

# Etiology and Outcome of Burns in Hamadan, Iran: A Registry-based Study

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## Abstract

**Background:** Burn prevention strategies are most effective when they are based on knowledge of etiological patterns of burn injuries and considering the geographical variations and socioeconomic differences in burn epidemiology. In this regard, this study aimed to investigate the etiology and outcome of burns in Hamadan, Iran. **Materials and Methods:** This registry-based, cross-sectional study was conducted on 798 burn patients admitted to the Besat Hospital from March 2013 to February 2018. The medical records of all the patients were extracted from hospital information system. **Results:** In males, the most common cause of burn was gas explosion (41.4%), whereas in females, the most common cause was hot liquids (37.1%). In below 5 years and 6–15 years age group, burning with hot liquids was the common cause of burn, whereas in other age groups, gas explosion was the common cause of burn. In the present study, 6.9% of the patients died because of their burns. With increasing age, the odds of death increases, so that patients between 30 and 59 years had 2.2 fold ( $P = 0.02$ ) and patients  $\geq 60$  years had 3.5 fold ( $P = 0.006$ ) higher odds of death compared to patients aged  $< 30$  years. **Conclusion:** Findings of the present study show that males and people aged 26–40 years and children 0–5 years were at a greater risk of burns. Furthermore, this study shows that self-immolation with a high rate of case fatality should be considered as a mental health challenge, and it is necessary to design preventive strategies to reduce it.

**Keywords:** Burns, epidemiology, etiology, Iran

## INTRODUCTION

Globally, burn has been considered as a serious public health problem, so that an estimated 265,000 deaths occurred annually because of fire-related burns. Over 96% of fatal fire-related burns occur in low- and middle-income countries. In addition to those who die, it imposes lifelong disabilities and disfigurements on victims of burns.<sup>[1]</sup>

Data obtained from hospitalized burn patients indicate that incidence rates for assault by fire and scalds are from 3% to 10% in the world, whereas the incidence rates of self-mutilation and suicide attempts by burning are relatively low, but these injuries carry a significant fatality rate (65%),

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worldwide.<sup>[2]</sup> Results of the systematic review study regarding the epidemiology of burn injuries in the East Mediterranean countries showed that the reported incidence of burns in these countries ranged from 112 to 518/100,000/year. The vast majority of victims were young people and approximately one-third of burn occurred in pediatrics. Hospital mortality in these countries ranged from 5% to 37%.<sup>[3]</sup>

Results of the conducted study in Tehran showed that women aged 21–30 years and children younger than 10 years had a higher risk of burn.<sup>[4]</sup> The fatality rate of burns in Iran is considerable, so that this rate in Kermanshah was 18.8%.<sup>[5]</sup> Burn imposed a huge socioeconomic cost on patients, their families, and society,<sup>[6]</sup> so that in 2012, the average cost of burns per patient in one hospital of Iran was nearly 1500 US \$.<sup>[5]</sup>

Burn prevention strategies are most effective when they are based on knowledge of etiological patterns of burn injuries and consider the geographical variations and socioeconomic differences in burn epidemiology. In view of these considerations, this study aimed to investigate the etiology and outcome of burns in Hamadan, Iran. Enhancing our knowledge of current epidemiological conditions can help health policy-makers to better planning and providing more efficient approaches for the reduction of the incidence of burns.

## MATERIALS AND METHODS

This registry-based, cross-sectional study was conducted on all burn patients referred to the Besat Hospital in Hamadan city (Hamadan province) from March 2013 to February 2018. Hamadan province with an area of 19,493 km<sup>2</sup> in extent is located in West of Iran and had a population of 1,738,234 people, according to the national census held in 2016 by Statistical Center of Iran.<sup>[7]</sup> The Besat Hospital is the sole referral burn center in the city, and most of the patients with severe burn injuries from across the province are referred to this hospital.

The medical records of all burn patients who had been admitted to the hospital in the mentioned time period were extracted from the hospital information system. In this study, the second-degree burns (partial thickness burns) and third-degree burns (full-thickness burns) were assessed and first-degree burns were excluded. A researcher-made form was used to collect demographic data of the patients, including age, gender, year of occurrence, degree of burn injury, underlying cause of burns and patient outcome. Data were retrieved from the patients' medical record folders by a trained staff.

Descriptive analyses including frequency tables and percentages were used to present and summarize the data. The Cochran–Armitage test was used to assess the trend of burn incidence during the study period. The Chi-square test was employed to assess the association between demographic characteristics of the patients and causes of burns as well as causes of burns and disease outcome. Finally, to determine the effect of predictors on patient's death, we

used logistic regression by categorizing patient's outcome in two groups (dead and alive). A Hosmer and Lemeshow test was used to build a model and the model is fitted with all variables that had  $P < 0.2$  in the crude model. All the analyses were done using Stata software (Version 11.2, StataCorp, College Station, Texas, USA). A significance level was considered  $< 0.05$ .

## RESULTS

From a total of 798 patients, 66.9% were male and other were female.

The mean age for all burn patients was 29.18 years with a range from under 1–89 years.

The incidence rates of hospitalized burn patients in Besat Hospital were 8.04, 4.83, 6.6, 8.8, 13.2, and 8.7/100,000 populations in the years of 2013–2017, respectively ( $P_{\text{for trend}} = 0.19$ ).

Furthermore, 171 (21.5%) of the burn cases occurred in children and 7.03% occurred in people over 60 years. Burning with gas explosion and hot liquids occurred in 38.1% and 23.93% of the cases, respectively, which were the common causes of burn in this study. In 17 (2.3%) cases, self-immolation was the cause of burn. Degree of burn in 75.6% of the cases was moderate and burns in 55 people resulted in death (6.9% of the cases) [Table 1].

**Table 1: Demographic characteristics, causes of burns, and their outcomes in burn patients**

Variable	Frequency (%)
Gender	
Male	534 (66.9)
Female	264 (33.1)
Age group (year)	
0-5	171 (21.5)
6-15	70 (8.77)
16-25	88 (11.0)
26-40	238 (29.9)
41-60	174 (21.8)
+60	56 (7.0)
Cause of burn	
Flame	76 (9.5)
Petrol	57 (7.1)
Gas explosion	304 (38.1)
Electrical	45 (5.6)
Hot liquids	191 (23.9)
Self-immolation	17 (2.1)
Chemical	46 (5.8)
Other	62 (7.8)
Degree of burn	
Moderate	603 (75.6)
Sever	195 (24.4)
Outcome	
Discharge	743 (93.1)
Death	55 (6.9)

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As shown in Table 2, in males, the most common cause of burn was gas explosion (41.4%), followed by hot liquids (32.4%), whereas in females, the most common cause was hot liquids (37.1%) followed by gas explosion (31.4%). Burning with hot liquids was the common cause of burns with the incidence rates of 66.1% and 41.4% in below 5 years and 6–15 years of age groups, respectively, whereas in other age groups, gas explosion was the common cause of burning.

According to Table 3, there is a significant relationship between degree of burn and causes of burns, so that in all causes of burns, majority of cases had a moderate degree of burn, while in 94.1% of self-immolation cases the degree of burn was severe ( $P < 0.001$ ). In the present study, 6.9% of the patients died because of their burns. In all cases of burns except self-immolation, the rate of discharge from hospital was higher and ranged from 100% discharge in electrical and chemical causes to 90.8% in flame cause; 52.9% of the cases died due to self-immolation ( $P < 0.001$ ).

Determinants of death among burn patients are presented in Table 4. As shown according to the adjusted model, female patients have 1.7-fold higher odds of death compared with males, but this relationship was not statistically significant ( $P = 0.08$ ). With increasing age, the odds of death increased, so that patients with 30–59 years of age had 2.2-fold ( $P = 0.02$ ) and  $\geq 60$  years patients had 3.5-fold ( $P = 0.006$ ) higher odds of death compared with below 30-year age patients. Patients

with severe burns had 11.5 fold higher odds of death (odds ratio = 11.5 [95% confidence interval = 5.9, 22.3],  $P < 0.001$ ).

## DISCUSSION

The pattern of burn injuries varies in different communities; therefore, epidemiologic studies about burn patients in each region are required to design and perform effective preventive strategies. The analysis of the demographic data revealed that males were more at risk of burn injuries than females, but females experience worse outcomes than males. The results of the present study are similar to several other published reports, which showed that men were at higher risk of burn injury than females [5,8] because of more dangerous working conditions for men.<sup>[9]</sup> Some studies have, however, reported the contrary results.<sup>[10,11]</sup> These contrasting results may suggest geographical variations in terms of gender distributions of burn injuries. Similar to several other published reports, we found that sex differences were related to clinical outcomes in burn patients and women with burn injuries were less likely to survive and died sooner than men with similar injuries.<sup>[12,13]</sup> This can be due to differences in biologic factors as well as clinical care between the two genders.

The results of the present study showed that the frequency of burns was highest among patients aged 26–40 years and children (0–5 years). Our results are in line with several studies that reported the higher risk of burns in children and middle age, compared to other age groups.<sup>[14–16]</sup> This can be explained that children who spend most of the day at home

**Table 2: Distribution of patients by gender, age group, and causes of burns**

	Flame	Petrol	Gas explosion	Electrical	Hot liquids	Self-immolation	Chemical	Other	P
Gender									
Male	50 (9.4)	45 (8.4)	221 (41.4)	45 (8.4)	93 (17.4)	12 (2.3)	26 (4.9)	42 (7.9)	<0.001
Female	26 (9.9)	12 (4.6)	83 (31.4)	0	98 (37.1)	5 (1.9)	20 (7.6)	20 (7.6)	
Age group (year)									
0-5	12 (7.0)	4 (2.3)	11 (6.4)	1 (0.6)	113 (66.1)	0	10 (5.9)	20 (11.7)	<0.001
6-15	10 (14.3)	6 (8.6)	13 (18.6)	3 (4.3)	29 (41.4)	1 (1.4)	2 (2.9)	6 (8.6)	
16-25	7 (8.0)	13 (14.8)	42 (47.7)	6 (6.8)	4 (4.6)	4 (4.6)	6 (6.8)	6 (6.8)	
26-40	25 (10.5)	21 (8.8)	112 (47.1)	24 (10.1)	9 (3.8)	11 (4.6)	21 (8.8)	15 (6.3)	
41-60	16 (9.2)	12 (6.9)	96 (55.2)	7 (4.0)	22 (12.6)	1 (0.6)	7 (4.0)	13 (7.5)	
+60	6 (10.7)	1 (1.8)	30 (53.6)	4 (7.1)	13 (23.2)	0	0	2 (3.6)	

**Table 3: Outcomes of burns according to causes of burns in burn patients**

	Degree of burn		Leading to surgery		Outcome	
	Moderate	Severe	Yes	No	Discharge	Death
Flame	51 (67.1)	25 (32.9)	19 (25.0)	57 (75.0)	69 (90.8)	7 (9.2)
Petrol	36 (63.2)	21 (36.8)	12 (21.1)	45 (79.0)	52 (91.2)	5 (8.8)
Gas explosion	228 (75.0)	76 (25.0)	51 (16.8)	253 (83.2)	279 (91.8)	25 (8.2)
Electrical	28 (62.2)	17 (37.8)	14 (31.1)	31 (68.9)	45 (100.0)	0
Hot liquids	176 (92.2)	15 (7.9)	19 (10.0)	172 (90.1)	186 (97.4)	5 (2.6)
Self-immolation	1 (5.9)	16 (94.1)	5 (29.4)	12 (70.6)	8 (47.1)	9 (52.9)
Chemical	41 (89.1)	5 (10.9)	6 (13.0)	40 (87.0)	46 (100.0)	0
Other	42 (67.7)	20 (32.3)	15 (24.2)	47 (75.8)	58 (93.6)	4 (6.4)
P		<0.001		0.004		<0.001

**Table 4: Determinants of death among burn patients**

Variables	COR	95% CI	P	AOR*	95% CI	P
Gender						
Males	1			1		
Females	1.5	0.9-2.6	0.16	1.7	0.9-3.1	0.08
Age group (year)						
<30	1			1		
30-59	2.4	1.2-4.5	0.01	2.2	1.1-4.4	0.02
≥60	4.8	2.9-15.4	<0.001	3.5	1.4-8.7	0.006
Degree of burn						
Moderate	1			1		
Sever	12.4	6.5-23.8	<0.001	11.5	5.9-22.3	<0.001

\*Adjusted for other variables in the model. COR: Crude OR, AOR: Adjusted OR, CI: Confidence interval

close stoves and heaters where burning with hot liquids happen, so that children need more protection from family members, and workplaces should offer more protection to adults, especially males. Also, the findings of the present study reveal that the chance of death increases with increasing age. The effect of aging on burn patients' outcomes has been shown in previous studies.<sup>[17,18]</sup> Elderly patients with immune dysfunction are prone to more infections and slower healing. In addition, pulmonary and cardiovascular dysfunctions and diabetes in the elderly are associated with poor outcome in these patients.

Our findings revealed that the most common cause of burn in male and female was gas explosion and hot liquids, respectively. The most common mechanism of injury in the present study was explosion from a domestic appliance or gas pipe. However, any explosion or blast involves unexpected high pressures and velocities directed at the person. It has been debated that the blast wave created by an explosion causes brain injury and neurological deficit that can affect learning and memory.<sup>[19,20]</sup> This result is consistent with the findings of Patel *et al.* and Bayuo *et al.* that reported gas explosions were the major etiological factors of men burns.<sup>[21,22]</sup>

Furthermore, similar to our findings, burning with hot liquids was the most common cause of burns among females in one previous study,<sup>[23]</sup> so that for women, the majority of burn injuries occurred at kitchen as the most common place for burn accidents. This result is in line with the findings reported in previous studies.<sup>[11,24]</sup>

The case-fatality rate in this study was 6.89% and burn had led to death in more than half of the patients with self-immolation. These results are consistent with previous several reports from other populations in developing countries, so that mortality rates from burn injuries in Taiwan,<sup>[25]</sup> Egypt,<sup>[26]</sup> Nigeria,<sup>[27]</sup> and Irrua<sup>[28]</sup> are reported 3.7%, 4.3%, 6.5%, and 9.72%, respectively. This death rate due to burn injuries is comparatively acceptable as compared to data available internationally. This probably is due to the existence of health facilities and establishment of specialized burn centers in our country. Furthermore, over 90% of self-immolations occur in

developing countries and over half of these self-immolation leads to death.<sup>[29]</sup>

Although many people with minor burns do not need to be hospitalized. Thus, epidemiology of minor burns is not well-defined worldwide.<sup>[30]</sup> Similar to some other studies,<sup>[31]</sup> the most frequent burn injuries were moderate. Consistent with a study conducted in Newcastle<sup>[32]</sup> and because of moderate symptoms, often patients were discharge from the hospital.

The present study had some limitations. First, a small portion of burn patients registered through hospital-based surveillance systems because the vast majority of burn patients (especially mild and moderate burns) are treated outside of these referral centers and therefore the findings are prone to underreporting. Second, because of the retrospective nature of the study, some information, such as the total body surface area burned and length of stay were not reported. Finally, it was not possible to access the denominator information to calculate the incidence rate of burns by age group and gender.

## CONCLUSION

The findings of the present study show that males and people aged 26–40 years and 0–5-year children were at a higher risk of burns. Furthermore, aging is an important factor that contributes to the poor clinical outcome of burn patients. The causes of burns in children have a different pattern compared to those in adults; gas explosion was the common cause of burns in adults, while burning with hot liquids was the most prevalent cause of burn in the below 15-year age group. The findings of this study demonstrate that self-immolation with a high rate of case fatality should be considered as a mental health concern, and preventive strategies are necessary to reduce the incidence of burn injuries.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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