

## ORIGINAL RESEARCH

# Epiemiologic Features and Hospitalization Cost of Burn Injuries in Iran Based on National Burn Registry; a Cross-sectional Study

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**Abstract:** **Introduction:** Burn is one of the most common causes of injury in the world. The aim of this study was to determine the epidemiologic features and cost of hospitalization associated with burn injuries in Iran. **Methods:** In this cross-sectional study, the data related to hospitalized burn cases in 2017 were obtained from the office of curative affairs in the Ministry of Health and Medical Education of Iran and analyzed regarding the epidemiologic features and hospitalization costs. **Results:** 35933 hospitalized burn patients, from the beginning to the end of 2017, with the mean age of  $29.37 \pm 21.41$  (1 – 99) years were studied (59.4% male). Scald burns (49.4%) were the most prevalent type of burns and 30.3% of burns occurred in spring. The most frequent severity of burn injury was second-degree burns (69.3%) with 1-20 percent involvement of body's surface area (74.7%). Frequency of scald burn was higher in females, while the frequency of flame was higher in males. Total hospitalization cost of studied cases was 66910.22 \$. In male patients, the highest average direct cost was related to electrical burns; while in females, the highest average direct cost was related to chemical burns. Higher degrees and percentages of burn injuries required a more costly treatment. **Conclusion:** Burn injuries most frequently happened in males, ages < 10 years, spring season, and with scald and flame. The most frequent injuries were second-degree burns with 1% – 20% body surface involvement. The highest direct hospitalization cost was related to chemical and electrical burns. There was a direct correlation between the degree and percentage of burn and the hospitalization costs.

**Keywords:** Burns; costs and cost analysis; epidemiology; accident prevention

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## 1. Introduction

Burn injuries and their related outcomes are major causes of mortality and disability in Iran and all over the world (1). Globally, about 195,000 deaths per year are attributed to burn injuries (2). Burn care is generally considered an expensive care (3) and this statement is clearly expressed in some recent studies (4-7). In Iran, burn injuries have ranked thirteenth in the burden of disease. They are among the top twenty outcomes with the highest rates of mortality and disability (8). In general, most burns occur in developing countries with

low or medium incomes (9) with more than half of them happening in Asia (10). The extent, severity, and degree of burns are the most important predictors of death in burn injuries (11). Various risk factors of mortality have been reported in different studies such as age under 4 and over 65 years (12, 13), male gender (14), poverty (15), crowding (16) and so on. Awareness of socioeconomic differences in the epidemiology of burning and recognition of etiological patterns of burn injuries could be useful in planning and adopting prevention strategies (17). The aim of this study was to determine the epidemiologic features and hospitalization cost of burn injuries in Iran.

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## 2. Methods

### 2.1. Study design and setting

This cross-sectional study was conducted on data of all burn patients that attended burn wards of hospitals affiliated to any of the Universities of Medical Sciences in Iran, throughout 2017. The study protocol was approved by the local Human Subject Review Board in Islamic Azad University, North Tehran Branch.

### 2.2. Participants

All burn patients whose data were collected in the burn registry database throughout 2017 were evaluated. There was not any gender or age limitation.

### 2.3. Data gathering

Data were obtained as a Microsoft Excel file, from data registry of burn patients in office of curative affairs, Ministry of Health and Medical Education. All physicians in charge of burn patients were trained for filling out the related data forms. Data were compiled and checked for duplicate entries at the burn units in each hospital and were then sent to the deputy of curative affairs on a monthly basis. Data included age, gender, reporting medical university, duration of hospitalization, season, burn severity (degree and percentage), cause, and the total cost of each burn injury.

### 2.4. Statistical Analysis

All the statistical analyses were conducted using SPSS, version 21 (IBM Inc., Armonk, NY, USA). Qualitative variables were presented as absolute frequency and percentage. Quantitative measures were expressed using mean and standard deviation. We used the t-test and analysis of variance (ANOVA) to compare the mean values of various continuous variables in different groups/categories. Chi-square test was used to compare categorical data. P values less than 0.05 were regarded as statistically significant.

## 3. Results

35933 hospitalized burn patients, from the beginning to the end of 2017, with the mean age of  $29.37 \pm 21.41$  (1 – 99) years were studied (59.4% male). Baseline characteristics of studied cases are presented in table 1. Scald burns (49.4%) were the most prevalent type of burns and 30.3% of burns occurred in spring. The most frequent severity of burn injury was second-degree burns (69.3%) with 1-20 percent involvement of body's surface area (74.7%).

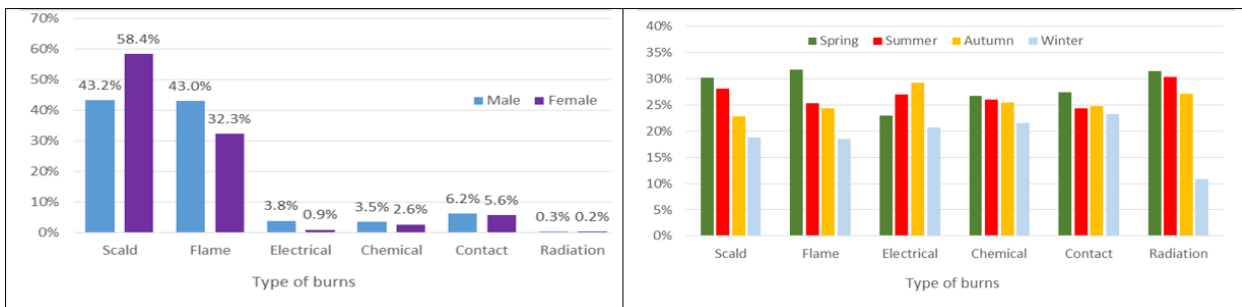
Analyses showed that the absolute number and percentage of scald burn during the study period was higher in females [8515 (58.4%) versus 9234 (43.2%); figure 1]; while the absolute number and percentage of flame burn in males

**Table 1:** Baseline characteristics of studied burn cases

Characteristics	Number (%)
<b>Gender</b>	
Male	21354 (59.4)
Female	14575 (40.6)
<b>Age (year)</b>	
<9	9321 (25.9)
10-19	3572 (9.9)
20-29	6352 (17.7)
30-39	6588 (18.3)
40-49	3833 (10.7)
50-59	2863 (8.0)
≥60	3404 (9.5)
<b>Season</b>	
Spring	10901 (30.3)
Summer	9597 (26.7)
Autumn	8571 (23.9)
Winter	6864 (19.1)
<b>Type of burns</b>	
Scald	17749 (49.4)
Flame	13890 (38.7)
Electrical	936 (2.6)
Chemical	1120 (3.1)
Contact	2146 (6.0)
Radiation	92 (0.3)
<b>Degree of burns</b>	
Burn I	2121 (5.9)
Burn II	21912 (69.3)
Burn III	8634 (24.0)
Burn IV	266 (0.7)
<b>Body's surface (%)</b>	
1-10	1627 (44.6)
11-20	10809 (30.1)
21-30	2961 (8.2)
31-40	3135 (8.7)
41-50	1289 (3.6)
>50	1712 (4.8)

was higher than females [9188 (43.0%) versus 4702(32.3%)]. Burns due to any of the studied causes had happened most frequently in spring (30.3%) and least frequently in winter (19.1%), except for electrical burns, which had happened most frequently in autumn.

Total hospitalization cost of studied cases was 66910.22 \$. Table 2 shows the distribution of hospitalization costs associated with burns according to gender in Iran in 2017. In males, the highest average direct cost was related to electrical burns; while in females, the highest average direct cost was related to chemical burns. Also, a direct relationship was observed between the degree and percentage of burn and the costs associated with treating patients in both genders. In other words, higher degrees and percentages of burns required a more costly treatment.



**Figure 1:** Distribution of burn injuries based on gender and season.

**Table 2:** Hospitalization cost of burn injuries in Iran, throughout 2017, based on different baseline variables

Variable	Total	Male Direct cost* (%)	Female Direct cost (%)	P
<b>Age (years)</b>				
<9	9040.55	6559.32 (18.83)	2481.23 (7.74)	0.001
10-19	5885.46	2591.18 (7.44)	3294.28 (10.27)	0.001
20-29	5879.94	2863.95 (8.22)	3015.99 (9.40)	0.209
30-39	8268.35	3945.34 (11.33)	4323.01 (13.48)	0.011
40-49	12115.43	5908.98 (16.96)	6206.45 (19.35)	0.234
50-59	14493.73	8193.67 (23.52)	6300.06 (19.64)	0.001
≥60	11226.76	4770.35 (13.69)	6456.41 (20.13)	0.001
<b>Type of burns</b>				
Scald	7928.54	4407.12 (13.34)	3521.42 (4.57)	0.001
Flame	9686.11	4991.39 (15.11)	4694.72 (6.10)	0.019
Electrical	60510.55	6541.89 (19.81)	53968.66 (70.11)	0.097
Chemical	13811.43	6219.64 (18.83)	7591.79 (9.86)	0.003
Contact	9554.34	5447.21 (16.49)	4107.13 (5.34)	0.001
Radiation	8518.29	5420.71 (16.41)	3097.58 (4.02)	0.094
<b>Degree of burns</b>				
Burn I	5685.83	4093.76 (13.38)	1592.07 (5.33)	0.001
Burn II	7319	4176.13 (13.65)	3142.87 (10.52)	0.001
Burn III	13657.8	6666.17 (21.78)	6991.63 (23.40)	0.035
Burn IV	33826.95	15668.70 (51.20)	18158.25 (60.76)	0.017
<b>Body's surface (%)</b>				
1-10	4604.89	2659.17 (6.25)	1945.72 (4.64)	0.001
11-20	11093.89	6440.27 (15.14)	4653.62 (11.10)	0.001
21-30	4121.14	2021.15 (4.75)	2099.99 (5.01)	0.487
31-40	9336.35	4446.86 (10.45)	4889.49 (11.67)	0.003
41-50	19390.56	9863.61 (23.19)	9526.95 (22.73)	0.134
>50	35897.7	17104.72 (40.21)	18792.98 (44.84)	0.001

\* Mean direct costs in US dollars (% of total cost).

### 4. Discussion

Based on the findings of the present study, burn injuries most frequently happened in males, ages < 10 years, spring season, and with scald and flame. The most frequent injuries were second-degree burns with 1% – 20% body surface involvement. The highest direct hospitalization cost was related to chemical and electrical burns. There was a direct correlation between the degree and percentage of burn and the hospitalization costs. Burn injury is an important cause of hospital admission (18). Previous studies conducted in USA (19), Iran (20), and Portugal (21) concluded that burn injury is a sig-

nificant source of morbidity and mortality in children. The results of the present study demonstrated that the incidence of burns was higher in children under the age of 10 years compared to other age groups, which is in line with the findings of previous studies (22, 23). Males were more affected by burns than females. The Predominant involvement of males in burn injuries was also reported by other published studies (24, 25). Low average age in our study is due to a higher incidence of accidents in boys, especially in the school-age period. Our findings regarding the most frequent type and season of burns were in line with some previous studies (22,



26). Scald [49.4 %,  $p < 0.001$ ] and flame [38.7 %,  $p < 0.001$ ] were predominant causes of burns among all patients (both genders) hospitalized due to burn injuries. We found that a high percentage of burns over the course of the present study (except electrical burns) occurred in the spring season, while the frequency of these causes decreased in the winter season. Contradictions exist between various studies regarding the distribution of leading causes of burns. These differences are mostly due to the differences in study method, the society under study, cultural and economic differences, lifestyle, and geographic location. Our results revealed that electrical burns had the highest frequency in males, while chemical burns were the most common type of burns among females. We also observed a direct positive relationship between the degree and percentage of burn increases and costs associated with treating patients. We believe that this evidence should be taken into account to prevent and reduce the burden of burn injuries. In summary, our findings in the current study can contribute to development of a prevention program to protect the population from burn injuries and the findings can also help prepare public and specific targeted interventions to promote safe behavior.

## 5. Limitation

Some limitations were recognized in our study. Given that the data from this study were extracted from the Microsoft EXCEL sheet provided by curative affairs associated with Ministry of Health and Medical Education of Iran in 2017, there were no details about the type of liquids or other sources or causes of burns. Also, there was no information about the final outcome (death or survival) of patients with a burn.

## 6. Conclusion

Based on the findings of the present study, burn injuries most frequently happened in males, ages < 10 years, spring season, and with scald and flame. The most frequent injuries were second-degree burns with 1% – 20% body surface involvement. The highest direct hospitalization cost was related to chemical and electrical burns. There was a direct correlation between the degree and percentage of burn and hospitalization costs.

## 7. Appendix

### 7.1. Acknowledgements

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### 7.2. Author contribution

Substantial contributions to conception and design, acquisition of data or analysis and interpretation of data, drafting the article and final approval of the version to be published: Reza Rezaee, Khalil Alimohamadzadeh and Seyed-Mojtaba Hosseini.

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### 7.4. Conflict of interest

The authors declare that there is no conflict of interest.

## References

- Zvizdic Z, Becirovic K, Salihagic S, Milisic E, Jonuzi A, Karamustafic A. Epidemiology and clinical pattern of paediatric burns requiring hospitalization in Sarajevo Canton, Bosnia and Herzegovina, 2012-2016. *Annals of burns and fire disasters*. 2017;30(4):250.
- Mock C, Peck M, Krug EG, Haberal MA. Confronting the global burden of burns: a WHO plan and a challenge. *Burns: journal of the International Society for Burn Injuries*. 2009;35(5):615-7.
- Hop MJ, Polinder S, van der Vlies CH, Middelkoop E, van Baar ME. Costs of burn care: a systematic review. *Wound repair and regeneration*. 2014;22(4):436-50.
- Alinia S, Rezaei S, Daroudi R, Hadadi M, Sari AA. Extent, nature and hospital costs of fireworks-related injuries during the Wednesday Eve Festival in Iran. *Journal of injury and violence research*. 2013;5(1):11.
- Austin RE, Schlagintweit S, Jeschke MG, MacDonald R, Aghari M, Shahrokhi S. The cost of burn transfers: a retrospective review of 7 years of admissions to a regional burn center. *Journal of Burn Care & Research*. 2018;39(2):229-34.
- Nygaard RM, Endorf FW. Frostbite vs Burns: Increased Cost of Care and Use of Hospital Resources. *Journal of Burn Care & Research*. 2018;39(5):676-9.
- Rezaeian S, Ahmadzadeh J, Esmailnasab N, Veisani Y, Shayan M, Moradi N. Assessment of health and nutritional status in children based on school screening programs. 2014.
- Naghavi M, Abolhassani F, Pourmalek F, Lakeh MM, Jafari N, Vaseghi S, et al. The burden of disease and injury in Iran 2003. *Population health metrics*. 2009;7(1):9.



9. Dave DR, Nagarjan N, Canner JK, Kushner AL, Stewart BT, Group SR. Rethinking burns for low & middle-income countries: differing patterns of burn epidemiology, care seeking behavior, and outcomes across four countries. *Burns*. 2018;44(5):1228-34.
10. Tripathee S, Basnet SJ. Epidemiology and outcome of hospitalized burns patients in tertiary care center in Nepal: Two year retrospective study. *Burns Open*. 2017;1(1):16-9.
11. Sen S, Heather J, Palmieri T, Greenhalgh D. Tracheostomy in pediatric burn patients. *Burns*. 2015;41(2):248-51.
12. Wanjeri JK, Kinoti M, Olewe TH. Risk factors for burn injuries and fire safety awareness among patients hospitalized at a public hospital in Nairobi, Kenya: A case control study. *Burns*. 2018;44(4):962-8.
13. Ward J, Phillips G, Radotra I, Smailes S, Dziewulski P, Zhang J, et al. Frailty: an independent predictor of burns mortality following in-patient admission. *Burns*. 2018;44(8):1895-902.
14. Waqas A, Turk M, Naveed S, Amin A, Kiwanuka H, Shafique N, et al. Perceived social support among patients with burn injuries: A perspective from the developing world. *Burns*. 2018;44(1):168-74.
15. Alnababtah K, Khan S, Ashford R. Socio-demographic factors and the prevalence of burns in children: an overview of the literature. *Paediatrics and international child health*. 2016;36(1):45-51.
16. Harats M, Peleg K, Givon A, Kornhaber R, Goder M, Jaeger M, et al. Burns in Israel, comparative study: Demographic, etiologic and clinical trends 1997–2003 vs. 2004–2010. *Burns*. 2016;42(3):500-7.
17. Rybarczyk MM, Schafer JM, Elm CM, Sarvepalli S, Vaswani PA, Balhara KS, et al. Prevention of burn injuries in low-and middle-income countries: a systematic review. *Burns*. 2016;42(6):1183-92.
18. Arifi H, Ahmeti H, Zatriqi V, Buja S, Rexhaj Z, Arifi N. Epidemiology of burn injuries in Kosovo: a 10-year review. *Annals of burns and fire disasters*. 2017;30(3):163.
19. Strobel AM, Fey R. Emergency care of pediatric burns. *Emergency medicine clinics of North America*. 2018;36(2):441-58.
20. Kazemzadeh J, Vaghardoost R, Dahmardehei M, Rabiipoor S, Farzan R, Kheiri AA, et al. Retrospective epidemiological study of burn injuries in 1717 pediatric patients: 10 years analysis of hospital data in Iran. *Iranian journal of public health*. 2018;47(4):584.
21. Santos JV, Viana J, Oliveira A, Ramalho A, Sousa-Teixeira J, Duke J, et al. Hospitalisations with burns in children younger than five years in Portugal, 2011–2015. *Burns*. 2019.
22. Lee CJ, Mahendraraj K, Houg A, Marano M, Petrone S, Lee R, et al. Pediatric burns: a single institution retrospective review of incidence, etiology, and outcomes in 2273 burn patients (1995–2013). *Journal of Burn Care & Research*. 2016;37(6):e579-e85.
23. Elsous A, Ouda M, Mohsen S, Al-Shaikh M, Mokayad S, Abo-Shaban N, et al. Epidemiology and outcomes of hospitalized burn patients in Gaza Strip: a descriptive study. *Ethiopian journal of health sciences*. 2016;26(1):9-16.
24. Moehrlen T, Szucs T, Landolt MA, Meuli M, Schiestl C, Moehrlen U. Trauma mechanisms and injury patterns in pediatric burn patients. *Burns*. 2018;44(2):326-34.
25. Cloake T, Haigh T, Cheshire J, Walker D. The impact of patient demographics and comorbidities upon burns admitted to Tygerberg Hospital Burns Unit, Western Cape, South Africa. *Burns*. 2017;43(2):411-6.
26. Li H, Yao Z, Tan J, Zhou J, Li Y, Wu J, et al. Epidemiology and outcome analysis of 6325 burn patients: a five-year retrospective study in a major burn center in Southwest China. *Scientific reports*. 2017;7:46066.

