Research Paper: Prevalence and Epidemiological Profile of Gasoline-Related Burn Injuries in Tehran: A Retrospective Descriptive Study

Mostafa Dahmardehei[1], Majid Khadem Rezaiyan[2], Farhang Safarnejad[3], Ali Ahmadabadi[4*]

1. *Burns Research Center, Iran University of Medical Sciences, Tehran, Iran.*
2. *Clinical Research Development Unit, Mashhad University of Medical Sciences, Mashhad, Iran.*
3. *Department of Surgery, Kurdistan University of Medical Sciences, Sanandaj, Iran.*
4. *Surgical Oncology Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.*

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ABSTRACT

Gasoline, a highly volatile, flammable liquid, is frequently misused as a fire accelerant, leading to severe burn injuries, particularly in young men. These injuries are often associated with high mortality, extensive total body surface area (TBSA) involvement, and inhalation injuries. This study aimed to investigate the prevalence of burn injuries resulting from the misuse of gasoline in Tehran and to explore the contributing factors associated with these incidents.This retrospective cross-sectional study was conducted in 2019 at Motahari Hospital in Tehran, Iran. All burns related to flammable and combustible liquids were examined. Demographic data and burn-related information were extracted. Data were analyzed using descriptive measures in SPSS software (version 28). Out of 1,984 burn cases, 84 (10.6%) were attributed to the misuse of flammable liquids, predominantly gasoline (77.4%). Most of the victims of flammable liquid burns were men (96.4%) with an average age of 31.6 years. The average TBSA burned was 25.5%, and the mean hospital stay was 10.8 days. Inhalation injuries occurred in 40.5% of cases, and the mortality rate was 11.9%. A significant proportion of injuries occurred at workplaces (56%), with construction workers, auto mechanics, and painters being the most affected. Seasonal trends showed increased incidents during spring and summer, particularly during national and religious festivals, such as *Chaharshanbeh Suri*. Gasoline-related burns present a significant public health burden, with high rates of morbidity and mortality. Targeted interventions, including public education on the dangers of gasoline misuse and enhanced safety regulations, are essential to mitigate the impact of these injuries.

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**** Corresponding Author(s):***
Ali Ahmadabadi, (MD)
Address: *Surgical Oncology Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.*
Tel: *+98 5138713801*
E-mail: *ahmadabadia@mums.ac.ir*

1. Introduction

Fire and flame burns are among the most common causes of burn injuries in most parts of the world, causing deep and extensive burns [1-5]. A significant percentage of these types of burns are related to inhalation injury; hence, the mortality rate is significant [6]. Flammable liquids, especially those with highly volatile vapors, such as gasoline, are implicated in many cases of flame burn injury [7, 8]. Gasoline, often inappropriately used as an accelerator, is much more volatile than other common accelerators due to its low flash point and vapor pressure [9]. Evidence shows that burns related to fire accelerants comprise more than 50% of burn injuries [10, 11].

Some studies conducted in Iran and the United States (US) reported gasoline-related burns as 18-23.3% of burn admissions [8, 12]. These injuries primarily affect young men and are often the result of improper or unsupervised gasoline use [13]. Gasoline burns are associated with high mortality, involvement of total body surface area (TBSA), and frequent inhalation injuries [12]. While most gasoline burns are accidental, self-inflicted burns using flammable liquids are also a concern, especially among people with psychiatric diagnoses and low socioeconomic status [14].

Many burn injuries occur in Iran during national and religious holidays and ceremonies, especially during the celebration of *Chaharshanbeh Suri*. Ancient Iranians used to light a fire and jump over it on the last Wednesday night of the year to ward off evil forces. This ceremony has changed drastically in recent years, and in addition to fireworks, other explosives have also been held [15]. Most of these injuries are caused by firecrackers, and some are related to improper gasoline use in these festivals. More research on burn injuries during national and religious holidays and public education, primarily through mass media, can be effective in reducing the incidence of burns. Overall, since burn injuries are still one of the most common causes of death in Iran, and due to the prevalence of burn injuries caused by gasoline in Iran, public education about the dangers of gasoline and targeted interventions for high-risk groups are recommended to prevent these injuries [12, 16, 17]. Proper knowledge about the mechanism of injury is required to adopt effective preventive policies. Therefore, this study investigated the prevalence and factors related to burn injuries caused by improper gasoline use in a burn referral center in Tehran, Iran.

2. Materials and Methods

This retrospective cross-sectional study was conducted at Motahari Burn Hospital in Tehran, Iran, between March 21, 2019, and March 20, 2020. The study included all patients with burn injuries caused by flammable or combustible liquids, excluding other mechanisms of burn injuries, ultraviolet burns, allergic reactions, and Stevens-Johnson syndrome.

2.1. Data Collection

Demographic information (age, gender, marital status, educational level, and occupation), burn-related data (percentage of TBSA burned, inhalation injury, cause and mechanism of burn, and activity leading to burn injury), and hospital-related data (length of hospital stay and outcome) were extracted from the hospital's information system and patient medical records.

2.2. Statistical Analysis

The collected data were analyzed using SPSS software (version 28). Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables, including gender, occupation, educational level, and burn causes, were presented as frequencies and percentages. Continuous variables, such as age, percentage of TBSA burned, and length of hospital stay, were expressed as means with standard deviations (SD) or medians with interquartile ranges (IQR), depending on data distribution. The normality of continuous data was assessed using the Kolmogorov-Smirnov test. Means and standard deviations were reported for normally distributed data, while medians and IQR were calculated for non-normally distributed data.

3. Results

During the study period, a total of 1,984 burn patients were hospitalized. Of these, fire and flame mechanisms injured 789 (39.8%). A subset of 84 patients (10.6%) sustained burn injuries due to the misuse of flammable or combustible liquids as fire accelerants, with gasoline being the most common

agent responsible for 65 cases (77.4%) (Table 1).

3.1. Demographics and Burn Characteristics

The mean age of the patients was 31.6 ± 15.9 years (range: 2-72 years), and 81 patients (96.4%) were male (Figure 1). Most patients (66.7%) had a low educational level, being either illiterate or only having primary school education. About half of the patients (52.4%) were married. The mean TBSA burned was 25.5% ± 22.5% (range: 5-95%), and the mean length of hospital stay was 10.8 ± 8.6 days (range: 1-44 days). Ten patients (11.9%) succumbed to their injuries, with a mean burned TBSA of 74% ± 22.1% among those who died. Inhalation injury was present in 34 patients (40.5%).

Table 1. Distribution of burns due to flammable or combustible liquids

	Agent	No. (percent)
Flammable liquids 78 (92.9%)	Gasoline	65 (77.3)
	Paint and paint thinner	8 (9.5)
	Alcohol	3 (3.6)
	Firestarter	1 (1.2)
	Glue	1 (1.2)
Combustible liquids 6 (7.1%)	Diesel	3 (3.6)
	Kerosene	3 (3.6)
Total		84 (100)

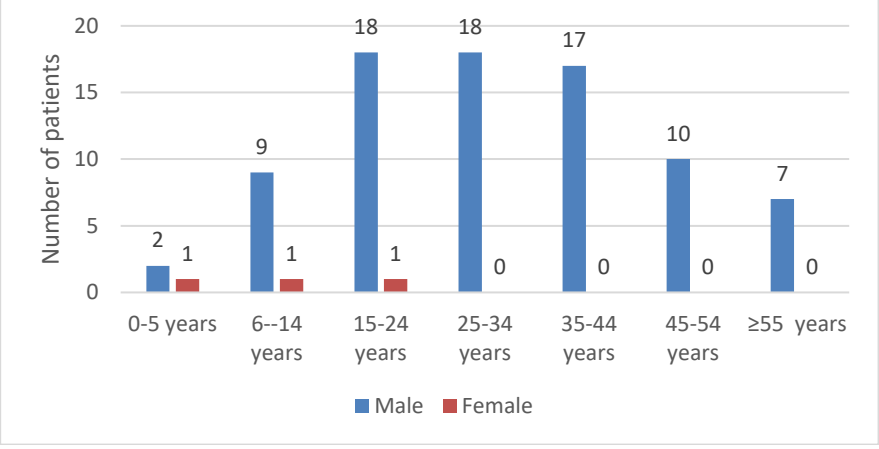

Figure 1. Age and gender distribution in burn injuries due to flammable or combustible liquids

3.2. Activity and Injury Mechanism

The majority of injuries occurred at workplaces (56%), particularly among construction workers, auto mechanics, and painters. Public places (29.7%) and recreational areas (13.1%) were also significant locations for these incidents. Only 1.2% of injuries occurred at home. Additionally, 13.1% of the injuries occurred during national and religious festivals and ceremonies, notably at *Chaharshanbeh Suri*, where five patients sustained injuries due to gasoline misuse. Eight patients (9.5%) were also injured while using tobacco and hookah and moving gasoline containers. In 76.2% of cases, the patient's own fault caused the burn, and the rest of the patients (23.8%) were only near the fire when another person poured flammable liquid on the fire.

3.3. Burn Severity and Outcomes

In 79.8% of cases, one or both upper extremities were involved, while 63.1% of patients had facial burns. Most burns required surgical intervention, with 81% of patients needing burn wound excision and skin grafting.

3.4. Workplace Incidents and Seasonal Variation

Workplace injuries occurred year-round, whereas recreational activity-related burns were more common in spring and summer. Burn injuries among homeless individuals occurred during cold weather months, as they used open flames for warmth.

4. Discussion

This study aimed to identify the prevalence and

effective epidemiological factors in gasoline-burn patients referred to Motahari Hospital in Tehran. Previous studies in Iran and some countries have reported the incidence of burn injuries caused by accelerators to be 18%-23% [12, 18, 19]. However, Smith et al. reported the prevalence of gasoline flame burns to be 27.4%, similar to our results [9]. Most of the injured people were men, which is consistent with the findings of other studies [8, 18-20]. In line with previous studies in Iran, most of the people suffering from gasoline burns were young (mean age about 31 years) [12, 20]. Similar to our findings, in a study conducted by Sreedharan et al., anatomical areas affected by gasoline burns were predominant on the face and limbs. This finding could be because most injuries may result from a burst pattern or sudden burn. The average TBSA in the mentioned study was 19.3%, and surgery was required in 70.4% of cases [18]. Except for a study by Firoozbakhsh et al., the average TBSA in other studies was also close to our results [12, 13, 21].

Many studies have shown that burn injuries related to the misuse of flammable liquids usually occur outdoors during recreational activities, especially in spring and summer [18, 22-25]. Our findings also demonstrated that burns related to recreational activities were more common in spring and summer, although workplace injuries occurred almost uniformly throughout the year and in all seasons. In our study, 13.1% of the injuries occurred during national and religious holidays and ceremonies, especially during the celebration of *Chaharshanbeh Suri*. Every year, a large number of injuries and deaths caused by burns are reported in Iran during the celebration of *Chaharshanbeh Suri*, which highlights the need to educate and raise awareness about the dangers of improper gasoline consumption [15, 26, 27]. Burns in other Iranian holidays and ceremonies, such as *Tasu'a*, *Ashura*, and *Sizdah Bedar*, have not been considered in the literature. Still, our findings showed that burns caused by improper use of gasoline in other holidays are almost as common as the celebration of *Chaharshanbeh Suri*. Based on the results, 9.5% of patients were injured while smoking, hookah, and moving gasoline containers, while almost a quarter of patients in a study by Sreedharan et al. were under the influence of drugs and/or alcohol [18]. In 76.2% of cases, the patient's fault caused the burn; in other cases, when the patient was near the fire, someone else poured flammable liquid on the fire. Because many gasoline burn injuries are attributable to human error, identifying and addressing unsafe gasoline practices is critical to reducing these devastating injuries [19, 28]. Inhalation damage was observed in 40.5% of patients, and the average length of hospitalization was about 11 days; however, 11.9% of patients died. In the study by Sreedharan et al., approximately one-third of patients required intensive care unit admission for ventilation, with more than one-fifth having confirmed evidence of airway injury, indicating the severity of gasoline burn injury. Burn injuries caused by gasoline were associated with a mortality rate of 7.4% [18]. In another study from Iran, inhalation injury was reported in 43% of patients, and the average duration of hospitalization was about 17 days, which was almost in line with our results [12]. Finally, our results highlight the extent of diesel flame burns and emphasize the importance of public education in reducing the inappropriate use of gasoline as an accelerant with the ultimate goal of reducing the significant morbidity associated with these burns. In Iran, gasoline and other accelerants are cheap and readily available and are often stored in homes or car trunks ready for use in motor vehicles and gardening equipment. The authors support and encourage public education campaigns to raise awareness of the potential dangers of improper use of flammable liquids, such as gasoline. Another preventive measure is to ensure that the packaging of accelerators has clear labels about the risks of abuse and safety features to minimize their risk.

The retrospective cross-sectional design of this study limits the ability to establish causality and capture all potential confounding factors. The data were drawn from a single referral burn center, which may restrict the generalizability of the findings to other regions or populations. Furthermore, the reliance on hospital records could introduce reporting bias, and certain critical factors, such as socioeconomic status and access to safety education, were not thoroughly assessed. Future studies should address these limitations by adopting a prospective design and including a broader range of variables and populations.

5. Conclusion

The study highlights the significant burden of burn injuries related to the misuse of gasoline as a fire

accelerant, particularly among young men in occupational settings. Gasoline remains the predominant cause of severe burns due to its high volatility. The findings underscore the urgent need for public education on the dangers of gasoline misuse and the importance of incorporating burn prevention strategies into occupational safety programs. Additionally, regulatory measures should be considered to restrict the availability of gasoline for non-vehicular use and to enforce proper labeling on flammable products. A multifaceted approach, including education, regulation, and enforcement, is essential to reduce the incidence and severity of gasoline-related burns in Tehran.

Ethical Considerations

Compliance with ethical guidelines

Data collection was done with the consent of the management of Motahari Hospital and using the hospital's data bank while preserving the privacy of the patients.

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Authors'contributions

MD, and AA: supervised the project. FS: participated in the study's design and performed the statistical analysis. MKhR: Collect and interpret the data. AA: Drafting or revisiting the article critically for important intellectual content. All authors discussed the results and contributed to the final manuscript.

Conflict of Interests

The authors declare no conflicts of interest.

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