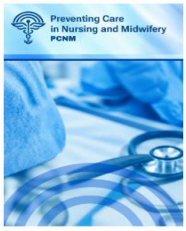
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Original Article

Five-Year Trends and Predictors of In-Hospital Mortality in Burn Patients in Southern Iran, 2019–2023

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Abstract

Background: Burn injuries cause death and disability, particularly in low- and middle-income countries. Local mortality patterns can inform prevention and clinical care.
Objectives: This study examined five-year trends in in-hospital mortality and associated factors among hospitalized burn patients in southern Iran from 2019 to 2023.
Methods: This retrospective study used records from a referral burn center in southern Iran. Data on age, sex, education, residence, burn characteristics, underlying conditions, length of stay, and outcome were extracted. Mortality factors and trends were analyzed using multivariable logistic and Poisson regression, respectively, in IBM SPSS Statistics version 26.0.
Results: Among 2,873 patients, mean age was 33.68 (SD = 21.06) years and mean total body surface area (TBSA) burned was 30.53 (SD = 27.17). Most patients were male (71.05%), had education below diploma level (31.90%), were urban residents (62.35%), and had no underlying conditions (75.36%). Flame was the most common burn agent (43.95%). Overall, in-hospital mortality was 24.95% (95% CI: 23.37–26.57%), declining from 50.00% in 2019 to 15.06% in 2023. Higher mortality odds were associated with older age (AOR = 1.05 per year, 95% CI: 1.00–1.07), greater TBSA burned (AOR = 1.05 per 1%, 95% CI: 1.03–1.09), female sex (AOR = 1.97, 95% CI: 1.21–3.20), hot-object burns (AOR = 6.48, 95% CI: 1.30–32.36), and electrical burns (AOR = 4.90, 95% CI: 1.06–22.61).
Conclusion: Burn admissions increased, whereas in-hospital mortality declined. Identifying high-risk patients and targeted prevention may improve outcomes in southern Iran.

Implications for Nursing and Midwifery Preventive Care

- Preventive care should focus on burn prevention education, safe heating-device use, and fire safety.
- Preventive care should specifically target women and individuals with lower educational attainment.

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Introduction

Burn injuries are a major public health problem worldwide and can lead to death, disability, and long-term physical and psychological consequences [1]. The World Health Organization estimates that nearly 11 million people sustain burn injuries each year, with severe injuries accounting for a substantial proportion of burn-related deaths [2]. Burns also place a considerable financial burden on healthcare systems, and mortality remains high even in well-equipped burn centers, with reported rates ranging from 10% to 20% [3].

The burden of burn-related mortality is greater in low- and middle-income countries than in high-income countries, partly because of limited resources for prevention, acute care, and rehabilitation [4]. In Iran, burns account for a substantial loss of productive life and represent the third-largest economic burden among non-fatal injuries, after traffic injuries and falls [5, 6]. Survivors may experience disfigurement, functional limitations, and psychological and social difficulties, often requiring prolonged medical care and rehabilitation [7].

Demographic, social, and clinical factors influence burn outcomes. Previous studies have reported associations between burn outcomes and age, sex, socioeconomic status, place of residence, injury intention, and comorbidities [8–10]. Differences in these factors, as well as variations in access to healthcare and burn-care resources, may contribute to differences in burn patterns and mortality across countries and regions [11]. Local epidemiological data are therefore important for planning burn prevention and care services.

Epidemiological studies can also show how burn admissions and mortality change over time. These patterns may reflect differences in population characteristics, exposure to burn hazards, healthcare access, treatment practices, or the organization of burn services [12–14]. Because burn patterns and outcomes may change over time, findings from older studies or other settings may not reflect current conditions. Updated data from individual regions are therefore needed.

Although burn epidemiology has been investigated in several parts of Iran, recent data on burn characteristics, temporal patterns, and in-hospital mortality in southern Iran, particularly Shiraz, remain limited. This study analyzed hospital records of patients admitted to Amir al-Mu'minin Burn Trauma Center in Shiraz between 2019 and 2023, focusing on their demographic and clinical characteristics, burn-related factors, and in-hospital mortality.

Objectives

This study aimed to examine five-year trends in burn admissions and in-hospital mortality, and to identify factors associated with in-hospital mortality among patients admitted to the Amir al-Mu'minin Burn Trauma Center in Shiraz, southern Iran, from 2019 to 2023.

Methods

Study Design

This retrospective observational study used hospital records of patients admitted with burn injuries to the Amir al-Momenin (AS) Burn Injury Educational and Therapeutic Center in Shiraz, Iran.

Setting and Population

The study included patients admitted between January 1, 2019, and December 31, 2023. All patients with burn injuries admitted to the study center during this period were identified from the hospital information system and medical records. The Amir al-Momenin (AS) Burn Injury Educational and Therapeutic Center is located in Shiraz, Iran, and serves as a major referral center for the diagnosis and treatment of burn injuries in southern Iran.

All eligible patients admitted during the study period were included. Patients were eligible if they had sustained a burn injury and were primarily admitted to and managed at the study center. Patients who presented more than 24 hours after the injury or who had initially received treatment at another hospital were excluded. Records that were inaccessible or lacked sufficient information to determine eligibility or in-hospital outcome were also excluded. For patients with multiple admissions during the study period, only the first eligible admission was included

to ensure that each patient contributed only one record to the analysis.

Data Source and Instruments

Data were collected using a structured data extraction form developed based on previous studies and published literature on burn epidemiology [1, 12].

The content of the data extraction form was reviewed by experts in medicine, nursing, and epidemiology with experience in burn care.

The extracted variables included age, sex, place of residence, educational level, burn agent, location of the incident, total body surface area (TBSA) burned, underlying medical conditions, length of hospital stay, and treatment outcome. In adults, TBSA burned was estimated using the Rule of Nines, whereas the Lund–Browder chart was used for children aged 12 years or younger. Data were extracted from the relevant sections of both paper-based and electronic medical records.

Statistical Analysis

Hospital admission data were obtained from the hospital information system. The dataset was reviewed and cleaned before analysis, and the extracted information was entered into Microsoft Excel spreadsheets. Data collection was performed by trained research assistants using a standardized data extraction form. To assess data-entry accuracy, an independent researcher cross-checked the extracted information against the original medical records for a random 10% sample of patients. Any discrepancies or inconsistencies were reviewed and corrected against the source records.

A total of 2,873 eligible patients with burn injuries were identified after excluding one record with missing outcome data.The primary outcome was in-hospital mortality, defined as death occurring during the index hospitalization.

Statistical analyses were performed using IBM SPSS Statistics version 26.0. Continuous variables were summarized using means and standard deviations, whereas categorical variables were presented as frequencies and percentages. Multivariable logistic regression analysis was performed to identify factors independently associated with in-hospital mortality. The model included age, TBSA burned, sex, place of residence, educational level, burn agent, and specific underlying medical conditions, including heart disease, kidney disease, respiratory disease, diabetes, mental health disorders, and disability. Age and TBSA burned were entered as continuous variables, while categorical variables were entered using predefined reference categories. The results were reported as adjusted odds ratios (AORs) with corresponding 95% confidence intervals (CIs). A two-sided $p < 0.05$ was considered statistically significant.

Temporal trends in in-hospital mortality during the study period were assessed using Poisson regression. The annual number of in-hospital deaths was modeled with the corresponding number of burn admissions incorporated as the exposure term. Incidence rate ratios (IRRs) with 95% CIs were calculated to quantify changes in mortality over time.

Result

A total of 2,873 patients hospitalized with burn injuries were included in the analysis after excluding one record with missing outcome data. The mean age was 33.68 years (SD = 21.06), ranging from 1 month to 98 years. The mean TBSA burned was 30.53% (SD = 27.17%), and the mean length of hospital stay was 12.49 days (SD = 10.92). Most patients were male (71.05%), lived in urban areas (62.35%), and had no underlying medical conditions (75.36%). The most common educational category was below diploma level (31.90%), and flame was the most common burn agent, accounting for 43.95% of cases. In-hospital mortality varied across demographic and clinical subgroups [Table 1].

Mortality was higher among female than male patients (33.65% vs. 21.40%). By educational level, mortality was highest among illiterate patients (36.58%), followed by patients with university education (34.95%). Mortality was higher among patients residing in urban areas than among those residing in rural areas (26.73% vs. 21.92%). In-hospital mortality was 26.42% among patients with underlying medical conditions and 24.47% among those without such conditions. Among burn agents, explosion-related injuries had the highest mortality (45.36%), followed by flame-related injuries

(32.46%). Overall, 717 of the 2,873 patients died during hospitalization, corresponding to an overall in-hospital mortality of 24.95%. The overall in-hospital mortality rate during the five-year study period was 24.95% (95% CI: 23.37–26.57%). The annual proportions of in-hospital mortality were 50% in 2019 (95% CI: 43.95–56.99%), 50.17% in 2020 (95% CI: 43.31–56.04%), 21.49% in 2021 (95% CI: 18.98–23.99%), 24.28% in 2022 (95% CI: 20.71–27.74%), and 15.06% in 2023 (95% CI: 12.59–17.52%). The number of burn admissions increased over the study period, whereas the annual number of in-hospital deaths fluctuated, with an overall downward trend [Figure 1].

Table 1. In-Hospital Outcomes of Burn Patients According to Demographic and Clinical Characteristics, 2019–2023

Variable	Category	Death, n (%)	Survived/discharged, n (%)	Total, n
Sex	Female	280 (33.65)	552 (66.35)	832
	Male	437 (21.40)	1605 (78.60)	2042
Education	Illiterate	105 (36.58)	182 (63.42)	287
	Below diploma	207 (22.57)	710 (77.43)	917
	Diploma	223 (29.26)	539 (70.74)	762
	University education	72 (34.95)	134 (65.05)	206
	Student	55 (19.30)	230 (80.70)	285
	Not applicable	55 (13.19)	362 (86.81)	417
Residence	Rural	238 (21.92)	844 (78.08)	1081
	Urban	479 (26.73)	1313 (73.27)	1792
Underlying medical conditions	No	530 (24.47)	1636 (75.53)	2166
	Yes	187 (26.42)	521 (73.58)	708
Cause of burn	Liquid	42 (9.75)	389 (90.25)	431
	Hot objects	20 (6.26)	299 (93.74)	319
	Flame	410 (32.46)	853 (67.54)	1263
	Explosion	225 (45.36)	271 (54.64)	496
	Electricity	13 (5.32)	231 (94.68)	244
	Chemical substances	7 (5.78)	114 (94.22)	121
Total		717 (24.95)	2156 (75.05)	2873

Note. One record with missing outcome data (residence: Island) was excluded from the analysis. Percentages are calculated within each subgroup. Data were obtained from archived hospital records

Multivariable logistic regression analysis was performed to identify factors independently associated with in-hospital mortality [Table 2].

Increasing age was associated with higher odds of in-hospital mortality (AOR = 1.05 per year, 95% CI: 1.00–1.07, p = 0.025). Similarly, each 1% increase in TBSA burned was associated with a 5% increase in the odds of in-hospital mortality (AOR = 1.05, 95% CI: 1.03–1.09, p = 0.010).

Female patients had higher odds of in-hospital mortality than male patients (AOR = 1.97, 95% CI: 1.21–3.20, p = 0.006). Compared with illiterate patients, those with university education had higher odds of mortality (AOR = 5.84, 95% CI: 1.92–17.74, p = 0.002). Compared with liquid burns, burns caused by hot objects (AOR = 6.48, 95% CI: 1.30–32.36, p = 0.023) and electricity (AOR = 4.90, 95%

CI: 1.06–22.61, p = 0.041) were associated with higher odds of in-hospital mortality.

Residence was not significantly associated with in-hospital mortality (AOR = 1.15, 95% CI: 0.70–1.89, p = 0.580). None of the underlying medical conditions included in the model were significantly associated with in-hospital mortality.

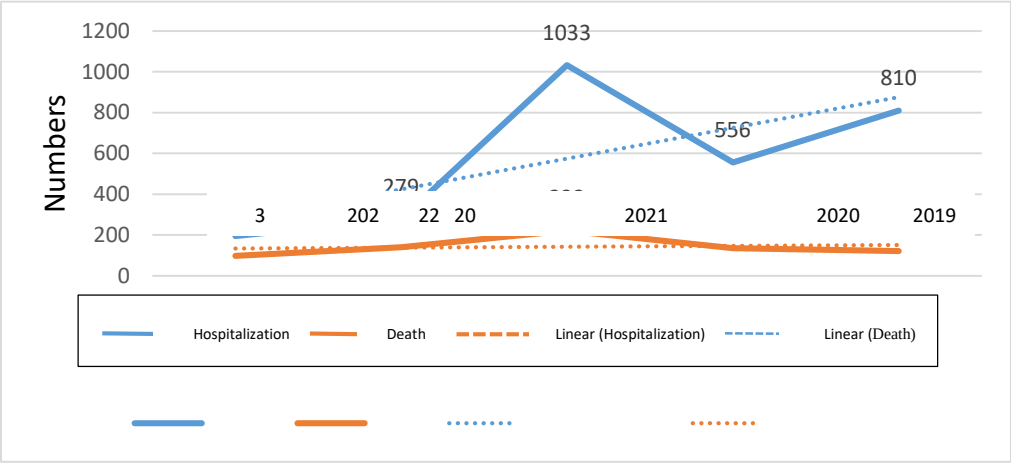


Figure 1. Trends in Burn-Related Hospital Admissions and In-Hospital Deaths at the Amir Al-Momenin Burn Injury Educational and Therapeutic Center, Shiraz, Iran, 2019–2023

Table 2. Adjusted Odds Ratios for Factors Independently Associated With In-Hospital Mortality Among Burn Patients, 2019–2023

Variable	Category/Unit	AOR	95% CI	*p*
Age	Per year	1.05	1.00–1.07	0.025
TBSA burned	Per 1% increase	1.05	1.03–1.09	0.010
Sex	Female vs. male	1.97	1.21–3.20	0.006
Residence	Urban vs. rural	1.15	0.70–1.89	0.580
Education	Below diploma vs. illiterate	2.51	0.64–9.77	0.185
	Diploma vs. illiterate	2.17	0.48–9.80	0.150
	University education vs. illiterate	5.84	1.92–17.74	0.002
	Student vs. illiterate	1.99	0.55–7.18	0.293
	Not applicable vs. illiterate	1.28	0.37–4.38	0.692
Burn agent	Hot objects vs. liquids	6.48	1.30–32.36	0.023
	Flame vs. liquids	1.62	0.26–10.00	0.599
	Explosion vs. liquids	1.69	0.38–7.54	0.489
	Electricity vs. liquids	4.90	1.06–22.61	0.041
	Chemicals vs. liquids	1.04	0.165–6.59	0.965
Underlying condition	Heart disease vs. no disease	4.15	0.01–79.37	0.656
	Kidney disease vs. no disease	1.40	0.02–83.25	0.916
	Respiratory disease vs. no disease	1.57	0.02–94.86	0.891
	Diabetes vs. no disease	1.88	0.01–81.57	0.846
	Mental health disorder vs. no disease	3.33	0.01–97.13	0.710
	Disability vs. no disease	3.32	0.01–77.66	0.708

Note. AOR = adjusted odds ratio; CI = confidence interval; TBSA = total body surface area burned. Reference categories were male sex, rural residence, illiterate education, liquid burns, and no underlying medical condition. Age and TBSA burned were entered into the model as continuous variables.

Discussion

This study examined five-year trends in burn admissions and in-hospital mortality among patients treated at a major referral burn center in Shiraz, southern Iran. The study population was predominantly male, and flame was the most common burn agent. These findings are broadly consistent with reports from other burn centers. Ortiz-Prado et al. reported a predominantly male hospitalized burn population in Ecuador, with thermal burns accounting for most injuries [1]. Similarly, Forbinake et al. reported a predominance of male patients and flame-related burns in a tertiary hospital in sub-Saharan Africa [2]. Flame-related injuries have also been reported as an important cause of burns in other populations [3, 14]. Differences in the distribution of burn mechanisms across studies may reflect variations in population characteristics, occupational and household exposures, and referral patterns. The predominance of flame-related injuries in the present study highlights the continued importance of prevention strategies targeting fire-related exposures [4].

The overall in-hospital mortality in this study was 24.95%, which was comparable to the 24.9% reported by Alipour et al. [6] and within the range reported in other studies [7–9]. In contrast, Ortiz-Prado et al. reported a lower mortality of 10.2% [1]. Direct comparisons between burn centers should be made cautiously because mortality is strongly influenced by case mix, particularly age, TBSA burned, injury severity, inhalation injury, and referral patterns. Previous studies have identified age and TBSA burned as important factors associated with burn mortality, supporting the relevance of these clinical characteristics when interpreting differences in mortality across settings [3, 10, 12, 14].

A notable finding was the substantial decline in annual in-hospital mortality, from 50.00% in 2019 to 15.06% in 2023, despite an overall increase in burn admissions. This pattern is consistent with the broader decline in burn-related mortality reported globally and in other settings [5, 10, 12]. However, the present study cannot establish the reasons for this temporal change. Differences in the severity and characteristics of admitted patients, referral patterns, and changes in clinical management may have contributed to the observed decline. Because these factors were not consistently available in the retrospective records, the decrease should not be attributed to a specific intervention or change in clinical practice.

Female sex was independently associated with higher odds of in-hospital mortality. Female patients had a higher crude mortality proportion than male patients (33.65% vs. 21.40%), and the association persisted after adjustment for the variables included in the multivariable model (AOR = 1.97, 95% CI: 1.21–3.20). Higher mortality among female burn patients has also been reported in previous studies [9, 13]. In the WHO Global Burn Registry cohort, female patients had higher in-hospital mortality than male patients, and female sex was associated with increased odds of in-hospital death in middle-income countries [13]. The mechanism underlying the association observed in the present study cannot be established from the available data. Differences in burn size, injury circumstances, delay in presentation, access to timely care, and other clinical or social factors may contribute. Importantly, female sex should therefore be interpreted as an associated characteristic rather than a direct cause of mortality.

Age and TBSA burned were also independently associated with in-hospital mortality. The odds of mortality increased by approximately 5% for each additional year of age and by approximately 5% for each 1% increase in TBSA burned. These findings are consistent with the established prognostic importance of age and burn size in patients with burn injuries. Previous studies have identified increasing age and TBSA burned as important predictors or correlates of mortality in burn populations [3, 10, 12, 14]. The clinical relevance of these findings is particularly important because age and TBSA are central components of commonly used burn prognostic models. Nevertheless, the magnitude of these associations should be interpreted within the context of the study population and the other clinically important predictors that were not available in the present dataset, particularly inhalation injury.

Burn agent was also associated with in-hospital mortality. Compared with liquid burns, burns caused by hot objects and electricity were associated with higher odds of mortality, with AORs of 6.48 (95% CI: 1.30–32.36) and 4.90 (95% CI: 1.06–22.61), respectively. The wide confidence intervals indicate substantial uncertainty around these estimates, which may partly reflect the relatively small number of deaths in some burn-agent categories. The observed associations should therefore be interpreted cautiously. Burn mechanism may also act as a marker for differences in injury severity, anatomical location, exposure circumstances, or associated trauma rather than representing an independent causal determinant of mortality. Previous studies have reported associations between burn mechanism, injury severity, and mortality, although the direction and magnitude of these associations vary across populations [3, 6, 8].

Educational level was associated with mortality in the adjusted analysis. Patients with university education had higher odds of in-hospital mortality than those classified as illiterate (AOR = 5.84, 95% CI: 1.92–17.74). This finding was unexpected and should not be interpreted as evidence that higher educational attainment increases mortality. The wide confidence interval indicates considerable uncertainty around the estimate. Moreover, educational level may be associated with occupation, age, type and circumstances of burn exposure, socioeconomic characteristics, or referral patterns, several of which were not adequately captured in the available records. The finding may therefore reflect residual confounding or differences in the composition of the educational subgroups. Further studies incorporating detailed socioeconomic, occupational, and injury-circumstance variables are needed to determine whether this association is reproducible.

None of the specific underlying medical conditions included in the multivariable model were significantly associated with in-hospital mortality. However, several estimates had wide confidence intervals, suggesting limited precision and possible sparse data within some comorbidity categories. The absence of a statistically significant association should therefore not be interpreted as evidence that comorbidities do not affect burn outcomes. Larger studies with more complete clinical information are needed to examine the contribution of individual comorbid conditions to mortality.

This study has several strengths. It included five years of hospital records and a relatively large number of patients treated at a major referral burn center, allowing the examination of both patient-level factors associated with mortality and changes in mortality over time. Including all eligible patients during the study period also minimized the potential for within-center selection bias.

Several limitations should be considered. First, the retrospective design restricted the analysis to information available in the medical records, and some clinically important variables, including inhalation injury, detailed injury severity characteristics, treatment interventions, and complications, were unavailable or incompletely recorded. Second, the single-center setting may limit the generalizability of the findings, particularly because referral centers may receive patients with more severe injuries and may have referral patterns that differ from those of other hospitals. Third, residual confounding by unmeasured clinical, socioeconomic, occupational, and environmental factors cannot be excluded. Fourth, the study could not reliably distinguish intentional from unintentional burns because information regarding the circumstances and intent of injury was incomplete. Finally, some regression model categories contained relatively few observations, leading to imprecise estimates and wide confidence intervals. Accordingly, the observed associations should not be interpreted as causal relationships.

Conclusion

This five-year retrospective study identified a substantial decline in in-hospital mortality among patients treated at a major referral burn center in Shiraz, despite an overall increase in burn admissions. Female sex, older age, greater TBSA burned, university education, and burns caused by hot objects or electricity were independently associated with higher odds of in-hospital mortality.

The findings highlight the importance of continued burn-prevention efforts and early identification of patients at increased risk of poor outcomes. However, the observed associations should be interpreted cautiously given the retrospective single-center design, potential residual confounding, and limited information on several important clinical factors. Multicenter studies incorporating detailed information on injury severity, inhalation injury, treatment, complications, socioeconomic characteristics, and circumstances of injury are warranted to explain better the determinants and temporal patterns of burn mortality in Iran.

Ethical Considerations

This study was approved by the Committee of Ethics in Human Research at Shahid Sadoughi University of Medical Sciences and Health Services in Yazd (IR.SSU.REC.1402.058). Data were collected from the health system/patient files while maintaining confidentiality, and the information was used solely for research purposes. The study protocol was submitted to the Amir al-Mu'minin Burn Trauma Center, which agreed to participate. As agreed by the Ethical Committee, this study was performed on anonymised health-related data; therefore, written informed consent from individual patients was not required.

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Conflict of Interest

The authors declare that they have no competing interests.

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Authors' Contributions

Conceptualization: M. Bayat, M. Taheri Soodejani, A. Keshavarzi, Kh. Nasiriani
Methodology: M. Bayat, M. Taheri Soodejani, A. Keshavarzi, Kh. Nasiriani
Data Curation: M. Bayat
Investigation: M. Bayat
Formal Analysis: Kh. Nasiriani
Writing – Original Draft: M. Bayat, M. Taheri Soodejani, A. Keshavarzi, Kh. Nasiriani
Writing – Review & Editing: M. Taheri Soodejani, A. Keshavarzi, Kh. Nasiriani
Supervision: M. Taheri Soodejani, A. Keshavarzi, Kh. Nasiriani
All authors read and approved the final manuscript.

Artificial Intelligence Utilization

During manuscript preparation, minor assistance from the artificial intelligence (ChatGPT-3) tool was utilized to enhance English phrasing and improve the clarity of scientific writing. The authors performed all analytical decisions and final editing. The use of AI complied with ethical standards of academic publishing and did not replace the authors' responsibility.

Data Availability Statement

This manuscript does not report data generation or analysis.

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