

Epidemiology and Outcome Analysis of Burn Patients with an ICD-10 Approach

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Abstract

Introduction: Burn injuries are a substantial public health concern worldwide. This study aimed to assess the characteristics and clinical outcomes of burn patients hospitalized in Kerman, Iran, using the ICD-10 classification.

Methods: This cross-sectional study assessed the data of 437 burn inpatients admitted to the primary academic burn referral center in Kerman, Iran, in 2023. Data were extracted using a checklist that included ICD-10 coding, demographic variables, burn characteristics, causes, complications, comorbidities, and clinical outcomes.

Results: Of the 437 patients, 75.1% were male and 24.9% female, with no reported pregnancies. The most represented age group was 35–45 (24.3%). Most (86.5%) were insured and lived in urban areas (57.2%). However, data on marital status (70.9%), education (65.9%), and employment (59.3%) were frequently missing. The most common burn etiology was flame (36.4%), and burns typically occurred in non-residential settings (60.9%). Most patients (94.1%) had third-degree burns, and 23.1% had burns covering 10–19% of total body surface area. Partial recovery was the most frequent outcome (62.9%), while the mortality rate was 12.1%.

Conclusion: This study showed the need for comprehensive data improvement and standardization of burn documentation using the ICD-10 coding system. Improve preventive strategies and integrated data collection systems to improve outcomes and screening.

Keywords: Burns, Burn Units, Epidemiology, ICD-10.

Introduction

Burn injuries represent a significant global public health issue, affecting approximately 11 million people and resulting in over 180,000 deaths annually¹. Beyond the immediate risk of mortality, burn injuries often lead to long-term physical disabilities, psychological trauma, and substantial socioeconomic burdens for individuals, families, and health systems^{1,2}. These consequences underscore the urgent need for effective prevention, management, and rehabilitation strategies^{2,3}. Epidemiological studies are crucial for determining the prevalence and factors associated with burns.

They help in developing programs to reduce mortality and morbidity^{3,4}. Moreover, robust epidemiological data are essential for assessing the performance of healthcare systems, designing prevention campaigns, and guiding the allocation of resources^{1,5}.

In this context, international classification systems such as the International Classification of Diseases, 10th Revision (ICD-10), have been strongly recommended to ensure consistency and comparability of epidemiological data⁶. ICD-10 provides a standardized framework for

documenting burn injury type, cause, severity, and intent, facilitating more accurate surveillance and international benchmarking ⁷.

However, in many developing countries, including Iran, the collection and reporting of burn data are often fragmented, incomplete, and inconsistent. This lack of standardized data impedes national-level planning and limits the ability to compare findings across different regions and countries ⁸.

Shafa Hospital in Kerman, Iran, serves as the sole academic burn center in the region and provides a valuable source of information for evaluating the local burden of burn injuries. Despite this, no comprehensive ICD-10-based analysis of burn epidemiology and patient outcomes has been conducted at this center.

Therefore, the present study aims to analyze the epidemiology and outcomes of burn patients admitted to Shafa Hospital in 2023, using the ICD-10 framework. The objective is to contribute standardized, high-quality data to the national and global burn research body and provide valuable insights for enhancing prevention and care strategies.

Methods

This study is a cross-sectional analysis conducted retrospectively by comprehensively reviewing the medical records of all inpatients diagnosed with burns at the burn department of Kerman University of Medical Sciences teaching hospital in 2023. As this is the only specialized burn hospital in Kerman, all eligible inpatient cases during the study period were included using a census sampling method, resulting in a total sample size of 437 patients. As outpatient and emergency records were incomplete, information was exclusively collected from the inpatient records. Inclusion criteria were: all patients admitted with a primary diagnosis of burn injury (T20–T32 codes according to ICD-10) to the burn department of Shafa Hospital between January 1 and December 31, 2023. Only inpatient cases with complete medical records were included. Exclusion criteria were: patients treated in the emergency department, outpatient clinics, and

cases with incomplete, illegible documentation that prevented accurate data extraction or ICD-10 coding.

The data collection checklist was a structured checklist developed by the research team based on burn-related classifications in the 10th edition of the International Classification of Diseases (ICD-10). The checklist was designed to ensure relevance and completeness using variables extracted from a previously published national minimum dataset (MDS) for burn information management in Iran ^{8,9}. Collected variables included: age, gender, marital status, occupation, place of residence (urban or rural), type of insurance, education, referral method, pregnancy status, burn year, burn intent, burn site, burn percentage, burn severity (degree), location of burn occurrence, activity at the time of burn injuries, burn reason, external cause of burn, disposition, burn injury complications and comorbidity, as well as length of stay (LOS) ¹⁰.

Data were entered into Microsoft Excel 2016 and analyzed in SPSS using descriptive statistics (mean, frequency, percentage).

Ethical considerations and patient identity confidentiality were observed during data collection in this study. Before entering the research environment, necessary permissions were obtained from Kerman University of Medical Sciences.

Results

Four hundred thirty-seven patients were included who were hospitalized due to burn injuries. Of these patients, 328 (75.1%) were identified as male and 109 (24.9%) as female, with no instances of reported pregnancies among the female cohort. The age group most prominently represented was 35 to 45 years, constituting 24.3% of the total population. Most patients lived in urban areas (57.2%), and 86.5% had their health insurance plans covered. Notably, a substantial amount of demographic information was absent from the medical records. Specifically, marital status was unrecorded in 70.9% of cases, education level in 65.9%, and employment status in 59.3%. Among the patients for whom educational data were available, 65.9% were unspecified, while 33.4% had attained a diploma or lower education. Among those with available occupational information, the largest group identified was unemployed (16.2%), followed by students (13.7%) and freelance workers (5.7%) (Table 1).

Table 1: Demographic Characteristics of Burn Patients

Variables	Categories	Frequency	Percentage
Gender	Male	328	75.1
	Female	109	24.9
Age	< 1	15	3.4
	1–5	55	12.6
	6–15	45	10.3
	16–25	56	12.8
	26–35	74	16.9
	36–45	106	24.3
	46–55	44	10.1
	56–65	18	4.1
	> 65	24	5.5
Education	diploma and below	146	33.4
	Associate degree	2	0.5
	Bachelor	1	0.2
	unknown	288	65.9
Marital status	single	116	26.5
	married	10	2.3
	deceased spouse	1	.2
	unknown	310	70.9
Occupation	home jobs	5	1.1
	Student	60	13.7
	government job	17	3.9
	freelance job	25	5.7
	Unemployed	71	16.2
	unknown	259	59.3
Place of residence	urban	250	57.2
	rural	173	39.6
	citizens	8	1.8
	unknown	6	1.4
Type of insurance	insurance	378	86.5
	no insurance	57	13.0
	unknown	2	0.5

The most common method of patient transfer to the burn center was via family members (51.5%), followed by transportation by ambulance (30.0%). Most patients (49.7%) were hospitalized for seven days or fewer, while 24% had stays ranging from 8 to 14 days. Extended hospitalizations were comparatively rare,

with only 3.7% of patients requiring hospitalization for more than 31 days. The distribution of incidence of burns was in the fall (29.5%), winter (27.0%), spring (26.1%), and summer (17.4%). Among burn patients, 62.9% achieved partial recovery, indicating significant improvement. However, in 0.2% of cases, the outcome was classified as fugitive from the hospital (Table 2).

Table 2: Referral Method and Seasonal Distribution, Length and Outcomes of stay

Variables	Categories	Frequency	Percentage
Season	spring	114	26.1
	summer	76	17.4
	fall	129	29.5
	winter	118	27.0
referral method	EMS	131	30.0
	family	225	51.5
	self	10	2.3
	Referral from other care centers	22	5.0
	referral from clinic	22	5.0
	unknown	27	6.2
Length of stay	7 days or less	217	49.7
	8-14	105	24.0
	15- 21	67	15.3
	22- 30	29	6.6
	31 days or more	16	3.7
	15hour	2	0.5
	unknown	1	0.2
Outcomes of stay	partial recovery*	275	62.9
	left the hospital against medical advice	88	20.1
	deaths	53	12.1
	transferred to other cities.	4	.9
	transfer to other hospital	3	.7
	improvement	13	3.0
	fugitive	1	.2

partial recovery* = discharge with documented functional limitations requiring ongoing outpatient rehabilitation, based on the American Burn Association's Burn Outcomes Questionnaire criteria

Burn incidents are more common in factories, schools, and public streets, with around 60.9% of cases happening in these non-residential environments. Interestingly, in 28.1% of incidents, we do not have the

exact location identified. When looking at what people were doing during these burns, a large majority—67.8%—were engaged in what was categorized as "other activities." In 30% of cases, we do not know what they were doing. Flames are the leading cause of burns, responsible for 36.4% of incidents. Other common causes include contact burns, which account for 19.7%, and explosions, making up 17.2% of cases. Most of these burns, about 75.5%, were accidental.

Unfortunately, about 21.7% had an unspecified intent, while a small fraction—2.1%—were classified as suicide attempts, and only 0.7% were linked to assault (Table 3). 65.7% of patients had burns in various areas, with burns in the head and neck area being rare (0.2%). Most of the injuries we observed were severe, with 94.1% classified as third-degree burns. Additionally, 23.1% of the patients had burns that impacted between 10% and 19% of their body surface area (Table 4).

Table 3: Place and activity at the time of burn injuries, burn reason and intent

Variables	Categories	Frequency	Percentage
Place of burn occurrence	Home	20	4.6
	Residential institution	1	.2
	Sports and athletics area	1	.2
	Street and highway	25	5.7
	Industrial and construction area	1	.2
	Other specified places	266	60.9
	unknown	123	28.1
activity at the time of burn injuries	sports activity	1	.2
	leisure activity	7	1.6
	working for income	1	.2
	resting, sleeping, eating or engaging in other vital activities	1	.2
	other specified activities	296	67.8
	unknown	131	30.0
burn reason	flame	159	36.4
	electrical burns	26	5.9
	scald burn	27	6.2
	contact burns	86	19.7
	lightning burns	1	.2
	chemical burns	10	2.3
	car accident	29	6.6
	burning of house	1	.2
	explosion of pot	1	.2
	explosion of material	75	17.2
	hot objects	7	1.6
	discharge of firework	2	.5
	unknown	13	3.0
burn intent (external cause of burn)	accidental	330	75.5
	assault	3	.7
	suicide	9	2.1
	unknown	95	21.7

Table 4: burn site, degree, and percentage

Variables	Categories	Frequency	Percentage
burn site	head and neck	1	.2
	trunk	27	6.2
	shoulder and upper limb	21	4.8
	wrist and hand	32	7.3
	hip and lower limb	38	8.7
	ankle and foot	28	6.4
	other internal organs	1	.2
	multiple body regions	287	65.7
	unknown	2	.5
Burn degree	degree 1	6	1.4
	degree 2	17	3.9
	degree 3	411	94.1
	degree4	1	.2
	unknown	2	.5
burn percentage (extent of total body surface area)	less than 10%	89	20.4
	10-19%	101	23.1
	20-29%	85	19.5
	30-39%	65	14.9
	40-49%	28	6.4
	50-59%	10	2.3
	60-69%	19	4.3
	70-79%	7	1.6
	80-89%	11	2.5
	90% or more	15	3.4
	unknown	7	1.6

93.4% of patients did not have any post-burn complications. Among patients with facial complications, the following were reported: infections (5.5%), respiratory issues (0.5%), heart disease (0.5%), and anemia (0.2%). Furthermore, a substantial 79.2% of burn patients had no comorbidities (Table 5).

There was a significant relationship between age group, gender, season of the burn, location of the accident, activity in which the injury occurred, and the cause. In other words, the cause of the burns is different in these specific groups (Table 6).

Length of stay was examined using Pearson's correlation coefficient to determine its correlation with burn percentage. The analysis indicated a weak yet statistically significant positive correlation between burn percentage and length of stay (Pearson's $r = 0.116$, $p = 0.016$) (Table 7). No statistically significant differences were found in the length of hospital stay

among patients with different degrees of burn severity (Table 8).

The relationship between total body surface area burned (TBSA) and in-hospital mortality was modeled using binary logistic regression. As illustrated in Figure 1, the predicted probability of mortality increased progressively with higher TBSA values. The logistic regression curve demonstrates a steep rise in mortality risk as TBSA exceeds moderate levels. The LA was calculated using the regression coefficients (intercept = 6.944, slope = -0.112), yielding an LA of 62.0%. Additionally, the close fit of the logistic curve to the observed mortality data suggests that TBSA is a strong predictor of mortality within this cohort.

The Pearson chi-square value for the relationship between the comorbidities and the occurrence of post-burn complications was found to be 65.519 with 72 degrees of freedom ($p = 0.692$). The p-value is much

higher than the conventional alpha level of 0.05, which would indicate no statistically significant relationship

between comorbidities and complications among burn patients (Table 9).

Table 5: burn injury complications and comorbidity

Variables	Categories	Frequency	Percentage
burn injury complications	Infection	24	5.5
	respiratory poisoning	2	.5
	cardiovascular disease	2	.5
	anemia	1	.2
	None	408	93.4
burn injury comorbidity	addiction	6	1.4
	cardiovascular disease	43	9.8
	neurological disease	4	.9
	mental disorders	2	.5
	infectious disease	1	.2
	neoplasm	2	.5
	diseases of the blood and blood-forming organs	2	.5
	respiratory disease	4	.9
	genitourinary disease	1	.2
	musculoskeletal disease	2	.5
	eye and ear disease	21	4.8
	nutritional and metabolic diseases	3	.7
	None	346	79.2

Table 6: Relationship between cause of burn injuries and patient demographics

Variables	Value	df	Asymptotic Significance (2-sided)
age	Pearson Chi-Square	214.492a	96
	Likelihood Ratio	194.920	96
	Linear-by-Linear Association	.325	1
gender	Pearson Chi-Square	27.102a	12
	Likelihood Ratio	29.743	12
	Linear-by-Linear Association	.895	1
season	Pearson Chi-Square	118.435a	36
	Likelihood Ratio	128.258	36
	Linear-by-Linear Association	1.389	1
place of occurrence	Pearson Chi-Square	38.743a	24
	Likelihood Ratio	35.207	24
	Linear-by-Linear Association	.346	1
activity at the time of burn injuries	Pearson Chi-Square	576.531a	72
	Likelihood Ratio	122.477	72
	Linear-by-Linear Association	.405	1

Table 7: Relationship between Length of stay and burn percentage

		Length of stay	burn percentage (extent of total body surface area)
Length of stay	Pearson Correlation	1	.116*
	Sig. (2-tailed)		.016
burn percentage (extent of total body surface area)	Pearson Correlation	.116*	1
	Sig. (2-tailed)	.016	

Table 8: Relationship between Length of stay and burn percentage

Length of stay			
Kruskal-Wallis H	2.247		
df	2		
Asymp. Sig.	.325		
Monte Carlo Sig.	Sig.	.324c	
	95% Confidence Interval	Lower Bound	.315

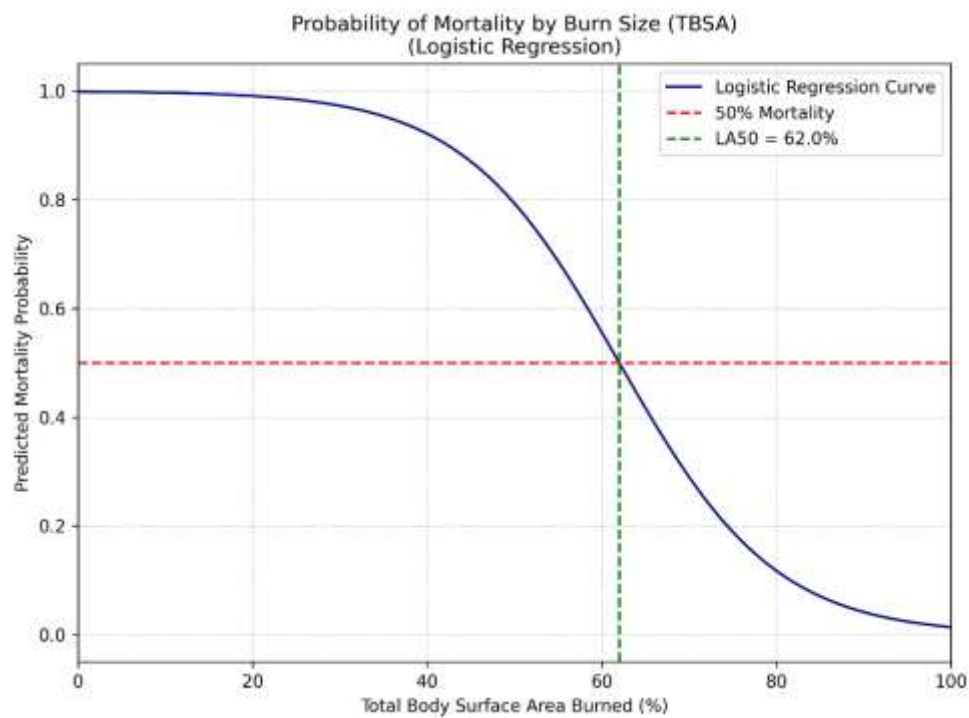


Figure 1: . The Lethal Area 50 (LA 50)

Table 9: Relationship between comorbidities and post-burn complications

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	65.519a	72	.692
Likelihood Ratio	55.032	72	.931
Linear-by-Linear Association	.000	1	.996

Discussion

This study assessed demographic and clinical characteristics, injury patterns, and outcomes of patients hospitalized due to burns, based on the ICD-10 coding system. The findings showed important epidemiological trends and emphasized systemic challenges associated with burn care in Iran and similar healthcare settings.

A significant finding of this study is the predominance of male burn victims. The evidence showed that men are at a higher risk for burn injuries due to increased occupational exposure and risk-taking behaviors^{8,11}. Furthermore, the age distribution reveals that the largest group of patients falls within the 35 to 45-year age range. Studies showed that working-age adults are particularly exposed to burn injuries⁸. Most burn patients were from urban areas^{8,12}. This trend may be attributed to the higher population density in these regions.

Incomplete documentation of demographic patient information, including marital status, educational level, and employment status, has been identified as an issue in this study. This finding is consistent with similar studies highlighting challenges documenting demographic information^{8,11}. Such gaps can impede comprehensive epidemiological analysis and hinder the development of effective, targeted prevention programs. Implementing standardized data collection protocols, aligned with the ICD-10 framework, could enhance the quality and comparability of the data^{13,14}. The absence of reliable data on risk factors significantly impedes developing and implementing effective burn prevention strategies. Furthermore, insufficient detail in the characterization of burn incidents leads to an underestimation of the severity of this public health concern¹⁵.

The seasonal pattern of burn incidents, with a notable increase during the fall and winter months, suggests that both environmental conditions and human behaviors contribute to the heightened risk of burns during this period. This finding is consistent with existing research that indicates a rise in burn occurrences associated with the increased reliance on heating appliances and indoor fire sources as temperatures decrease⁸. According to a study by Ribeiro et al., patients admitted in winter had a longer stay, and the level of burn was higher for those admitted in summer¹⁵.

As has been the case in other studies, the majority of burn cases observed in patients were attributed to flames

^{6,15}. This finding emphasizes the importance of implementing safety measures for heating devices to prevent such injuries in the future.

Identifying accidental burns as the leading cause suggests that many incidents are preventable by implementing safety measures and awareness programs. This finding aligns with the results of various studies, which demonstrate that most global burns are unintentional^{8,11}. A small percentage of burn injuries are associated with suicide attempts. By implementing mental health screenings and expansive intervention strategies, particularly for high-risk groups, this rate has the potential to be reduced to zero. Research has demonstrated that psychiatric disorders can both contribute to and result from burn injuries, underscoring the importance of integrated psychosocial care approaches¹⁶.

The predominant cause of burn injuries is flame-related burns, followed closely by contact burns and explosions. These findings are consistent with research conducted in both developing and developed nations, underscoring the ongoing significance of flame injuries as a major contributor to morbidity and mortality among burn patients⁸.

A significant proportion of patients were without comorbidities. However, this may be primarily due to underreporting, as suggested by previous research on the quality of administrative data in burn centers, which indicates that comorbidities are frequently inadequately documented in medical records¹⁴.

Complications following burn injuries are relatively infrequent, with infections representing the most common occurrence at a rate of 5.5%. The incidence of complications in burn victims is significantly influenced by the timeliness and quality of the initial first aid, as well as the immediate acute care and emotional support provided to them.

As in other studies, most patients experienced no post-burn complications¹¹. Among those who did, infections were the most common complication⁸.

The study's findings indicated that the cause of burns was associated with demographic factors, which included age group, gender, area of residence, activity at the time of injury, and season. More specifically, the causes of burns in children were hot water, while adults often had flames; and men were exposed to flame and electrical burns more than women. Further, electrical and chemical burns mainly occurred in industrial

environments, and for seasonal burns, flame burns were more prevalent in colder months due to the use of heat devices. These results support previous research, which demonstrated a variation of burn disease burden by gender and age groups on the worldwide level and calls for targeted prevention strategies^{2, 17}. Researchers also reported a significant effect of the cold season on flame burn increase in burn unit studies¹⁸. Given this evidence, intervention programs recommending education with families and workers, risks of seasons and environment, safety for heat appliances, and workplace safety policies can help further reduce the burden of burn disease.

The current study found that burn severity was not significantly associated with patient length of stay. These results are similar to that of previous studies that stated burn depth is an essential variable for predicting complications and outcomes, by itself it does not predict length of stay, with other factors such as the percentage of the burn surface, infection, increasing patient age, and surgical need all being factors that would play more of a role in predicting length of stay^{19,20}. Some studies have shown that the only significant effect was for TBSA and the incidence of complications, and not burn severity alone²¹. This finding reinforces the importance of multifactorial assessment in managing and making a prognosis for burn patients, and that decisions should not be made solely based on burn severity.

The results of this study show a positive, but weak, statistically significant association between total burn area (TBSA) and LOS. While this finding is clinically expected in that patients with a greater TBSA would have a longer duration of care, the weak correlation suggests that other factors in addition to TBSA are important when predicting LOS. Although most previous studies have identified TBSA as a significant predictor of LOS, many also note other significant factors, including age, inhalation burns, infection, multiple surgeries, and underlying disease or complications, that could either independently affect LOS or, in addition to TBSA (1922). The weak correlation noted in this study could be attributed to a more homogeneous patient population or treatment protocols and management of complications that did not allow for TBSA alone to impact LOS significantly. This highlights the need for a thorough assessment of the burn patient and consideration of the factors that affect LOS when planning for resource allocation^{22, 23}.

The current study's results indicated that there was no statistically significant association between having comorbidities and the presence of post-burn

complications. This finding was consistent with earlier studies, which noted that many burned patients who have underlying diseases do not become gravely ill while hospitalized and that several variables, including but not limited to the total burn size, the quality of acute care, patient age, and the occurrence of infection, are the most important elements regarding clinical outcome^{2, 24}. However, other studies have emphasized that the presence of particular underlying diseases, such as diabetes, kidney failure, or heart disease, may impact the rate of complications in specific patient populations²⁵. The absence of a significant association in this study may be due to a low incidence of complications, a low number of comorbidity cases reported, or the quality of care was at a very high level. Therefore, the authors recommend larger studies with a greater sample size and a more accurate assessment of the type of comorbidity to better elucidate the role of these variables regarding the incidence of burn complications.

Limitations and future research plan

The main limitation of this study was the incompleteness of data in patient records, particularly regarding the location of burn incidents and details related to the patients' activities, occupations, and educational backgrounds. Additionally, the assessment of medical records was confined to one year. It is recommended that future research include longitudinal studies that extend over several years to provide a more comprehensive understanding of the factors involved and more accurately evaluate risk factors, treatment outcomes, and long-term sequelae of burn injuries. In addition, implementing standardized and exhaustive data collection protocols—particularly regarding key demographic and clinical variables—should be prioritized.

To address the issue of missing or incomplete data, a quantitative audit and validation of the medical record documentation are required before archiving patient records after hospital discharge. Such a quality control process, performed with greater diligence and oversight, would ensure the accuracy, completeness, and utility of hospital data for clinical and research purposes. These improvements would enhance the reliability of future epidemiological studies and support evidence-based decision-making and policy development in burn care management.

Conclusion

This study showed the patterns of burn injuries in a regional hospital. The findings related to a single

institution and may not be universally applicable. The findings provide important insights into burn injuries in Iran, revealing similarities with global patterns and unique local challenges. This emphasizes the need for better data collection and more consistent use of the ICD-10 coding system to document these injuries effectively.

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Conflict of Interest Disclosures

The authors declared no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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Authors' Contributions

MShB: Validation, methodology, Software, Investigation, Formal analysis, Project administration, Writing - original draft, and Writing - review & editing. FZ: Data curation, and Writing - original draft. All authors read and approved the final manuscript.

Ethical Statement

Ethical considerations and the confidentiality of patient identities were diligently maintained throughout the data collection process in this study. Prior to engaging with the research environment, all necessary permissions were obtained from Kerman University of Medical Sciences.

Declaration of Generative AI and AI-assisted technologies

An artificial intelligence tool (Grammarly) was used for English-language editing. All underlying data interpretation, methodological decisions, and results synthesis were done manually by the authors.

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