


Characteristics of Burn Patients at Ibnu Sina Hospital, Gresik Regency - 2022–2024: A Retrospective Observational Descriptive Study

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ABSTRACT

Introduction: Burns are a significant cause of morbidity and mortality, particularly in developing countries with limitations in healthcare systems. This study describes clinical characteristics of burn patients at Ibnu Sina Regional Public Hospital, Gresik Regency, during the 2022–2024 period. **Methods:** A retrospective observational descriptive study on secondary data from medical records of burn patients admitted through the Emergency Department (ED) within the first 24 hours following injury. **Results:** Out of a total of 64 patients, the majority were male and within the productive age group (16–35 years). Most worked as entrepreneurs or factory workers. The most frequent causes of burns were flame exposure and gas explosions, mostly involving 20%–39% of the total body surface area (TBSA). Patients with inhalation trauma and comorbidities, such as diabetes mellitus or smoking habits, experienced longer hospital stays. **Conclusion:** Most moderate-to-severe burn injuries in this study occurred among factory workers and entrepreneurs as a result of open flame and gas explosions, indicating the need to strengthen occupational safety and burn prevention efforts in the workplace.

Keywords: Burn injury, Gresik, health system, inhalation trauma.

ABSTRAK

Pendahuluan: Luka bakar merupakan salah satu penyebab signifikan morbiditas dan mortalitas, khususnya di negara berkembang yang masih menghadapi keterbatasan dalam sistem pelayanan kesehatan. Penelitian ini bertujuan untuk mendeskripsikan karakteristik pasien luka bakar yang dirawat di Rumah Sakit Umum Daerah Ibnu Sina, Kabupaten Gresik, selama periode tahun 2022–2024. **Metode:** Penelitian deskriptif observasional retrospektif menganalisis data sekunder rekam medis pasien luka bakar dan dirawat inap melalui Instalasi Gawat Darurat (IGD) dalam 24 jam pertama. **Hasil:** Dari total 64 pasien, mayoritas laki-laki dan dalam usia produktif (16–35 tahun). Sebagian besar bekerja sebagai pengusaha dan pekerja pabrik. Mekanisme luka bakar yang paling sering adalah paparan api dan ledakan gas, dengan luas luka bakar terbanyak berkisar 20%–39% *total body surface area* (TBSA). Pasien trauma inhalasi dan komorbiditas seperti diabetes melitus atau kebiasaan merokok mengalami masa rawat inap yang lebih panjang. **Simpulan:** Sebagian besar luka bakar sedang–berat pada penelitian ini terjadi pada pekerja pabrik dan wirausahawan akibat api terbuka dan ledakan gas, sehingga diperlukan penguatan keselamatan kerja dan pencegahan luka bakar di lingkungan kerja. **Akhmad Setyo Rahman, Taufan Harijanto, Dono Marsetio Wibowo, Agung Kusuma Negara, Nur Lailatul Fadhilah. Karakteristik Pasien Luka Bakar di Rumah Sakit Ibnu Sina, Gresik, Indonesia – 2022–2024: Sebuah Studi Deskriptif Observasional Retrospektif.**

Kata Kunci: Luka bakar, Gresik, sistem kesehatan, trauma inhalasi.

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INTRODUCTION

Burn injuries continue to be one of the leading causes of morbidity and mortality worldwide, particularly in developing countries. According to data from the WHO, more than 11 million people suffer from burns annually, with approximately 180,000 of these cases resulting in death. The majority of these fatalities occur in the Southeast Asian and African regions.[1] Burns not only cause significant physical harm but also have far-reaching psychosocial and economic consequences. Burn patients frequently experience post-traumatic stress disorder, social isolation, and financial hardship due to

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loss of productivity.[2] Moreover, burn injuries are a major reason for prolonged hospital stays and impose an additional burden on healthcare systems, especially in areas with limited resources. A study conducted by Abarca, *et al*., (2023)[3] in Spain revealed that the mortality rate among burn patients remains high despite the provision of intensive care.[3] In Indonesia, research findings indicate that most burn patients are from the productive age group, with occupational accidents being the predominant cause.[4] Angkoso and Kekalih (2022) further demonstrated that prognostic factors such as age, the extent of the burn, and delays in initial treatment significantly affect clinical outcomes. Secondary healthcare facilities in developing countries continue to face major challenges, particularly the need for specialized care units, trained medical personnel, and the high costs of treatment. In the absence of structured epidemiological data, it becomes challenging to allocate resources and develop effective prevention policies. Therefore, a comprehensive understanding of the trends and characteristics of burn patients is essential to improving service quality and reducing mortality rates.[5]

Previous studies on burn patient epidemiology and mortality, such as those by Abarca, *et al*., (2023)[3] and Angkoso & Kekalih (2022)[5] have limited regional relevance. Abarca's study, conducted in Spain, reflects a different healthcare system, whereas Angkoso's research was limited to a single national referral hospital in Jakarta. No research has specifically explored burn patients in regional hospitals like Ibnu Sina Hospital in Gresik Regency, despite the region's unique context as one of Indonesia's industrial hubs where exposure to open flames, liquefied petroleum gas, and factory-related hazards is common. This study provides the epidemiological overview of burn patients in a regional hospital in East Java and highlights region-specific occupational risks critical for public health policies and workplace safety interventions in industrial communities such as Gresik.

METHOD

A retrospective observational descriptive design to describe demographic and clinical characteristics of burn patients treated at Ibnu Sina Regional Public Hospital, Gresik Regency, from January 2022 to December 2024. Thus, the 64 analyzed cases represent the entire population of burn patients hospitalized at Ibnu Sina Regional Public Hospital during the study period, rather than a partial sample. Ethical clearance was obtained from the hospital's ethics committee (Approval No. 059/437.52.35.57/2025) with formal authorization by the hospital administration (Letter No. 420/1504/437.52.35/2025). All patient identity data were anonymized to ensure confidentiality. The inclusion criteria comprised patients diagnosed with burn injury (ICD-10 codes T20–T32), admitted through the Emergency Department within 24 hours of injury to ensure uniformity in initial clinical presentation and to minimize bias related to delayed referral or prior treatment, and possessing complete medical records, while exclusion criteria included those with polytrauma that could confound outcomes, patients treated only in the outpatient clinic or discharged against medical advice, and those referred in from other hospitals after more than 24 hours post-injury. Secondary data were retrieved from electronic medical records and validated against admission logbooks, encompassing demographic characteristics (admission year, age, gender, occupation), clinical features (burn etiology, degree, total body surface area, presence of inhalation trauma, comorbidities such as diabetes mellitus, smoking, chronic kidney disease, and heart failure), and outcomes (length of hospital stay, discharge status, referral, or death). Data were analyzed using SPSS version 26; categorical variables were presented as frequencies and percentages.

RESULT

A total of 64 patients met the criteria, encompassing the entire population of burn patients admitted to Ibnu Sina Hospital between 2022 and 2024. Data included annual distribution, age, sex, burn mechanisms, and occupational background. All 64 cases met the inclusion criteria. Data validation was performed through cross-checking electronic medical records with emergency department logbooks and inpatient charts to ensure accuracy and completeness. The demographic patterns and contributing factors in burn incidents are summarized in **Tables 1–3.**

Table 1. Distribution of admission year of burn patients (2022–2024).

Year	n (%)
2022	26 (40.6)
2023	18 (28.1)
2024	20 (31.3)
Total	64 (100)

Table 1 illustrates the annual distribution of hospitalized burn patients during the study period. Although the annual variation was not substantial, the findings suggest a persistent burden of burn injuries across consecutive years, indicating the need for continuous preventive and clinical management strategies.

Table 2 shows the distribution of burn patients according to age group and gender. The majority of cases occurred among males (89.1%), while females accounted for only 10.9% of the total population. The most affected age group was 16–35 years (productive age), comprising nearly half of all cases (46.9%). Children and adolescents contributed a smaller proportion, with 7.8% in the 5–15 years category and 3.1% in those under five years old.

Table 3 presents the distribution of burn patients according to occupation and burn

Table 2. Distribution of burn patients by age group and gender.

Age Group	Female n (%)	Male n (%)	Total n (%)
< 5 years	0 (0)	2 (3.1)	2 (3.1)
5–15 years	1 (1.6)	4 (6.3)	5 (7.8)
16–35 years	2 (3.1)	28 (43.8)	30 (46.9)
36–55 years	4 (6.3)	14 (21.9)	18 (28.1)
> 55 years	0 (0)	9 (14.1)	9 (14.1)
Total	7 (10.9)	57 (89.1)	**64 (100)**

etiology. Entrepreneurs represented the largest group, making up half of all cases (50.0%), with most incidents caused by flame exposure (35.9%) and gas explosions (10.9%). Factory workers accounted for 21.9% of patients, all of whom were injured by gas explosions, highlighting the elevated risk associated with industrial environments. Other occupations contributed smaller proportions, including students (9.4%), housewives (7.8%), teachers (7.8%), and not yet working (3.1%), who sustained burns from a variety of causes such as hot water, flames, and electrical sources. Flame exposure emerged as the most common cause (48.4%), followed by gas explosions (39.1%), hot water (9.4%), and electrical accidents (3.1%).

The distribution of clinical features (burn etiology, burn degree, and total body surface area/TBSA) is presented in **Table 4**. The table illustrates the distribution of burn etiologies according to the extent of body surface area involvement and the depth of tissue injury.

Table 4 demonstrates that most patients (42 cases, 65.6%) sustained burns involving 20%–39% TBSA, predominantly from flames and gas explosions. Smaller groups were observed with less than 20% TBSA (12 cases) and with extensive burns exceeding 40% TBSA (10 cases). Overall, flame injuries were the most common etiology (31 cases), followed by gas explosions (25 cases), hot water (6 cases), and electrical injuries (2 cases). Notably, burns involving larger TBSA (≥ 60%) were predominantly caused by gas explosions, and were more frequently observed with deeper burn injuries, particularly mid-dermal to full-thickness burns.

Additional descriptive data were presented to show the distribution of discharge outcomes according to burn etiology, inhalation trauma, and comorbidities. Hospital length of stay was also described across different comorbidity groups. These results provide an overview of clinical characteristics and referral patterns among burn patients, as summarized in **Tables 5 and 6**.

Table 5 presents the distribution of burn outcomes by burn etiology and the presence of inhalation trauma. The majority of patients (78.1%) recovered without requiring referral,

Table 3. Distribution of burn patients by occupation and burn etiology .

Occupation	Hot Water n (%)	Flame n (%)	Gas Explosion n (%)	Electrical n (%)	Total n (%)
Not yet working	2 (3.1)	0 (0)	0 (0)	0 (0)	2 (3.1)
Entrepreneurs	1 (1.6)	23 (35.9)	7 (10.9)	1 (1.6)	32 (50)
Housewife	0 (0)	3 (4.7)	2 (3.1)	0 (0)	5 (7.8)
Factory worker	0 (0)	0 (0)	14 (21.9)	0 (0)	14 (21.9)
Student	1 (1.6)	4 (6.3)	0 (0)	1 (1.6)	6 (9.4)
Teacher	2 (3.1)	1 (1.6)	2 (3.1)	0 (0)	5 (7.8)
Total	6 (9.4)	31 (48.4)	25 (39.1)	2 (3.1)	64 (100)

Table 4. Distribution of burn patients by tbsa, degree, and burn etiology.

TBSA (%)	Degree	Hot Water	Flame	Gas Explosion	Electrical	Total n (%)
0–19	Epidermal	1	2	0	1	4
	Superficial Dermal	2	2	0	0	4
	Mid Dermal	1	1	0	1	3
	Deep Dermal	1	0	0	0	1
	Full Thickness	0	0	0	0	0
Subtotal		5	5	0	2	12
20–39	Epidermal	0	5	1	0	6
	Superficial Dermal	0	9	2	0	11
	Mid Dermal	1	3	5	0	9
	Deep Dermal	0	4	6	0	10
	Full Thickness	0	4	2	0	6
Subtotal		1	25	16	0	42
40–59	Epidermal	0	0	0	0	0


TBSA (%)	Degree	Hot Water	Flame	Gas Explosion	Electrical	Total n (%)
	Superficial Dermal	0	0	0	0	0
	Mid Dermal	0	0	1	0	1
	Deep Dermal	0	1	0	0	1
	Full Thickness	0	0	0	0	0
Subtotal		0	1	1	0	2
60–79	Epidermal	0	0	0	0	0
	Superficial Dermal	0	0	0	0	0
	Mid Dermal	0	0	0	0	0
	Deep Dermal	0	0	3	0	3
	Full Thickness	0	0	0	0	0
Subtotal		**0**	**0**	**3**	**0**	**3**
80–100	Epidermal	0	0	0	0	0
	Superficial Dermal	0	0	0	0	0
	Mid Dermal	0	0	1	0	1
	Deep Dermal	0	0	3	0	3
	Full Thickness	0	0	1	0	1
Subtotal		0	0	5	0	5
Grand Total		6	31	25	2	64

with flame injuries accounting for the largest proportion of these cases (29 patients). A smaller group (7.8%) also recovered but had concomitant inhalation trauma, mainly involving gas explosion and flame injuries. These findings show that most patients experienced favorable outcomes, while inhalation trauma was observed in 21.9% of cases and was more frequently present among referred patients. Referrals accounted for 14.1% of the total cases, all of which were linked to gas explosion injuries accompanied by inhalation trauma. Most inhalation injuries were observed in patients with burns from gas explosions and flames.

Table 6 shows the distribution of hospital length of stay according to comorbidities. Among recovered patients without comorbidities (51.6%), the majority were hospitalized for 1–5 days (24 patients). Among recovered patients, diabetes mellitus (17.2%) and smoking habits (9.4%) were observed across different lengths of hospitalization, while chronic kidney disease (6.3%) and heart failure (1.6%) were less common comorbidities. Among referred patients, smoking was the most common comorbidity (6.3%), followed by diabetes mellitus (3.1%) and CKD (1.6%).

DISCUSSION

The findings of this study indicate that the majority of burn patients treated at Ibnu Sina Hospital, Gresik Regency, were male in the productive age group. These findings indicate that burn injuries predominantly affect males in the productive age groups, reflecting occupational and environmental exposure risks. Which is consistent with previous research from Indonesia[6] and other low- and middle-income countries[7] showing that young males are more vulnerable due to occupational exposure to fire and flammable materials. Compared with the study by Abarca, *et al.*, (2023) in Spain,[3] where most burn injuries occurred in older patients within

Table 5. Distribution of burn patient outcomes by burn etiology and inhalation trauma.

Outcome	Inhalation Trauma	Hot Water n (%)	Flame n (%)	Gas Explosion n (%)	Electrical n (%)	Total n (%)
Recovering	+	0 (0)	2 (3.1)	3 (4.7)	0 (0)	5 (7.8)
	-	6 (9.4)	29 (45.3)	13 (20.3)	2 (3.1)	50 (78.1)
Referred	+	0 (0)	0 (0)	9 (14.1)	0 (0)	9 (14.1)
	-	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total		6 (9.4)	31 (48.4)	25 (39.1)	2 (3.1	64 (100)


Table 6. Length of hospital stay by comorbidity and outcome.

Outcome	Comorbidity	1–5 days	6–10 days	11–15 days	16–20 days	Total n (%)
Recovering	None	24	4	3	2	33 (51.6)
	Diabetes Mellitus	9	2	0	0	11 (17.2)
	Smoker	2	1	2	1	6 (9.4)
	Chronic Kidney Disease	3	1	0	0	4 (6.3)
	Heart Failure	0	1	0	0	1 (1.6)
Referred	None	2	0	0	0	2 (3.1)
	Diabetes Mellitus	2	0	0	0	2 (3.1)
	Smoker	4	0	0	0	4 (6.3)
	Chronic Kidney Disease	1	0	0	0	1 (1.6)
	Heart Failure	0	0	0	0	0 (0)
Total	-	47	9	5	3	64 (100)

domestic settings, our results highlight the unique occupational risks in an industrial region like Gresik. This difference may be explained by the high prevalence of factory and entrepreneurial work involving liquefied gas, welding, and machinery, which are not dominant sources of burns in high-income countries.[2]

The predominant causes of burn injuries identified in this study were fire and gas explosions. This observation supports the conclusions drawn by Jeschke, *et al*., (2020), that fire remains the leading cause of burns worldwide, especially in low and middle-income countries. Furthermore, the study reaffirms the critical role of gas explosions as a major contributing factor. This discrepancy underlines the influence of local industrial environments on burn epidemiology, suggesting that region-specific strategies are needed. Strengthening occupational safety regulations, providing mandatory training on gas handling, and ensuring the availability of personal protective equipment (PPE) are urgent measures for high-risk worker groups in Gresik.[8]

Additionally, the research highlights the occupational background of burn victims, with the majority originating from entrepreneurial and industrial sectors. Businesspeople represented the largest subgroup, with most injuries resulting from direct exposure to flames or gas-related incidents. These findings suggest that occupational setting plays an important role in burn risk, particularly in professions involving frequent contact with fire or flammable materials. At the same time, cases among non-industrial groups indicate that burn injuries are not confined to workplaces but also occur in domestic and educational contexts. This emphasizes the need for targeted preventive measures both in occupational safety regulations and in community education.[8] This is consistent with the findings of Cyuzuzo, *et al*., (2025), who reported that jobs involving high mobility and activity levels carry an elevated risk of burn injuries due to frequent use of open flames or flammable substances in daily operations. These insights underscore the necessity of reinforcing occupational health and safety measures, alongside educational interventions focused on burn prevention for individuals working in commercial and manufacturing settings.[9] The study identified that burn injuries resulting from gas explosions were predominantly observed among factory workers, suggesting a potential link between industrial work environments and this type of injury. This finding is consistent with previous studies reporting that gas explosions are commonly associated with industrial settings.[9]

The study identified that burn injuries resulting from gas explosions were predominantly found among factory workers, suggesting a strong correlation between the industrial work environment and heightened risk of this specific type of trauma. Previous research highlights that gas explosions are frequently linked to the use of industrial machinery and suboptimal implementation of occupational safety protocols.[10] Given these risks, there is a pressing need for more targeted preventive measures, including the enforcement of stringent regulations and rigorous supervision of workplace safety standards, particularly in factory settings where flammable gases and fuels are routinely utilized.[7]

The finding that most burn cases in this study were caused by open flame exposure and gas explosions, particularly among entrepreneurs and factory workers, indicates that the burn etiologies were considered to be related to occupational and domestic risk factors that are, in principle, preventable. Unsafe storage and use of LPG, limited safety training for workers, and suboptimal implementation of occupational health and safety (OHS) standards are presumed to contribute to the high incidence of moderate-to-severe burns in this group. Therefore, a clear understanding of the patterns and causes of burn injuries is essential for designing more targeted prevention strategies in both workplace and household settings, including education, stricter supervision of gas fuel use, and strengthening of safety regulations.

The study also revealed that most patients experienced burns affecting 20%–39% of their total body surface area (TBSA), with injury depth ranging from epidermal to full-thickness burns. These findings are

consistent with research conducted by Deng, *et al*., (2025), which demonstrated a strong association between the extent and depth of burn injuries and the incidence of clinical complications and morbidity. Burns involving more than 20% TBSA serve as a critical clinical threshold, significantly worsening patient prognosis and necessitating intensive medical care. Management of such cases often includes close monitoring, surgical debridement, and aggressive fluid resuscitation. This is because extensive burns are commonly linked to severe systemic complications such as infections, hypovolemic shock, multi-organ dysfunction syndrome (MODS), and acute respiratory distress syndrome (ARDS). Therefore, early clinical assessment and prompt intervention are essential to minimizing adverse outcomes and improving patient recovery trajectories.[11]

Inhalation trauma was observed in approximately 20% of patients, with the majority associated with gas explosion incidents. This type of trauma is recognized as a significant factor contributing to the severity of burn injuries. Inhalation trauma is a well-recognized factor associated with worse prognosis in burn patients, including increased risk of respiratory complications and mortality.[12] Therefore, early identification and appropriate referral are essential in the management of these patients.[12] These findings are supported by the study of Avila, *et al*., (2024), which established that inhalation trauma is a key determinant of mortality and is strongly linked to respiratory complications such as pneumonia, airway obstruction, acute respiratory failure, and ARDS. Consequently, patients presenting with inhalation injuries are frequently referred to specialized burn centers or intensive care units equipped with ventilator support and bronchoscopy facilities, especially when mechanical ventilation and comprehensive respiratory management are required.[12] These findings underscore the critical importance of timely identification and early intervention for inhalation trauma in burn patients, as this can significantly influence the course of treatment and clinical outcomes.[13]

Comorbidities such as diabetes mellitus, smoking, and chronic kidney disease were observed among burn patients in this study. These findings suggest that comorbid conditions, particularly diabetes mellitus and smoking, were more frequently observed among patients with longer hospital stays and referral outcomes. This pattern may reflect increased clinical complexity in patients with comorbidities. Patients with comorbidities, particularly diabetes mellitus and smoking, tended to have longer hospital stays. These conditions may increase clinical complexity, which may require closer monitoring and more intensive therapeutic interventions. This is in agreement with Klifto, *et al.,* (2019), which emphasizes that the presence of comorbid conditions significantly elevates the risk of complications and lengthens the treatment duration in burn patients.[14] Smoking, in particular, is known to impair tissue oxygenation, disrupt the inflammatory response, and weaken bactericidal activity, thereby delaying wound healing and increasing the likelihood of complications such as infection, necrosis, and wound dehiscence.[15] In addition to the harmful effects of smoking, diabetes mellitus compromises immune function and microvascular circulation, contributing to a threefold increase in mortality risk and further extending hospitalization for burn patients.[16]

These findings emphasize that burn epidemiology is not only a clinical issue but also a public health challenge shaped by regional occupational risks, lifestyle factors, and healthcare capacity. While international and national studies provide useful reference points, our results highlighted the necessity of localized data to guide prevention and management. For Gresik Regency, a highly industrialized district, this means that burn prevention policies should focus on workplace safety education, stricter supervision of liquefied gas usage, and enhancing secondary hospital preparedness to manage both severe burns and burn patients with comorbid conditions. These conclusions support earlier studies calling for integrated prevention policies, public health education, and improved preparedness of local health facilities in handling burn emergencies.[17]

Although this retrospective study based on hospital medical records did not directly assess the presence or compliance of safety regulations in the workplaces from which burn patients originated, the predominance of moderate-to-severe burns among factory workers and entrepreneurs exposed to flame and gas explosions suggests potential gaps in the implementation of occupational health and safety measures. These findings highlighted the need for formal evaluation of safety policies and their enforcement in industrial and small-business settings in this region. Because this study relied exclusively on retrospective hospital medical records, we were not able to obtain direct information on the presence, content, or implementation of safety regulations in the workplaces from which burn patients originated. This lack of factory-level data is a key limitation and may underestimate or misclassify the role of occupational safety practices in the occurrence of burn injuries.

CONCLUSION

Most burn patients treated at Ibnu Sina Hospital, Gresik Regency, during the study period were males of productive age, and a substantial proportion of moderate-to-severe burns (TBSA ≥ 20% with deeper burn depth) occurred among factory workers and entrepreneurs exposed to open flame and gas explosions. These findings indicate that work-related and industrial settings are major contributors to the burden of severe burn injuries in this region.

Based on these findings, several preventive strategies are recommended. Workplace safety regulations should be strengthened and consistently enforced in factories and small industries that frequently use liquefied petroleum gas (LPG) and open flames through regular safety audits and implementation of occupational health and safety (OHS) standards. Regular safety training for workers should emphasize safe LPG handling, early detection of gas leaks, emergency response to fires or explosions, and basic first aid for burn injuries. Community and workplace education programs on safe gas use should be implemented in collaboration with local health authorities. In addition, hospital protocols and referral systems for moderate-to-severe burn injuries should be strengthened. Future studies should combine hospital data with workplace safety assessments to evaluate regulatory implementation. Implementing these measures has the potential to substantially reduce the incidence and severity of work-related burn injuries in industrial regions such as Gresik.

PUBLICATION STATEMENT

The researchers have obtained permission from the Ibnu Sina Hospital, Gresik, to write the institution's name in the scientific publication of the resulting manuscript.

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