

■ Original article

Epidemiological characteristics and predictive factors of burns among Iranian elderlies (2008-2012): a retrospective study

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Abstract

Background and Purpose: Burn injury is one of the most common accidents that leads to mortality and disability. The elderly are more vulnerable to burns, compared to the youth; accordingly, a higher percentage of the elderly are at the risk of death due to burn injuries. Regarding this, the present study was conducted to determine the prevalence of burns and its subsequent mortality among the elderly.

Methods: This retrospective study was conducted on the burn patients aged ≥ 60 years who were admitted to the specialized burn centers of the Shahid Motahari and Shohadaye Yaft Abad hospitals in Tehran, Iran, during 2008-2012. Data collection was performed using a form covering both demographic and burn-related data, such as burn percentage, cause and time of burn incidence, burn site, underlying diseases, and time of discharge or death. The data were collected from the medical records of the patients.

Results: According to the results, the incidence of burn injuries in the elderly men was two times higher than that in the elderly women. The total mortality rate was 21.9%, which was uniformly distributed across the two genders. The demographic variables affecting the mortality risk were older age (OR=1.1, 95% CI: 1.09-1.19) and no psychological burden or other diseases (OR=9.9, 95% CI: 3.9-24.0). Furthermore, the best therapeutic approach for burn injuries with the lowest mortality (3.2%) was grafting/flap/amputation, followed by fasciotomy/grafting (7.4%) (OR=2.0, 95% CI: 0.5-8.7).

Conclusion: Several factors, such as surgery, no history of disease, age, and burn percentage were identified as the predictive factors of survival rate of the elderly with burn injuries. Therefore, it seems necessary to develop prevention strategies for burn injuries among the elderly population.

Keywords: Burn, Elderly, Epidemiology, Mortality, Predictive factors

Introduction

Burn injuries are among the most devastating and common health problems. This condition is a major worldwide public health crisis and the fourth most common type of global trauma after traffic accidents, falls, and interpersonal violence (1). Burn is an event that is recognized as the main cause of 5-12% of the traumas and accidents in the world. It can lead to mortality, disability, pain, as well as physical, psychological, and economic problems.

This accident imposes financial losses on the community and families (2-4).

According to the World Health Organization (WHO), it is estimated that annually, about 300,000 individuals lose their lives due to the fire burns. In this regard, the majority of the fire burns (95%) occur in the low- and middle- income countries (5, 6). According to the literature, the elderly are more vulnerable to burn injuries as compared with

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the youth; accordingly, a higher percentage of the elderly are at the risk of death due to burns (7). Burn is an important cause of morbidity and mortality throughout the world.

Like many countries, the population aging is on a growing trend in Iran, which is due to the advancement of health services, improvement of living standards, and enhancement of life expectancy. Accordingly, the population structure of this country is simultaneously evolving from a dynamic to a static structure (8). It is anticipated that the burn incidents would remain as a challenge in the elderly group (9). Regarding this, it is necessary to study the factors leading to burn injuries and identify the strategies preventing burns among the elderly population in Iran.

Based on the statistical data collected from the National Burn Registry of Iran, during 2014-2016, about 1,721 elderly patients had been admitted to the burn units across the country, who had a mortality rate of 12.8% (10). It is also worth mentioning that some specific conditions, such as chronic obstructive pulmonary disease and coronary artery disease, have greater prevalence among the elderly than that in the youth.

These conditions may prolong the duration of hospitalization, intensify the need for mechanical ventilation, and exacerbate the associated side effects in the elderly patients with burns (7). With this background in mind, the present study aimed to determine the incidence and mortality rates of burn injuries in the elderly patients in Iran. The results of this study could add to the existing knowledge of burn prevalence and its associated predictive factors in this vulnerable group so that appropriate preventive measures can be adopted.

Materials and Methods

This retrospective study was conducted on the elderly patients with burn injuries in 2016. To collect the required data, we reviewed the medical records of the burn patients aged ≥ 60 years (11) who were admitted to the specialized burn centers of the Shahid Motahari and Shohadai Yaft Abad hospitals in Tehran, Iran, during 2008-2012 using the census

method. These two centers are the only specialized and referral burn treatment centers in Tehran. Over the five years of the study, a total of 7,804 elderly patients were admitted to the mentioned burn centers, 565 of whom were hospitalized.

The data collection was performed using a form, which covered both demographic and burn-related data. The demographic data included the age, gender, duration of hospital stay, occupation, education level, and place of residence. Furthermore, the burn-related data entailed burn percentage based on the Landau Bradow table (completed by the physician), time interval between the burn incidence and hospital admission (based on the patient history or referral form), burn site, type of substance, being intentional or accidental, and time and place of the burn incidence, as well as other data, including underlying medical conditions, treatment, prognosis, mean time of discharge, medical consultation, and cause of death.

The validity of the items in this form was confirmed in a study by Moqarab et al. (12). Upon the patient arrival to the burn units of the selected hospitals and obtaining the informed consent, the medical records of those aged above 60 years were obtained to fill out the forms. All data were entered into the SPSS version 23.0 at the end of each working day.

Ethical considerations

Prior to the study, ethical approval was obtained from the Ethics Committee of the Shahed University (ID No: M-P/M105), Tehran, Iran. After obtaining the approval of the Health Deputy of the University, we coordinated with the hospital officials and informed them about the goals and details of the study. In addition, the patients' data were kept confidential.

Statistical Analysis

The numerical variables were presented as mean, standard deviation, and range, and the categorical variables were presented as frequency. In addition, the logistic regression was run to determine the predictors of mortality. All analyses were performed

using the SPSS version 23.0. *P-value* less than 0.05 was considered statistically significant.

Results

A total of 565 elderly burn patients were included in this study. The mean age of the subjects was 70.1 ± 8.5 years (age range: 59-96 years). According to the results, 358 (63.4%) patients were male (Table 1).

Table 2 displays the burn characteristics in

Table 1. Demographic characteristics of the study participants

Characteristics	
Age (years)	70.1 (8.5), range 59-96
Gender n (%)	
Male	358 (63.4)
Female	207 (36.6)
Disease burden n (%)	
No	143 (25.3)
Psychological	128 (22.7)
Internal	294 (52.0)

Table 2. Burn characteristics in the study population

Characteristics	
Burn percentage (%)	19.8 (18.1), range 3-90
Place of accident n (%)	
Home	439 (77.7)
Outdoors	126 (22.3)
Type of burn n (%)	
Hot liquid and steam	145 (25.7)
Gas	150 (26.5)
Flame	81 (14.3)
Chemical substance	23 (4.1)
Petrol and Petroleum	96 (17.0)
Others	70 (12.4)
Burn sites n (%)	
Face/neck	17 (3.0)
Trunk	34 (6.0)
Hand/foot	21 (3.7)
Hand	58 (10.3)
Foot	180 (31.9)
Total body	255 (45.1)

the participant. The mean burn surface was 19.8 ± 18.1 (range: 3-90). Furthermore, the results demonstrated that 439 (77.7%) burn incidences had occurred at home. In addition, 50% of the burn injuries were caused by hot water/steam and gas explosion. The majority of the participants (45%) had total body burns, and 32% of the cases were foot burns.

About one third of the subjects required fasciotomy and grafting. The maximum number of surgeries and length of hospital stay were 6 and 120 days, respectively (Table 3). However, 124 (21.9%) subjects did not survive.

The results of the multivariate logistic regression (Table 4) on the survival status of the burn patients demonstrated that a one-year increase in age ($P < 0.001$) and a 1% increase in burn percentage ($P < 0.001$) were associated with a 10% increase in mortality risk. Those with internal diseases had a better survival chance, compared to those with psychological illnesses or without any disease. Flame burns had a higher mortality risk, whereas the total body burn injuries had a borderline significance in this regard. Additionally, the best therapeutic approach for burn injuries with the lowest mortality (3.2%) was grafting/flap/amputation, followed by fasciotomy/grafting (7.4%) (OR=2.0, 95% CI: 0.5-8.7).

Table 3. Burn outcomes in the study participants

Characteristics	
Treatment n (%)	
No	153 (27.1%)
Fasciotomy	113 (20.0)
Debridement	21 (3.7)
Grafting	87 (15.4)
Flap	1 (0.2)
Amputation	5 (0.9)
Fasciotomy and debridement	9 (1.6)
Fasciotomy and grafting	176 (31.2)
Number of surgeries	1.23 (1.0), range: 0-6
Length of hospital stay (days)	12.9 (11.0), range: 0-120
Survival n (%)	
Dead	124 (21.9)
Alive	441 (78.1)

Table 4. Unadjusted and adjusted predictors of mortality

	Alive (n = 441)	Dead (n = 124)	Unadjusted		Adjusted	
			OR (95% CI)	P-value	OR (95% CI)	P-value
Age Mean (SD)	69.5 (8.2)	72.3 (9.3)	1.04(1.01 – 1.06)	0.001	1.1 (1.09 – 1.19)	<0.001*
Gender						
Male	276 (77.1%)	82 (22.9%)	1.2 (0.8 – 1.8)		0.8 (0.4 – 1.6)	0.565
Female	165 (79.7%)	42 (20.3%)	1.0	0.470	1.0	
Disease Burden						
No	103 (72.0%)	40 (28.0%)	6.0 (3.3 – 10.9)	<0.001	9.9 (3.9 – 24.0)	<0.001*
Psychological	62 (48.4%)	66 (51.6%)	16.3 (9.0 – 29.4)	<0.001	13.1 (5.2 – 33.0)	<0.001*
Internal	276 (93.9%)	18 (6.1%)	1.0		1.0	
Burn % Mean (SD)	14.1 (9.7)	40.0 (25.3)	1.1(1.08 – 1.13)	<0.001	1.1 (1.07 – 1.13)	<0.001*
Place of accident						
Home	338 (77.0%)	101 (23.0%)	1.3 (0.8 – 2.2)		1.2 (0.6 – 2.6)	0.602
Outdoor	103 (81.7%)	23 (18.3%)	1.0	0.257	1.0	
Type of Burn						
Scald	128 (88.3%)	17 (11.7%)	1.4 (0.5 – 3.8)	0.485	1.5 (0.5 – 5.8)	0.585
Gas	105 (70.0%)	45 (30.0%)	4.6 (1.8 – 11.3)	0.001	1.7 (0.5 – 6.3)	0.433
Flame	55 (67.9)	26 (32.1)	5.0 (1.9 – 13.1)	0.001	5.6 (1.4 – 22.3)	0.014*
Chemical	20 (87.0)	3 (13.0)	1.6 (0.4 – 7.0)	0.532	2.3 (0.3 – 16.0)	0.392
Petrol	69 (71.9)	27 (28.1)	4.2 (1.6 – 10.8)	0.003	2.0 (0.5 – 8.3)	0.336
Others	64 (91.4)	6 (8.6)	1.0		1.0	
Burn Site						
Hand/Foot	18 (85.7%)	3 (14.3%)	2.7 (0.5 – 14.4)	0.255	5.0 (0.5 – 48.7)	0.164
Hand	48 (82.8%)	10 (17.2%)	3.3 (0.9 – 12.9)	0.081	5.7 (0.9 – 35.3)	0.060
Foot	162 (90.0)	18 (10.0)	1.8 (0.5 – 6.3)	0.372	3.0 (0.5 – 16.0)	0.209
Total body	165 (64.7)	90 (35.3)	8.7 (2.6 – 28.8)	<0.001	5.2 (1.01 – 26.2)	0.048*
Face/neck/trunk	48 (94.1)	3 (5.9)	1.0		1.0	
Burn Treatment						
No	88 (62.0%)	54 (38.0%)	16.8 (5.1 – 55.7)	<0.001	15.0 (3.5 – 63.6)	<0.001*
Fasciotomy/ Scartomy	69 (61.1%)	44 (38.9%)	19.1 (5.7 – 64.2)	<0.001	19.2 (4.6 – 79.8)	<0.001*
Debridement	15 (71.4)	6 (28.6)	12.0 (2.7 – 53.2)	0.001	27.8 (3.6 – 214.0)	0.001*
Fasciotomy/ Debridment	6 (66.7)	3 (33.3)	15.0 (2.5 – 90.8)	0.003	21.0 (2.3 – 191.0)	0.007*
Fasciotomy/ Grafting	163 (92.6)	13 (7.4)	2.4 (0.7 – 8.6)	0.182	2.0 (0.5 – 8.7)	0.364
Grafting/flap/ amputation	90 (96.8)	3 (3.2)	1.0		1.0	

Note: OR=1.0 is the reference category; significant at $P<0.05$

Discussion

As the findings of this study revealed, the mortality rate of the elderly patients with burn injuries was 21.9%. The rate of death due to burns was found to have a significant relationship with age, burn percentage, and history of previous diseases. Burn injuries have a high prevalence in Iran and are

a major cause of mortality in this country (10). Regarding the growing population aging in Iran, it is expected to observe an increase in the number of elderly patients as well (13).

The patients suffering from burns are in need of a lot of care services, which must be provided

by the health centers and caregivers. They also need special trainings because most of them are inflicted with some types of underlying diseases, have no tendency to participate in the trainings, incline to live alone, and use complex electrical devices (10). According to various studies, the percentage of deaths due to burns in this age group range within 7.4-66%; moreover, in most cases, the mean mortality rate has been reported to be 30% (7, 14-18).

Burn has a very overwhelming effect on the elderly owing to several factors, such as the underlying conditions of the elderly and the difficulties in the rehabilitation of this age set as compared with the young people (7, 14). This phenomenon can be also attributed to the weakness of the defense mechanism of this population against accidents (i.e., susceptibility and lower rate of mobility), skin atrophy due to the loss of fluids, poor nutrition, vulnerability to underlying and opportunistic infection, and increased level of stress (19, 20).

After the first experience of burn injury, the symptom of underlying diseases is exacerbated, the skin healing process is weakened, and the patients' desire to cooperate with physicians is lost; as a result, the burn patients become more vulnerable (20). The people with burn injuries require a long-term and inclusive rehabilitation process (21). According to the findings of this study, the prevalence of burn injuries in the elderly men was about two times higher than that in the elderly women. This finding is consistent with the results of other studies (10, 22, 23).

Nevertheless, the prevalence of recurrent burns was higher in the elderly women, which might be due to the fact that men get better experience when dealing with burns. Nonetheless, it should be noted that in this study, gender was not proved to be a predictor of survival rate, which is in line with the results of a study conducted by Albornoza et al. (2011) (2).

In the present study, there was a significant relationship between the history of diseases and the rate of death due to burns (the odds of survival was raised by 13.59 fold), which is inconsistent with

the findings of other studies (16, 24). Nevertheless, in the mentioned studies, many elderly patients with burn injuries had been already affected by cardiovascular diseases and diabetes. Mc Campbell et al. showed that mortality (2%) did not differ significantly between the diabetic and non-diabetic cohorts in all age groups (25).

The infection rate among the burned people was significantly higher in the diabetic patients (who also had significantly higher number of full-thickness burn injuries), compared to the non-diabetic cases. A recent study investigated the comorbidities among a national sample of over 30,000 burned people in all age groups in the United States. In the mentioned study, it was revealed that various illnesses, such as cardiovascular diseases, were associated with increased mortality or length of stay, (26).

In line with other studies, it was suggested that the type of surgery (i.e., fasciotomy and debridement) could increase the odds of survival in the elderly patients with mild, moderate, and severe degrees of burn (20, 27, 28). Yin et al. (2009) showed a weak relationship between the type of surgery and the reduced risk of mortality in the critical burns (24). However, appropriate surgical measures must be adopted timely and proportional to the general condition of the patient (29).

Based on the findings of this study, with the annual increase of burn accidents among the elderly patients, the odds ratio of survival was reduced by 1.13 times. McGwin et al. (2003) conducted a retrospective study over 25 years and reported that the odds ratio of death due to burns significantly increased with the elevation of burn injuries in the elderly patients (30).

Regarding the accident location, our study demonstrated that burn injuries mainly occur at home followed by workplace, which is in accordance with the findings of other reporters (23, 31). Community surveys in Bangladesh and Ethiopia revealed that 80-90% of the burns occur at home. The women are usually burned in domestic kitchens by receptacles containing hot liquids, flames, or cook stove explosions. However, no significant relationship was

observed between the accident location and mortality rate.

Limitations of the study

One of the most important limitations of the present study was the lack of access to more comprehensive data in Iran, which prevented us to conduct further precise investigations and present the findings more assertively.

Recommendations for future studies

It is suggested to conduct more inclusive studies in the future. Many industrialized countries have managed to significantly decrease the rate of mortality due to burn injuries. Several factors, such as improvement of standards of living, trauma management, and availability of essential supplies at the time of crisis play a major role in the accomplishment of this goal. In a country like Iran, despite the efforts that have been made so far, it is necessary to make serious efforts and take effective measures in this field. According to the WHO, the rate of deaths due to burns can be easily reduced through alleviating the severity of the burns and training the people to manage trauma (32). Some of the suggested measures to be adopted are as follows:

- Enhancement of the safety of electrical heater appliances
- Installation of fire alarms, fire extinguishers, and fire controllers in the public places, schools, and homes
- Implementation of proper training for the police, teachers, and families about the use of first aid techniques for the treatment of burn patients (e.g., the use of cold water after burns)
- Provision of the most modern assistive devices and equipment for the intensive care units (for burn patients) to reduce the risk of patient mortality

Conclusion

In general, this study identified and presented

suitable factors for the estimation of the mortality rate due to burn injuries and its related predictive factors. The mortality rate was 21.9% in the 565 patients investigated in this study. Several factors, such as surgery, no history of disease, age, and burn percentage, were identified as the predictive factors for survival rate of the elderly with burn injuries. Therefore, it seems essential to develop prevention strategies for burns among the elderly population.

Conflicts of interest

The authors have declared no conflicts of interest.

Authors' contributions

All authors equally contributed to the writing of the scientific proposal, data collection, and manuscript drafting. The final manuscript was reviewed and approved by all the authors.

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