Original Article

Social and Medical Determinants of Burn-Related Mortality in Isfahan, Iran

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Abstract

Background: Burns and heat-related injuries often lead to mortality and great financial and social costs. This study aimed at investigating the social determinants of burn-related mortalities in a burn specialized hospital in Isfahan, Iran. **Materials and Methods:** This cross-sectional data secondary analysis study was conducted through the data related to burn patients hospitalized to burn specialized Imam Musa Kazim hospital, Isfahan, Iran, in a 4-year period. The data were extracted using Hospital's Information System, and analyzed descriptively and inferentially. **Results:** Among 3290 burn patients, 740 (22.49%) had passed away. The highest mortality percentage was observed in women (31.1%), aged higher than 60 years old (35.8%), in patients with low-financial status (27.4%), patients come from cities other than Isfahan (25.4%), and in Total Burn Surface Area (TBSA) of higher than 71% (86.6%). The results of logistic regression test showed that burn-related mortality is 50% lower in men compared to women (odds ratio [OR] = 0.50), 16% lower in 41-60 years of age group compared to over 60 years of age group (OR = 0.16), 41% higher in people with low financial status compared to those with high financial status (OR = 1.41) and 4% lower in people with 31–70 TBSA compared to those with TBCA higher than 71% (OR = 0.04). **Conclusion:** Burn-related mortality could be associated with treatment and health care as well as social factors. Therefore, parallel to hospital care and physical conditions of the burn patients, social factors including gender, age, income level, and place residence need to be addressed in burn policies to reduce burn-related mortalities.

Keywords: Burns, hospital, mortality, social factors

Introduction

Burns and heat-related injuries are one of the main medical and health-related problems around the world especially in developing countries which can result in mortality, long-term disabilities and great financial and social costs for patients and their families at a microeconomic as well as the macroeconomic levels.[1] More than 90% of burn-related mortalities worldwide occur in low-income countries with fewer preventive programs and low-quality of burn treatment.[2] According to the statistics published by the World Health Organization (WHO) in 2011, annually more than 300,000 people lose their lives to burn-related injuries, 95% of which occur in low- and medium-income countries.[3] In general, the mortality rate of burn-related injuries in developing countries is around 2.1 for every 100 thousand individuals.[4] In the year 2016 in the United States, the rate of burn-related mortality was reported to be 1.02 for every 100 thousand individuals[5] though this number is equal to 3.8 for every 100 thousand individuals in

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Iran.[6] This indicates that burn statistics is relatively high in Iran compared to developed countries. Studies have shown that if burn victims manage to survive their injuries, they will be faced with several physical and psychological problems which can influence facets of their lives and might lead to disabilities and adverse effects on their quality of life.[7]

Various factors influence the mortality rate of burn-related injuries some of which are the "social determinants." These factors including income level, education, occupation, nutrition, and social class are more likely to be the cause of medical conditions compared to biological factors; this way, they can play an important role in individuals' health condition. Discounting these factors makes it difficult to specify desirable criteria for a proper health-care system.[8]

Epidemiological studies regarding the causes for burn-related injuries indicate that burns and related mortality is a social.[9] These studies indicate that burn-related injuries are more common among poor people with lower education and low-income levels who are working at low-level jobs and live in inappropriate accommodations.[10] In other words, people form lower social status are more at risk of burn-related injuries compared to people from higher social status. Therefore, it is possible to explore burns and related mortality from the standpoint of individuals' social determinants.

Continuous risky behaviors and increase in burn-related mortality denote that it seems necessary to provide policy-makers with preventive strategies, factors affecting these mortalities as well as proper feedback on the issue. Furthermore, seeing as the risk factors and burn-related mortalities vary in different countries and regions due to the heterogeneity in social, financial, and cultural factors, it seems important to explore the social determinants as well as medical factors of burn-related mortalities in each country. It seems that, in Iran, no far-reaching studies have been carried out to explore social and medical factors of burn related mortality, simultaneously. Accordingly, the aim of this study is to explore the social and medical determinants of burn-related mortality in Iran. The results of this study can pave the way for the health policy-makers and health-care managers to develop apposite burn programs.

Materials and Methods

Setting

Isfahan is one of the metropolitan cities located in central Iran. Imam Musa Kazim hospital is the only specialized treatment center for burn-related injuries in central of Iran which delivers specialized services to a population of more than 5 million. This hospital, as one of the largest specialized centers for the treatment of burn-related injuries in Iran, admits around 2000 outpatient and inpatient burn cases annually.

Data

This study is a cross-sectional data secondary analysis which employs recorded data of 3290 burn patients admitted to Imam Musa Kazim Hospital in a 4-year period (viz., from March 2014 to March 2017). The necessary data were extracted from Health Information System (HIS) of the hospital and underwent the secondary analysis after preparation. The sampling was done through census method and all admitted patients except restorative and plastic surgery patients were included in the study.

Definition of the variables

Social variables were selected based on the WHO framework of social determinants of health introduced by Solar and Irwin.[11] These variables include admission year, age, gender, occupation, education, marital status, income situation, place of residence, place of residence (urban vs. rural), nationality, religion, location of burn occurrence, and type of insurance.

According to the previous studies[12,13] and data availability, total burn surface area (TBSA), burn degree, and patient's comorbidity situation were selected as medical factors.

As for the income level, the hospital includes a Social Services Unit (SSU) which provides help for patients with financial problems to cover hospitalization costs. Therefore, the amount of discount received from (SSU) of the hospital was used as a benchmark for income status of the patients. In other words, patients who received no discounts were placed in high-income category, those who received two discounts were placed in the middle-income category and those who received more than 2 discounts were placed in the low-income category.[12] For the TBSA, patients were divided into three categories of 30≥, 31–70, and 71≤ based on Lund and Browder chart.[14] The patient's comorbidity situation refers to burn patients accompanied by hypertension, diabetes, cancer, cardiovascular disease, and other chronic problems.

Statistical analysis

Data analysis was done after data preparation through STATA/SE (version 14; Stata Corporation, College Station, TX, USA) at both descriptive (frequency and percentage) and inferential (univariate and multivariate Logistic Regressions) levels. In the first stage, all variables were entered into the univariate regression model and variables, which failed to gain the necessary significance level ($P \leq 0.1$)[15] were eliminated from the very final model. The remaining variables were then employed in the multivariate regression model for analysis. This study also employed the Pearson Chi-square test to determine the fitting of the model and the Pseudo R^2 was used to measure the predictive power of the model.

Ethical considerations

All personal information and names remained confidential. Required permits were received from Research Ethics Committee of Isfahan University of Medical Sciences (ethics code of No: IR.MUI.REC.1396.3.760).

Results

From a total of 3290 patients hospitalized during the 4-year period, 740 patients (22.49%) passed away [Table 1].

Table 1: Frequency and percentage of mortality in hospitalized burn patients in burn specialized Imam Musa Kazim hospital between years 2014 and 2017

Variable	Frequency (%)
Burn-related mortality	
Yes	740 (22.49)
No	2550 (77.51)
Total	3290 (100)

As shown in Table 2, the largest numbers burn-related mortalities occurred in year 2014 (23.4%), in women (31.1%), in patients older than 60 years of age (35.8%), in married patients (27.8%), in individuals with high school diploma (26.7%), in low-income individuals (27.4%), in homemakers (39.9%), in Iranian nationals (22.9%), Shia patients (22.5%), patients from other provinces than Isfahan (35.4%), from rural areas (26.7%), with third degree burns (22.8%), with more than 71% TBSA (86.6%), patients with comorbidities (28.7%), patients using the Iranian health insurance (27.6%) and those who had suffered burns in their homes (24%).

The results of univariate regression analysis between burn-related mortality and investigated variables in patients hospitalized in burn specialized Imam Musa Kazim Hospital between years 2014 and 2017 are shown in Table 3. Based on the significance of error below 0.1, it is possible to say that there were no significant statistical associations between burn-related mortality and hospitalization year ($P = 0.823$), religion ($P = 0.517$), occupation ($P = 0.635$), and insurance type ($P = 0.444$).

The results of multivariate logistic regression as a final model are shown in Table 4. Seeing as the significance of error level below 0.05, it could be concluded that there was a significant relation between burn-related mortality and gender ($P \leq 0.001$) with men being nearly 50% less likely to die due to burn-related injuries. The results also indicated that there was a significant statistical relation between burn-related mortality and all age groups ($P \leq 0.001$) with individuals under 40 years old being 7% and people between 41 and 60 years old being 16% less likely to die due to burn compared to individuals older than 71 years old. Results regarding the income level indicated that there was a significant statistical relation between patients' income level and burn-related mortality. The results of odds ratios (ORs) showed that compared to high-income patients, those from middle-income and low-income families have 13% and 41% higher probability of dying due to burn-related injuries, respectively. The relation between city of residence and odds of burn-related mortality was also statistically significant ($P \leq 0.001$). OR shows that compared to people admitted from other provinces, individuals living in Isfahan and those living in surrounding counties had 38% and 44% less chance of dying due to burn-related injuries, respectively. The relation between TBSA and mortality was also statistically significant. Individuals with <30% and 31%–70% TBSA were 4% and 0.1% less likely to die due to burn-related injuries compared to those with TBSA higher than 71%.

Other variables including education, marital status, and place of residence, nationality, burn degree, medical conditions, and location of the accident had no significant relations to burn-related mortality.

Based on the results of pseudo-coefficient of determination test (0.48), it could be said that variables investigated in the logistic regression model explained 48% of the total variance of burn-related mortality. Furthermore, the significance of Pearson Chi-square test ($P > 0.05$) showed that the model had good fitting on the data.

Discussion

This study was carried out to explore the social and medical determinants of burn-related mortality in burn specialized Imam Musa Kazim in Isfahan (the only specialized treatment center for burn-related injuries in Isfahan). The percentage of burn mortality observed in the this study (22.49%) was lower than the results reported in studies by Wardhana *et al*., in Indonesia (24%)[16] and by Batra in India (23.3%)[17] but was higher than the result reported by Theodorou in Germany (17%).[18] The results also indicated that gender, age, income level, city of residence, and TBSA had significant relations with burn-related mortality.

The results indicated that there is a significant relation between burn-related mortality and gender. Although burn-related injuries are more common in men compared to women, women are two times more likely to die due to burn-related injuries. This can be due to their inattention to safety precautions while working in homes, especially in kitchens. Furthermore, suicide studies in Iran have indicated that the rate of self-immolation is higher in women compared to men.[19] Another reason for this can be lower physical resistance of women against infections resulting from burn-related injuries. Likewise, several other studies have shown that female gender is associated with a higher risk of mortality.[20] The results of other studies in Iran,[21] India,[20] Iraq,[22] and Bangladesh[23] also support the results of this study.

Results regarding the association between burn-related mortality with age indicate that the odds of burn-related mortality increases with age. The importance of age in patient mortality is related to the performance of their immune system. It is an accepted fact that the performance of body's immune system is weaker in older individuals; that is to say, they have a very low chance of healing their burn-related injuries which can play an important role in their mortality. This way, with increase in age and weakening of body's immune system, the likelihood of burn-related mortality increases. These results are corroborated by Wardhana *et al*., in Indonesia,[16] Batra in India[17] and Queiroz *et al*., In Brazil.[24]

The findings show that there is a statistically significant relation between the income level and burn-related mortality;

Table 2: Frequency and percentage of deaths based on investigated variables among patients hospitalized in Imam Musa Kazim hospital of Isfahan between years 2014 and 2017

Variable	Number of patients (percentage)	Mortality (percentage)
Hospitalization year		
2014	891 (27.08)	209 (23.4)
2015	861 (26.17)	185 (21.5)
2016	798 (24.26)	177 (22.2)
2017	740 (22.49)	169 (22.8)
Gender		
Male	2214 (67.29)	405 (18.3)
Female	1076 (32.71)	335 (31.1)
Age		
≤5	591 (17.96)	59 (10)
6-15	251 (7.63)	36 (14.3)
16-25	601 (18.27)	160 (26.6)
26-40	1105 (33.59)	259 (23.4)
41-60	541 (16.44)	154 (28.5)
>60	201 (6.11)	72 (35.8)
Marital status		
Single	1623 (49.33)	278 (17.1)
Married	1642 (49.91)	456 (27.8)
Divorced	9 (0.27)	2 (22.2)
Widowed	16 (0.49)	4 (25)
Education status		
Illiterate	808 (30.42)	149 (18.4)
Elementary	546 (20.56)	139 (25.4)
Middle school	452 (17.02)	97 (21.5)
High school	632 (23.80)	169 (26.7)
University	218 (8.21)	44 (20.2)
Income level		
High	492 (14.95)	57 (11.6)
Middle	1198 (36.41)	245 (20.4)
Low	1600 (48.63)	438 (27.4)
Religion		
Shia	3232 (98.24)	729 (22.5)
Sunni	58 (1.76)	11 (19)
Place of residence		
Urban	2288 (69.54)	472 (20.6)
Rural	1002 (30.46)	268 (26.7)
City of residence		
Isfahan	867 (26.35)	112 (12.9)
Isfahan province	1041 (31.64)	138 (13.2)
Other provinces	1382 (42.01)	490 (35.4)
Occupation		
Unemployed	1140 (34.66)	191 (16.7)
Laborer	712 (21.64)	110 (15.4)
Self-employed	705 (21.43)	168 (23.8)
Housewife	634 (19.27)	253 (39.9)
Office worker	99 (3)	18 (18.2)
Nationality		
Iranian	3147 (95.65)	721 (22.9)
Non-Iranian	143 (4.35)	19 (13.3)
Insurance type		
No insurance	423 (12.86)	89 (21)
Social security	1366 (41.52)	248 (18.1)
Health services	107 (2.25)	26 (24.3)
Armed forces	111 (3.37)	24 (21.6)
Iranian health insurance	1277 (38.82)	352 (27.6)
Private	6 (0.18)	1 (16.7)
Burn degree		
First degree	5 (0.15)	1 (20)
Second degree	50 (1.52)	0 (0)
Third degree	3235 (98.33)	739 (22.8)
TBSA percentage		
≥30	1437 (49.76)	34 (2.1)
31-70	1189 (36.14)	304 (25.5)
71≤	464 (14.10)	402 (86.6)
Comorbidity		
Have	445 (13.53)	128 (28.7)
Not have	2845 (86.47)	612 (21.5)
Location of burn occurrence		
Home	2306 (70.09)	553 (24)
Work	586 (17.81)	104 (17.71)
Public locations	398 (12.10)	83 (20.8)

TBSA: Total burn surface area

people with low- and medium-level incomes being more likely to die due to burn-related injuries compared to high-income individuals. Evidence shows that health status is worse in individuals with lower financial levels.[8] This establishes a social gradient in health, which moves form higher to lower levels of society with each level having a better health status compared to lower levels. This means that the income level of households is directly related to their health situation. Studies from worldwide have shown that differences in disease prevalence in lower-income groups with more deprived individuals being more likely to suffer from chronic conditions while also having a higher change of disability at a younger age and untimely death.[8] For example, in Finland, 42% of people belong to low-income groups suffer from chronic conditions while only 18% of high-income individuals deal with these conditions. There are numerous examples of differences in criteria related to psychological health, cardiovascular conditions, accessibility, and quality of healthcare services based on the income level.[8] Various studies have shown that the occurrence of burns are more common among individuals with lower income compared to those with higher income. The results of the studies done by Soltani *et al*., in Iran,[25] He *et al*., in Bangladesh,[23] Tripathee and Basnet in Nepal[26] and Smolle *et al*.,[9] are in line with the results of this study.

Based on the results, the majority of burn-related mortalities were occurred in burn patients come from other cities rather than Isfahan. It seems that lack of access to a well-equipped

Table 3: Univariate regression between burn-related mortality and investigated variables in burn specialized Imam Musa Kazim hospital during 2014-2017

Variable	Coefficient	OR	*P*	CI (95%)
Hospitalization year	−0.008	0.991	0.823	0.921-1.067
Gender	0.702	2.019	<0.001	1.706-2.389
Age	0.276	1.318	<0.001	1.242-1.400
Marital status	−0.605	0.991	<0.001	0.463-0.642
Education status	0.078	1.081	0.022	1.011-1.156
Income level	−0.109	0.896	0.075	0.794-1.010
Religion	−0.218	0.803	0.517	0.414-1.552
Place of residence	0.339	1.404	<0.001	1.181-1.669
City of residence	0.774	2.170	<0.001	1.931-2.438
Occupation	0.005	1.005	0.635	0.982-1.028
Nationality	−0.662	0.515	0.008	0.315-0.841
Insurance type	0.097	1.102	0.444	0.858-1.415
Burn degree	1.988	7.303	0.005	1.808-29.482
TBSA	2.875	17.740	<0.001	14.336-21.952
Comorbidity	0.387	1.473	0.001	1.175-1.842
Location of burn occurrence	−0.153	0.858	0.015	0.758-0.970

OR: Odds ratio, CI: Confidence interval, TBSA: Total burn surface area

medical center, lack of proper prehospital care for burns, lack of burn trained staffs, and delay in treatment increase the chance of mortality in patients come from other cities.[27] Some of the studies in developing countries show that lack of equal access to quality health care in burns is due to lack of a national strategy and lack of information and limited resources. For example, in India, emergency prehospital services lack a fair distribution and there are significant differences between urban and rural areas as well as among people paying for the services and those using free-charge healthcare.[28] The lack of an appropriate pattern for prehospital care for burns can also be due to lack of proper equipment and trained staff which should also be considered for further development. It appears that it is necessity to improve the referral system to burn specialized hospitals in rural areas and surrounding cities while also providing patients and their families with information regarding the length of treatment and possible complications in health centers. The results of studies in Germany[29] Taiwan[30] also agree with the current results.

The TBSA is one of the medical predictors of patient survival in burns. As can be seen in the results, in higher TBSA percentages, the odds of patient mortality significantly increases. TBSA percentage is calculated based on the burnt locations and relative thickness of the burns. Therefore, higher percentages lead to higher chance of death.[9] There can be two reasons for higher patient mortality at higher TBSA percentages in our study. First, we have to remember that the majority of patients referred to the hospital, especially those from other provinces or cities, have high TBSA percentages and the majority of mortality cases are also form these patients. Furthermore, given the majority of patient mortalities have occurred at TBSA higher than 60% and since based on LA50 (Lethal Area 50) criterion in Iran (the TBSA percentage which leads to patient death in 50% of cases) which is equal to 60%[31] and shows the quality of burn treatment, it is possible to say that patients with TBSA of higher than 60% are more likely to die due to their burn injuries. This shows that the quality of hospital care for burn-related injuries is still relatively low in Iran. These results are similar to the ones reported in Iran[21] and other countries.[10,18,32]

Although unlike studies conducted by Soltani *et al*., in Iran,[25] Chien *et al*., in Taiwan[33] and He *et al*., in Bangladesh,[23] this study revealed no relation between education and burn-related mortalities; the results of descriptive statistics show that the majority of mortalities occur in patients with high school diploma and individuals with university education are less vulnerable to burns and related deaths. This can be due to their higher knowledge regarding risky situations, which help them avoid possible accidents.

One of the strengths of this study was a large sample size and the selection of explanatory variables has been based on an approved and high cited framework.

One of the limitations of this study was lack of access to information because some of the patients have not been registered in HIS. In these cases, the necessary information was extracted by direct viewing of patient records.

Conclusion

Along with their health care and medical aspects, burns and related mortalities also have important social aspects. Therefore, parallel to hospital care and physical condition of the burn patient, social factors including gender, age, income level, and city of residence could be addressed in burn policies to help reduce burn related mortalities. Through

Table 4: Multivariate logistic regression between burn-related mortality and investigated variables in burn specialized Imam Musa Kazim hospital between years 2014 and 2017

Variable	Coefficient	OR	*P*	CI (95%)
Gender				
Male	−0.0696	0.498	<0.001	0.374-0.663
Female	-	1	-	-
Age				
≤40	−2.564	0.076	<0.001	0.038-0.168
41-60	−1.830	0.162	<0.001	0.087-0.295
>60	-	1	-	-
Marital status				
Divorced	-	1	-	-
Married	−0.705	0.493	0.560	0.046-5.298
Single	−0.508	0.601	0.675	0.055-6.488
Widowed	−1.042	0.352	0.490	0.018-6.816
Education				
Illiterate	0.246	1.278	0.434	0.690-2.370
Elementary school	0.375	1.456	0.195	0.824-2.572
Middle school	0.177	1.194	0.550	0.667-2.137
High school	0.252	1.287	0.368	0.743-2.229
University	-	1	-	-
Income level				
High	-	1	-	-
Middle	0.891	1.130	<0.001	1.109-1.541
Low	0.345	1.410	0.025	1.045-1.905
City of residency				
Isfahan	−0.947	0.387	<0.001	0.262-0.571
Isfahan province	−0.813	0.443	<0.001	0.315-0.623
Other provinces	-	1	-	-
Place of residence				
Urban	0.212	1.230	0.154	0.923-1.653
Rural	-	1	-	-
Nationality				
Iranian	0.160	1.173	0.674	0.557-2.471
Non-Iranian	-	1	-	-
Burn degree				
1st and 2nd degree	−1.042	0.443	0.438	0.025-4.903
Third degree	-	1	-	-
TBSA				
≥30	−6.250	0.001	<0.001	0.001-0.003
31-70	−3.210	0.040	<0.001	0.027-0.058
71≤	-	1	-	-
Comorbidity				
Have	-	1	-	-
Not have	−0.249	0.746	0.158	0.497-1.123
Location of burn occurrence				
Home	-	1	-	-
Work	0.057	1.059	0.260	0.728-1.538
Public location	0.237	1.267	0.763	0.839-1.915
Pearson's goodness of fit test			Coefficient of determination	
Pearson χ^2=1481.05			Pseudo R^2=0.486	
P=0.939				

TBSA: Total burn surface area, OR: Odds ratio, CI: Confidence interval

intersectorial collaboration and advocacy from none health-care organizations, addressing social determinants of burn related mortalities, leads to reduce social and economic costs of burns. Furthermore, understanding these social determinants can set the scene for achieving health in all policies.

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Conflicts of interest

There are no conflicts of interest.

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