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RESEARCH ARTICLE

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Predictors of short-term outcomes of burn in a newly established burn centre in Iran

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Abstract

Aim: This study aimed to determine the predictors of hospital stay and mortality in patients with burns.

Design: This is a cross-sectional, retrospective study.

Methods: This study was performed on 626 medical records in Velayat Subspecialty Burn and Plastic Surgery Center in Rasht, Iran, during 2008–2013.

Results: Men comprised 78.4% of the study population. Overall, 50.2% of the participants lived in rural areas, and 72.5% were married. The majority of burns occurred at home (49.5%), and thermal factor (87.4%) was the major cause of burn injuries. Also, 6.9% of the patients died after burns. The mean length of hospital stay was 12.62 ± 13 days. Age (OR = 1.07), total body surface area (TBSA%) (OR = 1.12) and length of ICU stay (OR = 1.06) were the strongest predictors of mortality. Gender (IRR = 0.85), TBSA% (IRR = 1.01), location of burn (IRR = 1.1), skin graft (IRR = 2.12), length of ICU stay (IRR = 1.04), re-hospitalization (IRR = 1.77) and burn degree (IRR = 1.09) were the predictors of the length of hospital stay.

Conclusion: BSA is still an important predictor of mortality and length of hospital stay, as the most important short-term outcomes of burns.

KEYWORDS
burns, inpatients, Iran, length of stay, mortality

1 | INTRODUCTION

Burn injuries are one of the most important health challenges worldwide, resulting in long hospital stays and a heavy financial burden on patients, families and communities (Herndon, 2012). They are the fourth most common type of trauma worldwide, following traffic accidents, falls and interpersonal violence (Knowlin et al., 2016). Annually, burns result in more than 7.1 million injuries and loss of almost 18 million disability adjusted life years (DALYs)(Rybarczyk et al., 2016). A total of 195,000 deaths are reported annually due to burn injuries worldwide, more than 95% of which occur in developing countries (Herndon, 2012). In Iran, burns are one of the most common forms of trauma and the seventh most important cause of disease burden due to injuries (Emami et al., 2016).

Despite advances in the treatment of burn injuries, they still result in metabolic changes, complications and undesirable effects that may influence the entire body (Townsend et al. 2016). In general, the outcomes of burn injuries can be categorized into short-term, intermediate-term and long-term outcomes. Mortality and length of hospital stay (LOS) are two of the short-term outcomes of burns. Generally, evaluation of burn outcomes can help healthcare providers to determine the health status of burn patients after receiving burn treatments (Falder et al., 2009). However, objective evaluation of the probability of death due to burns is difficult. The most widely used tools for predicting mortality from burns are based on a minimal set of easily measurable variables. A classic example of these tools is the Baux index (Knowlin et al., 2016). This index is based on two strong determinants of burn mortality, that is, age and percentage of total body surface area (TBSA%), which are easily recorded with minimal diagnostic ambiguity.

Mortality is still one of the most important outcome measures in burn care (Steinvall et al., 2016). Patients with burns are a heterogeneous population, with major differences in age, mechanisms of injury, depth, site of burns and comorbidities (Pavoni et al., 2010). Considering the heterogeneity of burn patients around the world, different outcomes have been reported in different parts of the world. For example, the mean hospital LOS and mortality rate were 21.6 days and 29.3% in Sari, Iran, and 13 days and 18.7% in Tabriz, Iran, respectively (Maghsoudi et al., 2005). Moreover, the mean LOS was reported to be 9.04 days in Kermanshah, Iran (Matin et al., 2012), and the mortality rate was estimated at 2.1% in Taiwan (Chen et al., 2014) and 7.1% in Belgium (Brusselaers et al., 2005). Therefore, these outcomes can be used for effective management of burn patients and provide comprehensive information about the patients' demographics, burn-related factors and treatment costs for health policymakers (Falder et al., 2009; Matin et al., 2012).

Burn injuries continue to cause major medical, economic and social challenges in developing countries, such as Iran (Mohammadi-Barzelighi et al., 2011). Therefore, this study was conducted to determine the predictors of some short-term outcomes of burn injuries in patients hospitalized in a newly established burn centre (Velayat Subspecialty Burn and Plastic Surgery Center) in Rasht, Iran, which is the only referral centre for burn injuries in Guilan Province in north of Iran.

2 | METHODS

This cross-sectional, descriptive, analytical, retrospective study evaluated the medical records of patients with burn injuries hospitalized in Velayat Subspecialty Burn and Plastic Surgery Center in Rasht, Iran, during 2008–2013 to determine the predictors of some short-term outcomes of burn injuries (i.e. mortality and LOS). This centre is the only burn centre in Guilan Province, where the patients' medical records are available. It was established in 2008, with an average of more than 900 admissions per year. According to evaluations performed in this centre, a total of 5,435 patients with burns were admitted between 2008 and 2013, 213 of whom died. Overall, 2,365 patients were admitted to this centre only for burns during 2008–2013.

Regarding the sample size, we required the data of 626 patients. First, we calculated the sampling interval and then selected the patients systematically (systematic sampling). We calculated the sampling interval (K) by dividing the total number of patients by the calculated sample size (2,365 ÷ 626 = 3.7). To reach the desired sample size, we studied 703 medical records; if the patients were not eligible to enter the study, they were excluded. A total of 626 patients, who met the inclusion criteria, were evaluated in this study. The inclusion criteria were as follows: age above 18 years; burns involving the eyes, ears, face, feet or perineum that are likely to result in cosmetic or functional impairments; high-voltage electrical burns; burn injuries complicated by major trauma or inhalation injuries; and TBSA% at any level (Herndon, 2012). On the other hand, the exclusion criteria were self-inflicted burns, mental diseases, mental retardation and hearing or visual impairment, based on the medical records.

The data collection tool was a two-part questionnaire. The first part was a researcher-made questionnaire with four questions to collect data on sociodemographic characteristics (i.e. gender, residential area, marital status and education level) and 11 questions to collect data on burn-related factors (i.e. medical insurance, location of burn accident, cause of burn injury, burn degree, inhalation injury associated with burns, time of the first skin debridement, history of escharotomy, fasciotomy, and skin graft, hospital LOS, and mortality). To examine the effects of baseline comorbidities on the outcomes, the comorbidities were documented for each patient, according to their medical reports.

We first obtained approval from the Deputy of Research of Guilan University of Medical Sciences and informed the managers of Velayat Subspecialty Burn and Plastic Surgery Center of the approval. Considering the incomplete data of many medical records, the patients were contacted via phone calls whenever necessary (Figure 1).

Descriptive statistics were used to describe the distribution of study variables. Moreover, the Lilliefors test (based on Kolmogorov–Smirnov test) and Shapiro–Wilk test were used to assess the normality of quantitative variables, such as age, TBSA, ICU stay, Baux score, length of mechanical ventilation and length of hospital stay. According to these tests, quantitative variables did not have a normal distribution.

Mann–Whitney U test, Kruskal–Wallis test and Spearman's rho test were used for evaluating the inferential statistics of continuous variables, and chi-square and Fisher's exact tests were used for categorical variables. Moreover, a logistic regression analysis was performed to evaluate the effects of variables on the likelihood of death in patients, using the backward stepwise (likelihood ratio) method. The binary outcome was mortality (no: 0; yes: 1) in this study. All independent variables that were statistically significant in the univariate analysis were entered into a logistic model simultaneously to assess the predictive ability of each variable while controlling for all other variables. All two-way interactions were excluded from the model because they were not statistically significant. The results are presented as the odds ratios (ORs) and 95% confidence intervals (CIs).

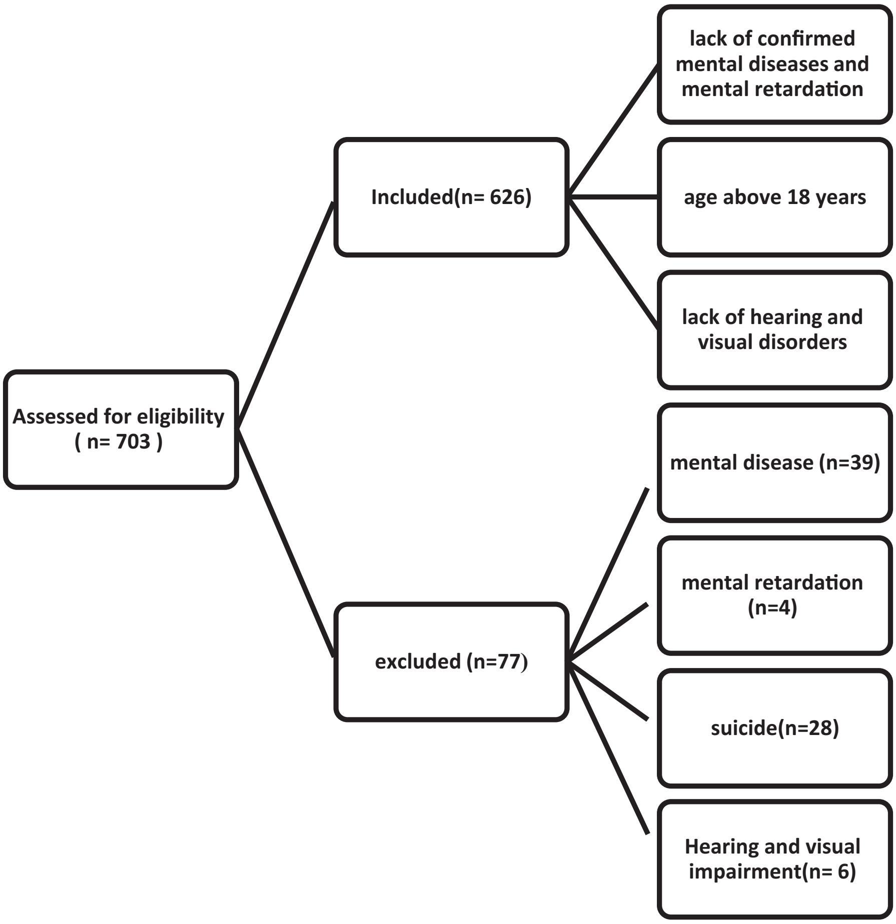

FIGURE 1 Flow chart showing the study sample selection process

Since the variable of LOS showed overdispersed and zero-truncated data, we calculated the incidence rate ratios (IRRs), using a zero-truncated negative binomial (ZTNB) model. The IRRs with 95% CIs were estimated using generalized linear models, where a negative binomial distribution was used with a log link function. All statistical analyses were performed in SAS version 9.4 (SAS Institute, Cary, NC, USA). All tests were double-sided, and the level of statistical significance was set at 0.05.

3 | RESULTS

The sociodemographic characteristics and burn-related factors of burn survivors and non-survivors are presented in Table 1.

Most of the patients were male (78.4%), living in rural areas (50.2%). Also, 96.5% of the patients had one type of insurance. Overall, 72.5% of the patients were married, 25.9% were single, 1.1% were widows, and 0.5% were divorced. In terms of educational level, most patients were undergraduates (43.9%), 24.5% were graduates, 10.6% had university education, and 20.9% were illiterate. Also, in terms of occupational status, 30.4% of the patients were workers, 27.5% were self-employed, 19.6% were housewives, 5.8% were employees, 6.2% were retired, 2.7% were students, and 7.8% had other jobs.

Most burns occurred at home (49.5%), while 31.1% (n = 154) of burns occurred in the workplace; also, 96 (19.4%) burns occurred in other places, such as gas stations and streets. The cause of burn in most cases was thermal (87.4%), followed by electrical and chemical factors (6.7% and 5.9%, respectively). Overall, 67.7% of the patients had undergone one type of surgery (escharotomy, fasciotomy or skin graft). Moreover, 5.1% of the patients were re-hospitalized after discharge. Regarding comorbidities, hypertension (9.9%), coronary artery disease (4.8%), hyperlipidaemia (4.5%), cerebrovascular disease (1.4%), chronic obstructive pulmonary disease (1.9%), diabetes (6.2%), epilepsy (2.4%) and heart failure (0.6%) were reported in the patients.

The mean age of the participants was 41.03 ± 17.31 years, and 6.9% of them (n = 43) died following burn injuries (95% CI: 4.8–8.9). The mean TBSA in survivors was less than non-survivors (12.98 ± 11.59 vs. 57.15 ± 26.33). The mean LOS was 12.62 ± 13.05 days (range: 1–136 days). Seventeen patients with a Baux score <100 died in this study. The mean Baux score of survivors was lower than that of non-survivors (53.20 ± 19.21 vs. 109.57 ± 26.13). Cardiopulmonary arrest was the cause of death in all patients, according to their medical records.

A logistic regression analysis was performed to investigate the effects of variables on the likelihood of death, using the backward stepwise (likelihood ratio) method (Table 2).

TABLE 1 Sociodemographic characteristics and burn-related factors of the patients

Variable	Alive (*n* = 583) N (%)	Dead (*n* = 43) N (%)	Total (*n* = 626) N (%)	*p*-Value
Gender				
Male	463 (94.3)	28 (5.7)	491 (78.4)	.028*
Female	120 (88.9)	15 (11.1)	135 (21.6)	
Type of injury				
Inhalation	11 (61.1)	7 (38.9)	18 (2.9)	<.001**
Trauma	17 (100.0)	0 (0.0)	17 (2.7)	
Other	555 (93.9)	36 (6.1)	591 (94.4)	
Burn site				
Upper limb	176 (99.4)	1 (0.6)	177 (28.3)	<.001*
Lower limb	144 (98.0)	3 (2.0)	147 (23.5)	
Both	263 (87.1)	39 (12.9)	302 (48.2)	
Burn Degree				
Partial thickness	178 (99.4)	1 (0.6)	179 (28.6)	<.001*
Full-thickness	152 (90.5)	16 (9.5)	168 (26.8)	
Partial and full	253 (90.7)	26 (9.3)	279 (44.6)	
Time of the first debridement				
Without debridement	26 (86.7)	4 (13.3)	30 (4.8)	.025*
Admission day	79 (87.8)	11 (12.2)	90 (14.4)	
One Day after Admission day	478 (94.5)	28 (5.5)	506 (80.8)	
Escharotomy				
Yes	297 (90.6)	31 (9.4)	328 (52.4)	.007*
Fasciotomy				
Yes	0 (0.0)	3 (100.0)	3 (0.5)	<.001**
Graft				
Yes	244 (100.0)	0 (0.0)	244 (39.0)	<.001*
Location of Graft				
No Graft	336 (88.7)	43 (11.3)	379 (60.5)	<.001*
Upper limb	96 (100.0)	0 (0.0)	96 (15.3)	
Lower limb	104 (100.0)	0 (0.0)	104 (16.6)	
Both	47 (100.0)	0 (0.0)	47 (7.5)	
Cerebrovascular disease				
Yes	6 (66.7)	3 (33.3)	9 (1.4)	.019**
Chronic Obstructive Pulmonary Disease				
Yes	8 (66.7)	4 (33.3)	12 (1.9)	.006**
Heart Failure				
Yes	2 (50.0)	2 (50.0)	4 (0.6)	.025**
Variable	**Alive (*n* = 583) Mean ± *SD* (median)**	**Dead (*n* = 43) Mean ± *SD* (median)**	**Total (*n* = 626) Mean ± *SD* (median)**	***p*-Value**
Age	40.2 ± 16.5 (36.0)	52.4 ± 23.2 (44.0)	41.0 ± 17.3 (37.0)	.001***
Extent of burn(TBSA)	13.0 ± 11.6 (10.0)	57.2 ± 26.3 (55.0)	16.0 ± 17.2 (10.0)	<.001***
Length of ICU Stay	0.8 ± 3.8 (0.0)	10.2 ± 11.2 (7.0)	1.4 ± 5.2 (0.0)	<.001***
Baux Index	53.2 ± 19.2 (51.0)	109.6 ± 26.1 (113.0)	57.1 ± 24.4 (53.0)	<.001***
Duration of Mechanical Ventilation	0.2 ± 1.5 (0.0)	6.4 ± 6.5 (5.0)	0.6 ± 2.8 (0.0)	<.001***
Length of Hospital Stay	12.6 ± 13.1 (9.0)	12.8 ± 12.4 (8.0)	12.6 ± 13.0 (9.0)	.988***

*Pearson chi-square.
**Fisher's exact test.
***Mann–Whitney U test.

Advancing age was associated with an increased likelihood of mortality; in other words, with a one-year increase in age, the risk of death increased by 7.0% (OR = 1.07). A larger burn was associated with a higher likelihood of death; in other words, with a 1% increase in the extent of burn, the risk of death increased by about 12% (OR = 1.12). Moreover, a longer LOS in ICU was associated with a higher likelihood of death; in other words, with a one-day increase in the ICU stay, the risk of death increased up to 6% (OR = 1.06).

The sociodemographic characteristics and burn-related factors according to hospital LOS are presented in Table 3 and Table 4.

The maximum LOS was reported to be 136 days. The median, mean and standard deviation (*SD*) of LOS were 9.0, 12.62 and 13.0 days, respectively. Figure 2 shows the distribution of LOS for all admitted patients.

Moreover, the results of ZTNB regression between the covariates and LOS are presented in Table 5. After adjusting for all other variables, male patients were 1.17 times more likely to have a longer LOS than women ($p < .05$). Patients with both upper and lower limb burns were 2.34 times more likely to have a longer hospital LOS, as compared to those with only upper limb burns ($p < .0001$). The present results indicated that patients with both types of burns were 2.18 times more likely to have a longer LOS, as compared to those with partial-thickness burns ($p < .001$).

Besides, LOS had a direct relationship with the extent of burns. In other words, patients with larger burns were more likely to stay longer at the hospital. The patients with grafts were also 2.12 times more likely to have a longer LOS in comparison to those without grafts ($p < .0001$). With a one-day increase in the length of ICU stay, the LOS increased by 1.04 folds, as well. Regarding re-hospitalization, patients with re-hospitalization were 1.77 times more likely to have a longer LOS, as compared to those who were not re-hospitalized ($p < .0001$).

4 | DISCUSSION

Velayat Subspecialty Burn and Plastic Surgery Center in Rasht, Iran, is the only burn referral centre in Guilan Province, delivering medical care to patients with burns in north of Iran. The mortality rate of burns is still high in some areas, although survival has increased in recent years as a result of advances in clinical care, use of burn resuscitation formulae, antimicrobial treatments, early parenteral nutrition, early surgery and debridement, and use of wound dressing products and artificial skin (Miguel et al., 2005).

In the present study, 6.9% of the patients died following burn injuries. Panjeshahin et al. reported a mortality rate of 33.3% during 1994–1995 and 33% during 1997–1998; the overall fatality rate was estimated at 34.4% in south-west of Iran (Panjeshahin et al., 2001). However, in a study by Mohebbi et al. (2014) on 619 women with burns in south of Iran, 37.8% died because of burns and the associated complications during 2009–2011 (Mohebbi et al. 2014). Of all 307,000 home injuries reported during 2000–2002 in Iran, about 125,000 cases (41%) were unintentional burn injuries. Of all burn victims, 791 died, and 48 were disabled; the condition of the remaining patients improved, or they underwent therapy (Sadeghi-Bazargani & Mohammadi, 2013). We believe that this improvement may be partly attributed to changes in the injury severity, technological advances, improved infrastructure and implementation of clinical guidelines.

In the present study, the mean age of non-survivors of burn injuries was 52.42 ± 23.18 years. In this regard, Pavoni et al. reported that the mean age of non-survivors was 53.8 ± 19.8 years (Pavoni et al., 2010). In our study, the number of male patients was higher than females. The predominance of burn injuries in males has been also reported in other studies (Knowlin et al., 2016). However, a study by Sadeghi-Bazargani and Mohammedi on 125,000 patients, selected from a national registry, showed that women comprised 58% of unintentional burn victims (Sadeghi-Bazargani & Mohammadi, 2013). Men were more exposed to burns than women, which might be related to the fact that men are involved in more dangerous jobs than women (Soltan Dallal et al., 2016). Similarly, in the present survey, most burns occurred in men and married patients. This finding can be explained by the fact that married people need to work in different places to support their families financially.

In the present study, most of the patients had health insurance (n = 600, 96.5%). In Iran, there are various health insurance programmes that can support patients financially. Even unemployed individuals can use health insurance facilities by paying the monthly cost. Rural insurance is provided by the government for people who live in rural areas. Half of the patients (n = 304, 50.2%) in this survey were living in rural areas and used their rural insurance to pay for the medical costs.

In the present study, 49.5% of burns occurred at home. In the study by Sadeghi-Bazargani and Mohammedi, 65.2% of domestic burn injuries occurred in living rooms or bedrooms, followed by 27% in kitchens (Sadeghi-Bazargani & Mohammadi, 2013). In the present study, most burns occurred outside the house (n = 250). This finding seems logical, as married people work in different environments, even high-risk or low-security environments, to support their families. However, we did not investigate the workplace security in our survey; therefore, further studies must be designed to examine this factor.

More than half of burns occurred in rural areas due to thermal factors. Thermal burns (87.4%) were the leading cause of patients' admission to the hospital. In this regard, Khaliq et al. reported that thermal burns were the leading cause of hospital admission in

TABLE 2 Adjusted death odds ratios among 626 patients in the logistic regression analysis

Variables	Estimate (SE)	OR (95% CI)
Intercept	−9.58 (1.161)	
Age	0.07 (0.014)**	1.07 (1.04,1.10)
Extent of burn(TBSA)	0.11(0.015)**	1.12(1.08,1.15)
Length of ICU stay	0.06 (0.026)*	1.06 (1.01,1.12)

*$p < .05$; **$p < .0001$.

TABLE 3 Sociodemographic characteristics and burn-related factors of the patients according to the length of hospital stay

Variable	Category	Length of Hospital stay: Mean ± *SD* (median)	*p*-Value
Gender	Male	12.7 ± 13.4 (9.0)	.729*
	Female	12.3 ± 11.5(9.0)	
Address[a]	Urban	11.0 ± 13.8(7.0)	<.001*
	Rural	14.4 ± 11.8(11.0)	
Insurance[a]	Yes	12.7 ± 13.1(9.0)	.062*
	No	7.5 ± 4.6(7.0)	
Marital status[a]	Single	13.4 ± 16.7(9.0)	.906**
	Married	12.4 ± 11.6(9.0)	
	Divorced	13.7 ± 8.5 (14.0)	
	Widow	11.1 ± 7.2 (10.0)	
Level of Education[b]	Illiterate	11.9 ± 10.6 (9.0)	.351**
	Under the diploma	13.5 ± 14.6 (10.0)	
	diploma	12.2 ± 11.5 (10.0)	
	Academic	11.6 ± 15.0 (7.0)	
Patient Job[b]	housewife	12.5 ± 11.8 (9.0)	.129**
	worker	13.4 ± 14.8(10.0)	
	Employee	9.1 ± 6.2(8.5)	
	self-employment	11.3 ± 10.2(9.0)	
	Retired	11.2 ± 11.9(6.5)	
	Student	14.8 ± 24.1(6.5)	
	Other	17.7 ± 16.5(15.5)	
Location of burn[a]	Home	14.0 ± 14.8(10.0)	.314**
	Workplace	11.4 ± 13.1(8.0)	
	other	11.6 ± 8.7(10.0)	
Cause of burn	Thermal	12.6 ± 12.4(9.0)	.396**
	Chemical	9.6 ± 7.5(7.0)	
	Electrical	15.4 ± 21.6(10.0)	
Type of injury	Inhalation	21.0 ± 21.1(12.0)	.001**
	Trauma	27.5 ± 34.7(16.0)	
	other	11.9 ± 11.2(9.0)	
Burn site	Upper limb	8.6 ± 7.6(6.0)	<.001**
	Lower limb	9.2 ± 9.7(6.0)	
	both	16.6 ± 15.5(12.0)	
Burn degree	Partial thickness	8.8 ± 7.5(7.0)	<.001**
	Full-thickness	13.6 ± 15.1(8.5)	
	partial and full	14.5 ± 13.9(11.0)	
Time of the first skin debridement	Without debridement	7.8 ± 10.6(3.5)	<.001**
	Admission day	16.3 ± 17.8(12.0)	
	One day after admission day	12.3 ± 12.0(9.0)	
Escharotomy	Yes	14.5 ± 15.0(10.5)	<.001**
	No	10.5 ± 10.1(7.0)	
Fasciotomy	Yes	10.0 ± 1.0(10.0)	.806*
	No	12.6 ± 13.0(9.0)	

(Continues)

TABLE 3 (Continued)

Variable	Category	Length of Hospital stay Mean ± *SD* (median)	*p*-Value
Graft	Yes	19.1 ± 16.4(16.0)	<.001**
	No	8.5 ± 7.8(6.0)	
Surgery	Yes	15.1 ± 14.5(11.0)	<.001**
	No	7.6 ± 6.9(6.0)	
Graft location	No Graft	8.4 ± 7.4(6.0)	<.001**
	Upper limb	21.0 ± 19.4(17.0)	
	Lower limb	14.8 ± 12.0(12.0)	
	Both	25.0 ± 16.8(21.0)	
Hypertension	Yes	12.5 ± 11.2(9.0)	.838*
	No	12.6 ± 13.2(9.0)	
Coronary artery disease	Yes	10.3 ± 6.5(9.0)	.758*
	No	12.7 ± 13.2(9.0)	
Hyperlipidaemia	Yes	10.4 ± 8.8(9.0)	.402*
	No	12.7 ± 13.2(9.0)	
Cerebrovascular disease	Yes	8.2 ± 7.3(8.0)	.217*
	No	12.7 ± 13.1(9.0)	
Chronic obstructive pulmonary disease	Yes	9.4 ± 12.0(6.0)	.096*
	No	12.7 ± 13.0(9.0)	
Diabetes	Yes	9.0 ± 8.2(6.0)	.031*
	No	12.9 ± 13.2(9.0)	
Epilepsy	Yes	21.1 ± 19.3(13.0)	.031*
	No	12.4 ± 12.8(9.0)	
Heart failure disease	Yes	20.0 ± 18.5(16.0)	.423*
	No	12.6 ± 13.0(9.0)	
Re-hospitalization	Yes	36.1 ± 29.8(23.0)	<.001*
	No	11.4 ± 10.0(9.0)	

*Mann–Whitney U test.
**Kruskal–Wallis test.
***Spearman's rho test.
[a]Less than 5% missingness.
[b]More than 10% missingness.

TABLE 4 Correlation between the length of hospital stay with some of burn-related factors of the patients

Correlation Coefficient	Length of Hospital Stay	
Extent of burn(TBSA)	0.495	<.001[a]
Length of ICU stay	0.260	<.001[a]
Baux	0.280	<.001[a]
Time of mechanical ventilation	0.108	.007[a]
Age	0.02	.668[a]

[a]Spearman's rho test.

patients aged 16–34 years, while electrical burns were more common in patients under the age of 30 years (Khaliq et al., 2013). Moreover, a study by Ansari-Moghaddam et al. on 713 medical records of burn patients showed that two-thirds of them (62.0%) died as a result of fire-related burns, and one-third of them died because of scald burns (33.1%). Intentional self-harm injuries accounted for 14.3% of all admissions (Ansari-Moghaddam et al., 2013). Additionally, the results of a study by Soltan-Dallal on 200 patients with second-degree burns, admitted to Motahari Referral Center of Burn in Tehran, Iran, showed that the most common cause of burn was hot liquid in both sexes (Soltan Dallal et al., 2016).

The mentioned findings of the present study can be attributed to the fact that in some rural areas of Guilan, people are forced to use traditional ways to heat their houses, such as traditional heating appliances or wood heaters; therefore, the possibility of burns in these areas may increase. Another reason may be that people who live in rural areas usually have lower educational levels; therefore, they may not have enough information or knowledge about the ways

FIGURE 2 Histogram of length of hospital stay

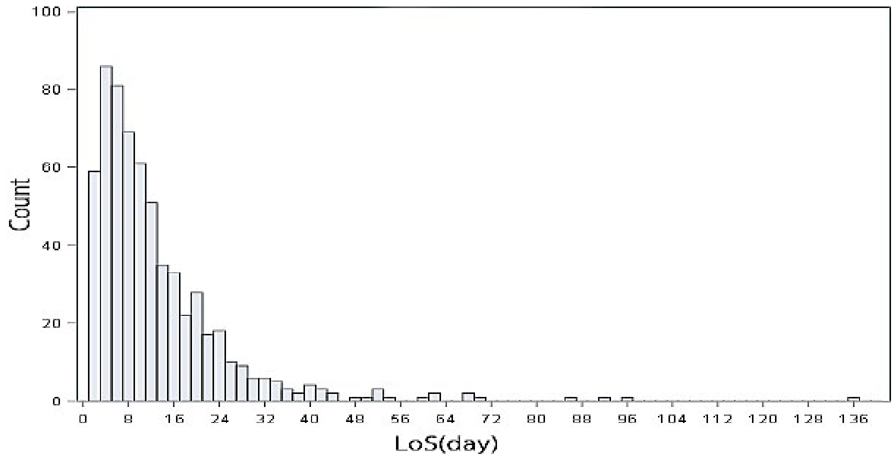

TABLE 5 Adjusted length of hospital stay IRR among 626 patients in the zero-truncated negative binomial regression analysis

Variables	Estimate (SE)	IRR (95% CI)
Intercept	1.51 (0.126)	
Gender (men/women)	−0.16 (0.065)*	0.85 (0.74,0.96)
Burn site (up/down/both)	0.16(0.035)***	1.17 (1.09,1.25)
Degree of burn (partial/full-thickness/both)	0.09 (0.033)**	1.09 (1.02,1.16)
Extent of burn	0.01 (0.002)***	1.01 (1.00,1.02)
Graft (no/yes)	0.75 (0.055)***	2.12 (1.90,2.36)
Length of ICU stay	0.03 (0.005)***	1.04 (1.02,1.05)
Re-hospitalization(no/yes)	0.57 (0.113)***	1.77 (1.37,2.16)
Alpha	0.32(0.026)***	

*$p < .05$; **$p < .001$; ***$p < .0001$.

of preventing burns. Additionally, in the present study, we found that various medical conditions can affect burn mortality. In the present study, hypertension was the most common comorbidity among patients. Nevertheless, few studies have examined the impact of comorbidities on burns. A larger study by Thombs et al. in 2007 examined the effects of various comorbidities on burn injury mortality, based on the National Burn Repository (NBR) report of 31,338 burn records from 1995 to 2005. They found that medical conditions affected burn mortality (Thombs et al., 2007).

Determination of the predictors of mortality in burn patients can help prevent mortality. In the present study, age, TBSA and LOS in ICU were the definite predictors of mortality. This result is in line with the findings of previous studies. For example, Wang et al., in a study on 102 patients with extensive burn injuries in Shanghai, showed that the burn percentage (TBSA%), severity of inhalation injury, full-thickness burns, serum creatinine level, use of inotropes, platelet count below 20,000, sepsis and ventilator dependence was associated with mortality. Of these parameters, a low platelet count, sepsis and ventilator dependence were associated with an increased risk of mortality in burn patients (Wang et al., 2010).

A study by Chen et al. on 21,791 burn patients in Taiwan showed that age and inhalation injury, concomitant with skin burns, decreased the survival of burn patients (Brusselaers et al., 2005). Also, a study by Wearn et al. in Birmingham Burn Center showed that age, TBSA% and inhalation injury were associated with mortality (Wearn et al., 2015). Also, Colohan concluded that TBSA%, presence of inhalation injury and age were the strongest predictors of mortality (Colohan, 2010). The reason why inhalation injury, concomitant with burn injury, was not identified as a predictor of mortality in our study is that only 18 (2.9%) patients had concomitant inhalation injuries; meanwhile, LOS in ICU was one of the predictors of mortality in our study. The possible explanation for this finding is that critical patients are normally admitted to ICUs; therefore, the possibility of mortality in this group may be high.

In the present study, the mean score of the Baux index was lower in survivors than in non-survivors; nevertheless, it was not a predictor of mortality in our patients. On the other hand, Pavoni et al., by evaluating 50 patients with severe burns hospitalized in ICUs, reported that the Baux index, severity of burn injury upon ICU admission, complications and time of the first skin debridement were the predictors of mortality (Pavoni et al., 2010). This discrepancy between the results may be due to differences in the inclusion criteria, as we included all burn patients in our study, even those who were not admitted to the ICU, whereas Pavoni et al. only studied ICU patients.

Moreover, a study by Karami et al. from Kermanshah, Iran, on 388 burn patients revealed that the extent of burn injury, gender, age, cause of burn injury and burn degree were associated with mortality (Matin et al., 2012). Another study showed that gender (female) and TBSA were the strongest predictors of patient survival (Mohammadi-Barzelighi et al., 2011). In the present study, gender, skin graft, LOS in ICU, re-hospitalization, burn degree, burn site and TBSA% were the predictors of LOS in burn patients, which are novel findings. In addition, we found that men were hospitalized more frequently than women; this finding may be due to the fact that most burn cases were male. Also, patients who underwent skin grafting in our study stayed at the hospital longer. It seems that undergoing surgeries can cause longer LOS. Also, Farhadi Hassankiadeh et al. found that the type of surgery had a considerable effect on the LOS in the general surgical unit (Hassankiadeh et al., 2017); therefore, it is logical that our patients with skin grafts stayed longer at the hospital.

Conrad Y. Puozaa found that a higher severity of disease increased the LOS in Nigerian patients (Puozaa, 2016). In our study, patients who were either re-hospitalized or had a longer ICU stay had a longer hospital stay, as well. Overall, the majority of patients admitted to ICUs have critical conditions and need more nursing and medical attention; therefore, hospital stay can be longer in this group of patients. Moreover, we found that the hospital LOS was longer in patients with burns of both upper and lower extremities and those with partial- and full-thickness burns simultaneously; this finding is in line with the study by Conrad Y. Puozaa (Puozaa, 2016).

We also found that TBSA was one of the predictors of LOS. In this regard, Hussain et al. found that age and TBSA were the strongest predictors of LOS. They also found that full-thickness burns, female gender, inhalation injury, procedures such as escharotomy, and burn depth were other predictors of LOS in hospitals for thermal burn patients (Hussain & Dunn, 2013). Also, Khaliq et al. investigated 489 burn patients in Pakistan and found that age, gender, inhalation injury, burned part of the body and TBSA were important factors determining the hospital LOS and survival of burn victims (Khaliq et al., 2013).

In the current study, patients who received their first skin debridement on the first day of hospitalization had a longer LOS, which could be due to the use of traditional methods of burn treatment rather than modern methods in the early years of the centre establishment. Patients from rural places had a longer LOS (14.38 ± 11.79) than patients living in urban areas. This may be due to the fact that most burn patients in our study resided in rural areas. Therefore, physicians sometimes avoided early discharge of patients in fear of loss to follow-up and kept them at the hospital until significant improvement of burn wound was achieved. Finally, the role of TBSA in predicting the hospital LOS could be attributed to the need for debridement and repeated operations for extensive burns; consequently, LOS is usually longer in patients with extensive burns.

The limitations of this study are inherent to any retrospective study. Since this is a single-centre study, caution must be taken in generalizing the findings. Also, another limitation of this study was the incomplete data in the medical records of some patients. Although we tried to overcome this limitation by contacting the patients via phone calls, we were not always successful, as some phone numbers were wrong or had changed. Since patients with burn injuries were evaluated in this study according to the American Burn Association (ABA) criteria, it is suggested to investigate the outcomes and predictors of burn injuries in patients with certain extents of burn injuries (e.g. 40% or more). Future studies should also evaluate the outcomes of severe burns and their predictors in children hospitalized in Velayat Subspecialty Burn and Plastic Surgery Center. Finally, the effects of haematological and biochemical tests, such as platelet count, serum creatinine and urea levels, and blood products, on the outcomes must be assessed in future studies.

5 | CONCLUSION

To the best of our knowledge, this is the first study examining the predictors of hospital LOS and mortality following burn injuries in Velayat Subspecialty Burn and Plastic Surgery Center. The results showed that most burns occurred in rural places among men, married people and people with low levels of education. It seems that providing safe work conditions and increasing the public knowledge about the methods of prevention and treatment of burns can be effective in reducing the incidence of burns. The results also showed that older age, TBSA and hospital LOS were among the predictors of mortality and that gender, burn site, extent of burn injury (TBSA%), skin grafting and LOS in ICU were some predictors of hospital LOS in burn injuries. The findings also showed that TBSA is still an important predictor of mortality and hospital LOS. It seems that providing home care facilities for burn patients, immediate coverage of their bodies with skin substitutes, use of modern methods of surgery and treatment, and paying more attention to the older patients and those with underlying medical conditions can be effective in reducing the rate of mortality in burn patients and decreasing the hospital LOS following burns. Finally, identifying the predictors of burn outcomes can help us allocate the costs of treatment properly and design appropriate healthcare plans for patients with burn injuries.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

All data that support this survey are available upon reasonable request.

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