Original Article

Burn injuries in a tertiary hospital setting: risk factors and outcomes

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Abstract

Background: Burn injuries constitute a major cause of trauma-related morbidity and mortality, particularly in low- and middle-income countries.
Aim: To identify the risk factors and clinical outcomes of burn injuries managed at the University of Port Harcourt Teaching Hospital.
Methods: This was a retrospective study of all burn patients managed by the Plastic Surgery Unit of the University of Port Harcourt Teaching Hospital (UPTH), a tertiary referral centre located in Port Harcourt, Rivers State, South-South Nigeria from 1st April 2015 to 31st March 2023 to assess the risk factors and outcomes. Data on demographics, burn aetiology, severity, and outcomes were analyzed.
Results: A total of 703 burn patients were admitted, with a male-to-female ratio of 1.1:1. The younger age groups were mostly affected. Majority of burn injuries occurred in individuals from low and middle-income settings. The most common causes were kerosine burns, petrol burns and gas burns. Flame burns were the most common aetiology (76.6%), followed by scalds (11.7%), electrical burns (4.6%), and chemical burns (1.5%). The mortality rate was 39.2% and increased with the total burn surface area.
Conclusion: Burn injuries are common. The younger age group are commonly affected. There was a male preponderance. Majority of burn injuries occurred in individuals from low and middle-income settings. The most common causes were kerosine burns, petrol burns and gas burns. Flame burns were the most common followed by scalds. The mortality rate was 39.2% and it increased with the total burn surface area.

Keywords: Burn injuries,risk factors, outcomes, flame burns, scald, electrical burns, chemical burns

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INTRODUCTION

Burn injuries, defined as thermal trauma to the skin or deeper tissues resulting in coagulative necrosis, remain a significant global public health concern.[1] In low-income countries such as Nigeria, burns contribute substantially to both morbidity and mortality, with a rising incidence of cases occurring outside domestic settings.[1,2] Notably, flame burns have been identified as the predominant cause of these injuries. While burns in middle- to high-income countries are increasingly reported in occupational environments such as offices, similar trends are emerging in low-income settings as well.[1-3]

Burn injuries can be categorized by cause such as scalds (hot liquids), contact burns (hot surfaces), and flame burns (fire) and in rare cases, inhalation injuries are also considered burn-related.[4-6] Classification may also be based on depth, total body surface area (TBSA) affected, and anatomical location. [6-8] While middle- and high-income countries have implemented standardized coding and data collection systems for burns, LMICs often lack such frameworks. This has hindered the development of comprehensive burn registries. To address this, the International Society for Burn Injury (ISBI) issued practice recommendations between 2014 and 2016 aimed at improving burn care monitoring and treatment in resource-limited settings.[9]

Globally, burn injuries accounted for 238,000 deaths in 2000, making burns the eighth leading cause of mortality at the time.[10] More than 95% of these deaths occurred in LMICs. For context, India alone admits 700,000–800,000 burn patients annually, and worldwide, an estimated four million women suffer severe burn injuries each year a figure comparable to global HIV/AIDS prevalence among women.[11]

Despite the prevalence and severity of burn injuries, they remain under-prioritized in public health agendas. While some regions have successfully established patterns and epidemiological data on burns due to well-structured healthcare systems and effective data collection,[3,4] Nigeria still lacks a comprehensive, state-wide overview. In particular, data from Port Harcourt, South-South Nigeria, remain limited.[12] Such data are critical for planning effective burn care interventions and preventive strategies.

Burn injuries present multifaceted challenges in both clinical management and public health response. Their complications are extensive, ranging from early to late sequelae, severe pain, and the high cost of surgical and rehabilitative care.[3,6,7,10,13] One of the key biological hurdles in burn wound healing is the genetically influenced impairment of the pro-inflammatory polymorphic response, which contributes to delayed healing in many patients. Moreover, the psychological and emotional toll of burn injuries extends beyond the victims to affect family, friends, and the wider community, especially in cases of fatal outcomes.[1,7,13]

Beyond initial pre-hospital interventions, the prevention of mortality and long-term disability from burns is both complex and costly.[1,7,10,11,13] Treatment strategies such as physical therapy, occupational rehabilitation, cosmetic surgery, and vocational recovery are often required even for moderate burn injuries.[1-6] These interventions aim to restore functionality and reduce long-term disability. Public health education and community-based prevention programs are essential to reduce the incidence of burns and minimize the associated human and economic toll.[1-5,10]

Overcrowding and rapid industrialization are key drivers of the increasing incidence and severity of burns in developing countries, particularly in Nigeria.[1,2,4,5,10,11] Major burns are associated with prolonged hospital stays, increased healthcare costs, and a higher likelihood of complications, including hypertrophic scarring, contractures, and the need for secondary surgeries.[1-7,10-13] Chemical burns, in particular, tend to be more severe due to their deep tissue penetration. The skin, primarily composed of epithelial layers structured as phospholipid bilayers covalently bonded to proteins, is highly susceptible to extensive destruction by coagulative necrosis following exposure to caustic substances.[14-19] Consequently, chemical burns from acids and alkalis often carry poorer prognostic outcomes.[14-19]

Contributing to the high burn incidence are unsafe living conditions, particularly in low-income communities that depend on hazardous energy sources such as candles, kerosene lamps, open firewood, low-quality stoves, and substandard generators. [1,2,5,7,10-12] These areas often lack basic fire safety infrastructure and public awareness of burn prevention measures. Poor access to education further limits knowledge of safety practices, while the absence of firefighting tools such as fire extinguishers heightens community vulnerability to fire-related accidents.[1,2,5,7,10-12]

Current research on burn injuries in Nigeria has primarily addressed epidemiological trends, clinical outcomes, and treatment interventions, highlighting the urgent need for coordinated

national strategies in burn care.[1,2,5,7,10,12] For pre-hospital management, the use of copious amounts of running tepid water for approximately 30 minutes remains the recommended first-line intervention to minimize tissue damage.[5,10]

In contrast, the use of chemical antidotes for acid or alkali burns is discouraged. Delays associated with locating and administering an antidote may defer the timely application of water irrigation, thereby allowing corrosive agents to continue their destructive activity. Moreover, the neutralization reaction between acids and bases is exothermic, releasing heat that further deepens burn injury due to increased coagulative necrosis.[14-20] Thus, the indiscriminate use of chemical neutralizers may exacerbate rather than mitigate tissue damage, particularly within the Jacksonian zones of injury.

Infection further complicates the clinical course of burn injuries, contributing significantly to the progression of partial-thickness wounds to full-thickness lesions.[21-24] Burn wound infections, particularly those affecting the epithelial surface, demand extensive laboratory diagnostics and targeted antibiotic therapy, both of which add to treatment costs.[21-24] Infected wounds also prolong hospitalization, increase the risk of systemic complications, and further escalate healthcare expenditures.[7,13] These factors collectively amplify the physical, psychological, and financial burdens faced by burn patients, their families, and healthcare providers.[7,10,13,25]

Bearing in mind the peculiarities of burn injuries in developing countries,the aim of this study is to identify the risk factors and clinical outcomes of burn injuries managed at the University of Port Harcourt Teaching Hospital, Nigeria. It is believed that this will contribute to the improvement of patient care and burn management protocols in Nigeria.

METHODOLOGY

This was a retrospective study of all burn patients managed by the Plastic Surgery Unit of the University of Port Harcourt Teaching Hospital (UPTH), a tertiary referral centre located in Port Harcourt, Rivers State, South-South Nigeria from 1st April 2015 to 31st March 2023 to assess the risk factors and outcomes. The hospital serves as a major treatment centre for burn injuries in the region. The sources of information were the medical records, including admission registers, case notes, and discharge summaries. Information collected included: age, sex, occupation, residence; burn characteristics: cause of burn (flame, scald, chemical, electrical), total body surface area (TBSA) involved, depth of burn, and presence of inhalational injury; treatment modalities: resuscitation, wound care, surgical interventions, rehabilitation; outcomes: duration of hospital stay, complications, mortality, and functional status at discharge. Patients with incomplete or missing medical records, outpatients who were not admitted for treatment and patients who were referred to or from other institutions after partial management were excluded from the study.

Data Analysis: Data were coded and entered into IBM SPSS Statistics version 26.0 (IBM SPSS, Armonk, NY, USA) for analysis. Descriptive statistics were used to summarize demographic variables and burn characteristics (frequencies, percentages) and chart (pie) was also constructed.

Ethical approval was obtained from the Ethics Committee of the University of Port Harcourt Teaching Hospital. Confidentiality of patients' data was maintained throughout the study.

RESULTS

During the 8-year study period, a total of 703 burn patients were admitted giving an average annual admission rate of 88 patients. They were aged 1 day to 85 years and there were 344 (53.2%) males and 329 females (46.8%) giving a male to female ratio of 1.1:1. Of the 703 patients, 88 patients (12.5%) had incomplete data and were therefore excluded. Six hundred and fifteen patients were therefore used for further analysis. Table 1 shows the age distribution of burn patients.

The highest frequency was in the 26 – 35 years age group (28.0%) followed by the 16 – 25 years age group (21.1%). The 16 – 35 years age group constituted 49.1%. Over 30% of burns occurred in children who were 15 years and below.

Majority of burn injuries [523(85.0%)] occurred in individuals from low and middle-income settings.

Table 2 shows the cause of the burns against gender. The most common causes were kerosine burns (36.6%), petrol burns (21.1%) and gas burns (12.7%). Burn injuries were generally more common among males [331(53.8%)]. The type of burn injury is shown in Table 3.

Table 1: Age distribution of burn patients

Age (Years)	Frequency	Percentage
0 – 5	102	16.6%
6 – 15	103	16.7%
16 – 25	130	21.1%
26 – 35	172	28.0%
36 – 45	71	11.5%
46 – 55	29	4.7%
56 – 65	5	0.8%
66 – 75	2	0.3%
76 – 85	1	0.2%
	615	**100**

Table 2: Cause of burns tabulated against gender

Cause	Male	Female	Total	Percentage
Kerosine burns	90	135	225	36.6%
Petrol burns	97	33	130	21.1%
Gas burns	44	34	78	12.7%
Scald burns	34	38	72	11.7%
Flame burns	13	16	29	4.7%
Electric burns	22	6	28	4.6%
Chemical burns	8	1	9	1.5%
Diesel burns	5	0	5	0.8%
Candle burns	1	3	4	0.6%
Others	17	18	35	5.7%
	331	**284**	**615**	**100%**

Flame burns were the most common (76.6%) followed by scalds (11.7%) (Table 3).

The total burn surface area against outcome is shown in Table 4. The mortality rate increased with the TBSA affected as shown in Table 4.

The summary of the outcome is shown in Figure 1. Those who signed against medical advice (SAMA) constituted 8.8% and the mortality rate was 39.2%.

Table 3: Type of burn injury among the patients

Type	Frequency	Percentage
Flame fire	471	76.6%
Scald	72	11.7%
Electric burns	28	4.6%
Chemical burns	9	1.5%
Others	35	5.7%
	615	**100%**

Table 4: Total burn surface area (TBSA) against outcome

TBSA Group	Outcome			
	Survivors	SAMA	Died	Total
1 – 10	36	1	0	37
11 – 20	91	9	3	103
21 – 30	71	12	8	91
31 – 40	63	10	24	97
41 – 50	36	9	26	71
51 – 60	17	6	33	56
61 – 70	4	5	38	47
71 – 80	2	0	49	51
81 – 90	0	2	38	40
91 – 100	0	0	22	22
	320	**54**	**241**	**615**

SAMA – Signed against medical advice

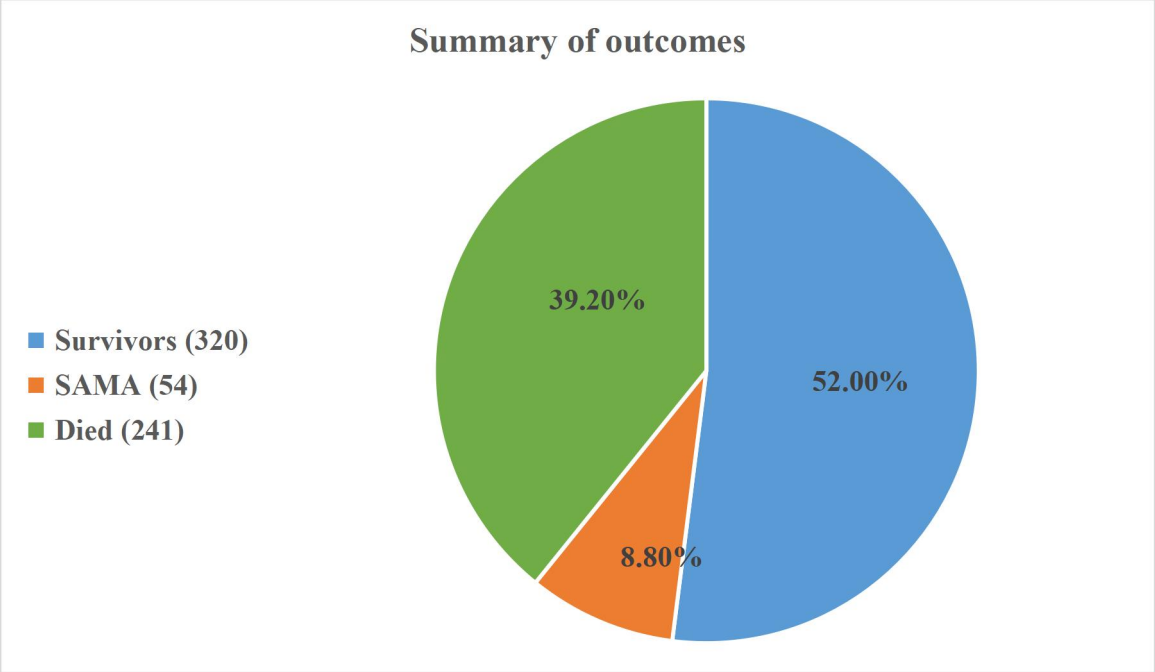

Figure 1: Summary of outcomes

DISCUSSION

Today, burn injuries represent a common type of trauma worldwide.[1,2,6,10,12] A disproportionate number of these injuries occur in low- and middle-income countries (LMICs), largely due to the absence of preventive legislation and inadequate burn care infrastructure.[1,2,6,10-12]

The epidemiological data in this study are predominantly hospital-based, reflecting trends within institutional care.The present study found an annual admission of approximately 88 patients. In the present study, flame burns emerged as the most prevalent cause of burn injuries (76.6%), even among children. Gender-based differences were observed in the source of flame burns: females were more frequently injured by kerosene-related incidents, while males were predominantly affected by petrol-related burns patterns consistent with known exposure risks.Similar findings have been documented by other workers.[1,2,10,12,25,26] The high prevalence of flame burns in this study is partly attributable to recent burn-related disasters in the region. This alarming rise in burn injuries may be related to increasing youth restiveness and the illicit refining of petroleum products, driven by socio-political agitation for resource control. These locally operated refineries lack proper safety standards and use primitive methods of fractional distillation. This results in poorly separated petroleum products, particularly those with high concentrations of volatile components such as improperly refined premium motor spirit (PMS). These mixtures are significantly more flammable than standard products, contributing to a heightened risk of fire and gas explosions.[27-29] Several of these disasters have been linked to deliberate sabotage, including the pilfering of gasoline from underground pipelines and the contamination of kerosene—a widely used household fuel—with gasoline during transportation or storage. Such contamination significantly increases the volatility of kerosene, leading to explosions when it is used to refill lit cooking stoves or lamps. Similarly, a common and highly dangerous practice involves refueling petrol-powered generators while they are still running or hot, which frequently results in fires and explosions.[27-29] Another contributing factor to flame burn is the widespread use of small petrol-powered generators, often refuelled multiple times a

day using petrol stored unsafely in domestic environments.

Scald burns, although common among children, was also a common burn injury in the present study. Similar findings have also been reported by others.[1,2,10,12,25,26] The under-representation of minor burns, such as scalds, in hospital-based reports is likely due to patients opting for home-based care or visiting non-specialist facilities.

Over 30% of children in the present study sustained burns. Children are frequently present in the kitchen during cooking, increasing their exposure to open flames. In many cases, entire families mothers, siblings, and children—sustain burn injuries simultaneously, a phenomenon sometimes referred to as the "family burn entity."

Gas burns was a significant cause of burns (12.7%) in the present study. Gas burns have also been reported by other workers.[1,26] It had been suggested that there is a higher incidence of gas explosions when petroleum products are sourced from these illegal refineries, compared to those obtained from regulated, commercial refineries. This underscores the need for stricter enforcement of safety regulations and public education on the dangers associated with the use and storage of petroleum products.[27-29]

Electrical burn injuries accounted for 4.6% of cases in this study. These findings align with previous research by others.[1,2,10,26] Electrical burn injuries is relatively uncommon. However, due to the predominance of hospital-based studies in Nigeria, accurately determining the true population-level incidence of burn injuries remains challenging. Many individuals, particularly those affected by poverty or limited health literacy, either seek care from traditional healers or self-medicate, leading to significant under-reporting. Furthermore, severe electrical burns often result in fatalities that are inaccurately recorded merely as electrocutions, with little or no documentation of the associated thermal injuries. Although autopsies can provide definitive diagnoses in such cases, cultural and traditional opposition to postmortem examinations remains a significant barrier.[10]

Although chemical burns are relatively rare compared to flame burns, they are becoming more frequent, comprising 1.5% of burn injuries in the present study. The pattern of chemical burn injuries observed aligns with reports from other regions globally.[1,10,15-20,26] A notable proportion of chemical burns result from accidental contact with or ingestion of caustic soda—either in powder or liquid form—commonly used in household soap production.[15-20] Such exposures often cause oro-facial and oesophageal burns, especially as many of these soap-making activities occur in makeshift domestic 'factories' within residential spaces. Our study reflects this emerging trend, consistent with the observations made by Gbeneol and Aria.[20] Their research noted that chemical burns were historically rare and often the result of intentional harm, unlike the typically accidental nature of flame burns. They further observed that no patients in their study received an antidote or neutralizing agent during the initial management of chemical burns.[20] Chemical burns, particularly those resulting from assaults, are also on the rise. The importance of proper first aid in chemical burns cannot be overstated.[15-20] While 30 minutes of tepid water irrigation is generally effective for acid burns, it is insufficient for alkali burns due to their prolonged interaction with skin proteins and lipid membranes. Continuous irrigation should be maintained until the patient is hospitalized, where pH testing can assess the extent of neutralization. Surgical intervention in chemical burn cases must be approached with caution.[15-20] Excision should not be performed until there is confirmation that the chemical agent has been fully neutralized, as residual toxins can continue to damage tissue post-operatively. Notably, even burns involving a small total body surface area (TBSA) can be life-threatening, depending on the chemical involved, the duration of contact, and

especially the age and physiological vulnerability of the patient.[15-20]

The mortality for burns in the present study was 39.2% and this was more with higher total burn surface area.[1,2,10,12,25-29] Burns are associated with significant morbidity and mortality, with the burden being especially severe in LMICs.[1,2,10-12,25-29] The most affected tends to be individuals in their late teens through middle age—a group crucial to the socioeconomic fabric of their families and nations. The resulting disability and loss of productivity contribute to a cycle of poverty and further strain healthcare systems.

Urban migration, mass illiteracy, and poverty have all contributed to the increased incidence of burns, despite a perceived decline in some urban areas.[1,2,10,26] Burn incidents occurring in public spaces require greater public safety enforcement. Seasonal variations, such as those seen during the Harmattan period, also necessitate intensified burn prevention efforts.[1,2,10,26,28]

Stronger legislation such as banning bush burning could help reduce fire-related injuries. Fire rescue services should be trained to provide immediate first aid, including 30-minute irrigation with tepid water, which is critical for limiting the progression of thermal damage. Early assessment, appropriate triage, and fluid management are central to reducing morbidity and mortality. Medical staff must be well-versed in the criteria for inpatient versus outpatient management to optimize outcomes.[1,2,10]

Prehospital care for burn patients in Nigeria is often inadequate due to the lack of organized ambulance systems and trained paramedics. Regionalization of burn care via the establishment of specialized burn centres would significantly improve outcomes. These centres would support structured data collection, specialized staff training, and the development of high-dependency and intensive care units, as well as the establishment of skin banks.

Financing remains one of the most urgent challenges in burn care.[1,2,7,10,11,13] The current out-of-pocket payment model is unsustainable and directly impacts patient outcomes. A transition toward universal health coverage or donor-supported burn care is essential. Burn management is costly, and complications, when poorly handled, add substantial financial strain to the healthcare system.

Limitations

This study was limited by its retrospective design and it was a single centre study. Consequently, burn cases managed at other facilities in Port Harcourt were not included. This exclusion likely led to a significant under-representation of the total burn injury burden in the region. Furthermore, minor burn injuries involving less than 15% of the total body surface area cases that typically do not require hospital admission were also not captured. As such, the findings may not fully reflect the broader epidemiology of burn injuries in Port Harcourt.

CONCLUSION

Burn injuries are common. The younger age group are commonly affected. There was a male preponderance. Majority of burn injuries occurred in individuals from low and middle-income settings. The most common causes were kerosine burns, petrol burns and gas burns. Flame burns were the most common followed by scalds. The mortality rate was 39.2% and it increased with the total burn surface area.

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Nil

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this study.

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