System
HSD: Honestly Significant Difference

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