

Burns Caused by Bioethanol Fireplaces: A Prospective Epidemiological Analysis in a Referral Burn Unit in Bogotá, Colombia (2020-2025)

Quemaduras por chimeneas de bioetanol: análisis epidemiológico prospectivo de una unidad de referencia de Bogotá, Colombia (2020-2025)

Queimaduras por lareiras de bioetanol: análise epidemiológica prospectiva em uma unidade de referência em queimados em Bogotá, Colômbia (2020-2025)

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ABSTRACT

Introduction: Bioethanol fireplace burns represent an emerging public health issue associated with decorative devices using volatile fuels, posing severe injury risks. **Objective:** To describe clinical, demographic, and contextual characteristics of patients with bioethanol fireplace burns treated at a specialized burn unit in Bogotá. **Methodology:** Prospective, observational, and analytical study of all cases (n=24) between January/2020 and June/2025. Clinical, sociodemographic, and contextual variables were analyzed. Descriptive statistics, survival analysis, and quadratic regression were applied. **Results:** Median age was 40 years (IQR: 25–42); 66.7 % were men. Surgery was required in 50 %, mechanical ventilation in 25 %. The mortality rate was 16.7 %. Infections were present in 41.7 %. Most injuries occurred during ignition (75 %) and one-third had delayed hospital admission. Frequent ICD-10 codes: T311, T312, T315, T270, Y260, X040. **Conclusion:** Bioethanol burns are severe and increasing. Regulatory action, public education, and safer product designs are needed.

Keywords

burns; bioethanol; accidents home; accident prevention; Colombia.

RESUMEN

Introducción: Las quemaduras por chimeneas de bioetanol constituyen una problemática emergente de salud pública, derivada del uso de dispositivos decorativos con combustibles altamente volátiles. Estas lesiones tienden a ser graves y están en aumento. **Objetivo:** Describir las características clínicas, demográficas y contextuales de pacientes con quemaduras por chimeneas de bioetanol atendidos en una unidad especializada en Bogotá. **Metodología:** Estudio prospectivo, observacional y analítico de los pacientes (n = 24) atendidos entre enero de 2020 y junio de 2025. Se analizaron variables clínicas, sociodemográficas y contextuales. Se aplicó estadística descriptiva, análisis de supervivencia y regresión cuadrática. **Resultados:** La mediana de edad fue 40 años (RIQ: 25-42); el 66,7 % eran hombres. El 50 % requirió cirugía, y el 25 %, ventilación mecánica. La mortalidad fue del 16,7 %. El 41,7 % presentó infecciones. El 75 % de los casos ocurrió al encender el dispositivo, y un tercio tuvo ingreso hospitalario tardío. Los códigos CIE-10 más frecuentes fueron T311, T312, T315, T270, Y260 y X040. **Conclusiones:** Estas quemaduras presentan alta severidad y requieren una respuesta multisectorial con enfoque regulatorio, educativo y de rediseño de dispositivos.

Palabras clave

bioetanol; quemaduras; accidentes domésticos; prevención de accidentes; epidemiología; Colombia.

RESUMO

Introdução: Queimaduras por lareiras de bioetanol são um problema emergente de saúde pública, associadas a dispositivos decorativos com combustíveis altamente voláteis. **Objetivo:** Descrever características clínicas, demográficas e contextuais dos pacientes queimados por lareiras de bioetanol atendidos em uma unidade especializada em Bogotá, Colômbia. **Metodologia:** Estudo prospectivo, observacional e analítico com todos os casos (n = 24) entre janeiro de 2020 e junho de 2025. Foram aplicadas estatísticas descritivas, análise de sobrevivência e regressão quadrática. **Resultados:** Mediana de idade: 40 anos (RIQ: 25-42); 66,7 % eram homens. A cirurgia foi necessária em 50 %, e ventilação mecânica, em 25 %. A letalidade foi de 16,7 %. As infecções estiveram em 41,7 %. A maioria dos eventos (75 %) ocorreu durante o acendimento. Códigos CIE-10: T311, T312, T315, T270, Y260, X040. **Conclusão:** Lesões graves requerem gestão clínica especializada e ações regulatórias urgentes.

Palavras-chave

queimaduras; bioetanol; acidentes domésticos; prevenção de acidentes; Colômbia.

Introduction

Thermal injuries are one of the most common reasons for consultation in specialized emergency and burn units (1,2), representing a significant public health issue due to their high impact on morbidity, mortality, and healthcare burden (3). Within this spectrum, burns caused by bioethanol represent an emerging form of severe thermal trauma, linked to decorative household devices such as bioethanol fireplaces (4). These structures, promoted for their aesthetic appeal, portability, and presumed safety, have gained popularity without sufficient regulation or awareness of the associated risks.

Bioethanol is a highly volatile fuel, nearly invisible, and has a low flash point, making it a particularly dangerous agent (5,6) in uncontrolled environments. Unlike other flammable liquids used in industrial or rural settings, its use in urban and residential environments introduces new risk dynamics. Injuries tend to occur during the ignition or refueling of the device, in the presence of residual heat, or due to the inadvertent proximity of people to the device while it is in operation.

Despite its increasing incidence, bioethanol burns are underreported in the scientific literature (2,7), particularly in Latin American countries, which complicates the development of evidence-based strategies. This prospective study focuses on describing the demographic, clinical, and contextual characteristics of patients burned by this cause in a burn unit in Bogotá (Colombia).

Methodology

Study Design. A prospective epidemiological study was conducted, of an observational, descriptive, and analytical type, based on the systematic follow-up of consecutive cases of burns caused by bioethanol fireplaces treated between January 2020 and June 2025.

Study Population and Setting. A total of 24 patients were included, all of whom were treated in the Burn Unit of the Simón Bolívar Hospital Empresa Social de Estado (ESE), a referral center

in Bogotá (Colombia). The unit is equipped for intensive care and specialized surgical procedures in thermal trauma.

Inclusion Criteria. Patients with burns secondary to the use or manipulation of bioethanol fireplaces, with a complete clinical record and institutional consent for data usage for research purposes.

Data Collection. Data were collected through direct review of clinical records and administrative logs. An anonymized database was created, including sociodemographic variables (age, sex, and place of residence), clinical characteristics (percentage of total body surface area burned [%TBSA], ABSI score, use of mechanical ventilation, hospitalization, length of stay, microbiology, and antimicrobial treatment), and contextual factors (event location, injury mechanism, and time of admission post-accident).

Variables

- Quantitative: age, percentage of total body surface area burned, ABSI, days of hospitalization, hours until hospital admission.

- Qualitative: sex, type of surgical procedure, need for mechanical ventilation, microbiological findings, requirement for hospitalization, and clinical outcome.

Statistical Analysis

The statistical software Minitab®, version 19.2020.1, was used for analysis. Quantitative variables were described using medians and interquartile ranges (p25-p75), while qualitative variables were described using absolute and relative frequencies. Graphical techniques were employed to represent the distribution of age, the temporality of cases, and the relationship between clinical variables (ABSI and %TBSA). Additionally, survival analysis was conducted to evaluate the time from the event to hospital admission, and a quadratic regression was applied to explore the association between the

percentage of total body surface area burned and the ABSI score.

Results

Demographic Characteristics The median age was 40 years (IQR: 25-42), with a range of 8 to 79 years. The mean age was 37.1 years. 66.7% of the cases were male (16/24), and 33.3% were female (8/24) (Table 1).

Table 1.
Clinical and Demographic Characteristics

Variable	Value
Age (median, IQR)	40 years (25-42)
Male sex (%)	66,7
%TBSA (median, range)	12,5 (7-25,8)
ABSI (median, max.)	5,5 (max. 10)
Surgery required (%)	50
Mechanical ventilation (%)	25
Mortality (%)	16,7
Microbiological infections (%)	41,7

Clinical Characteristics

The median percentage of total body surface area burned (%TBSA) was 12.5% (IQR: 7%-25.8%), with a maximum of 54%. The ABSI score had a median of 5.5 (IQR: 3-7), with a maximum value of 10. 33% of the patients had an ABSI ≥7, indicating increased risk. 50% of the patients (12/24) required some type of surgical procedure. 25% (6/24) required mechanical ventilation.

The mortality rate was recorded at 16.7% (4/24). No significant pre-existing comorbidities were noted in most patients, a factor that did not notably influence the initial severity. 41.7% of patients (10/24) had positive microbiological cultures, indicating a significant rate of hospital-acquired infections. The median time from burn to infection development was 7 days (IQR: 5-11), consistent with what is reported in the literature, where most infections in burn patients occur

between the fifth and tenth day after the injury (2,7).

Although the primary design of this study is descriptive, an exploratory correlation was conducted between %TBSA and the ABSI score to identify relevant clinical trends and strengthen the external validity of the findings. Previous studies have used this type of correlation in descriptive cohorts of burn patients (5,8). In the quadratic regression analysis, a positive relationship was observed between %TBSA and the ABSI score, indicating that as the extent of the burn increases, so does clinical severity. Figure 1 shows the relationship between %TBSA and the clinical severity score (ABSI), adjusted by quadratic regression.

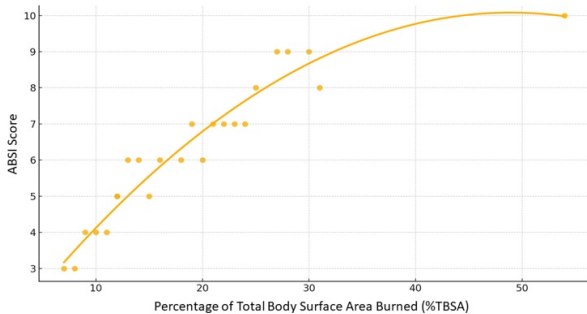


Figure 1. Relationship between the percentage of total body surface area burned and the ABSI score (quadratic regression)

Contextual Characteristics

During the period from January 2020 to June 2025, 24 patients with burns secondary to the domestic use of bioethanol fireplaces were identified. The most common codes from the tenth edition of the International Classification of Diseases (ICD-10) were T31.1: burn affecting 10% to 19% of the body surface; T31.2: burn of 20% to 29%; T31.5: burn of 40% to 49%; T27.0: burn of the larynx and trachea; Y26.0: contact with flames from flammable liquids; and X04.0: exposure to flammable liquid fuels. A sustained increase in cases was observed in the last two years of the study (2023 and 2024), which may be

related to a higher use of these devices or a lack of awareness of the associated risks.

Temporally, the cases were concentrated in the second and third quarters of the year. The most frequent mechanism was the ignition of the fireplace (75%), followed by refueling while the device was still hot or had an invisible flame. 30% of the population suffered thermal injuries solely from being in proximity to the fireplace, highlighting that the danger is not limited to improper use but also to close exposure during operation. Testimonies refer to phrases such as: "I thought it was off, but it still had a flame" or "when they lit the fireplace, I got burned." This reveals a pattern of ignorance about the inherent risks of bioethanol (Table 2).

Table 2. Most Common Burn Mechanisms

Mechanism	Number of Patients (%)
Ignition of the device	18 (75)
Refueling with residual invisible flame	4 (16,7)
Accidental proximity to the lit device	2 (8,3)

Geographically, most of the events occurred in Bogotá and its surrounding municipalities, with a predominance in the northeastern and northwestern areas of the city (Figure 2). The median time from the event to hospital admission was 6 hours; however, one-third of the patients were admitted to the hospital more than 8 hours after the accident, which represents an additional risk of mortality.

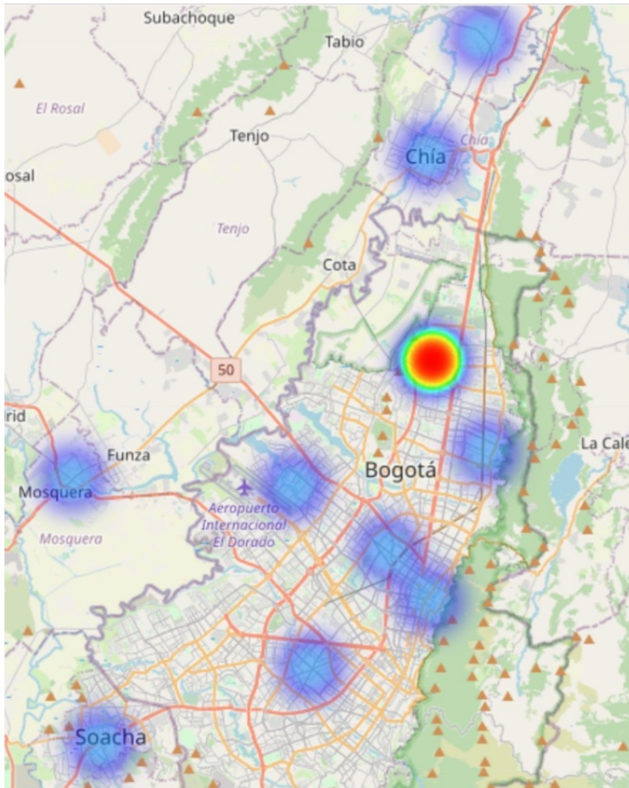


Figure 2.
Heat map of the geographic distribution of bioethanol-related events in Bogotá and surrounding municipalities
Note. The map represents the intensity of cases according to the location of the event. The areas of Bogotá with the highest frequency of incidents are highlighted, including Suba, Usaquén, Engativá, as well as neighboring municipalities such as Chía and Cajicá.

Discussion

Burns are a public health issue. Determining the epidemiology of different types of injuries is essential to understanding the phenomenon under study and generating effective prevention policies and interventions (1). Since 2016, there has been a significant increase in the number of people suffering from burns, especially in countries with low, lower-middle, and middle socio-demographic indices (2). There are marked differences between regions and countries, as they primarily affect low-income areas, which also experience higher mortality and incidence

rates (1,7). This confirms that burns are one of the pathologies with the greatest inequity in the world.

The findings reveal a clear risk profile in patients burned by bioethanol fireplaces: predominantly young and older adults, mostly men, with burns sustained in a domestic setting during device ignition. The description of the devices involved reveals a key preventive pattern: most of the fireplaces were portable, small, and sold without basic safety mechanisms, increasing the risk of accidents during ignition and refueling. This aligns with European reports linking more severe burns to portable models without protective systems. The lack of regulation on the design and sale of these devices in the Colombian context exacerbates the problem (6,7).

Most of the incidents required immediate hospital care, surgical procedures, and, in some cases, life support such as mechanical ventilation. 50% of patients required surgery, highlighting the depth and extent of the injuries. Additionally, the infection rate of 41.7% and the need for broad-spectrum antibiotics indicate a significant risk of septic complications. The mortality rate of 16.7% aligns with reports in the literature on burns caused by flammable liquids, which are more severe than other thermal causes. Authors like Neubrech et al. (6) describe a mortality rate of 15%, while Kraemer et al. (8) report a rate of 17%.

Numerous studies have demonstrated that the use of flammable liquids is associated with greater severity of thermal injuries (9-13), prolonged hospital stays, and a higher likelihood of intensive care unit admission. The characteristics of bioethanol, such as its low flash point and nearly invisible flame, increase this risk. Additionally, its use in decorative devices without an essential thermal function makes it an unnecessary risk, especially when combined with unsafe handling practices, such as immediate refueling after use or in the presence of residual heat (14,15).

This study reinforces previous observations by Kraemer et al. (8) and Van Zoonen et al. (16), which identified similar patterns: injuries during refueling or ignition, involvement of

multiple specialized areas, and a high rate of reconstructive procedures. Kraemer et al. (8) report a mortality rate of 17% and surgery in 58% of cases, while Van Zoonen et al. (16) document that 22% of events also affected people near the user, a finding observed in our cohort in a significant percentage, amplifying the public health impact.

Studies such as those by Tapking et al. (7), Van Zoonen et al. (17), and Neubrech et al. (6) report complication rates similar to those found in our study: infections over 40%, surgery in more than 50% of cases, and involvement of multiple areas (18). The seasonal distribution also mirrors European contexts, where the use of fireplaces increases in the second and third quarters of the year (19).

The documentation of bioethanol cases in Latin America remains scarce, and this study represents one of the first regional prospective reports to systematically and quantitatively analyze these events. Moreover, it provides strong evidence of the need to regulate the commercialization of these devices and liquids, establish mandatory visible warning standards, and promote research into more effective safety systems in bioethanol fireplace design.

Clinical management must be specialized from the first contact, with protocols to quickly identify bioethanol burns and prevent secondary infections. A delay of more than 8 hours in one-third of the cases represents an opportunity window for community intervention.

The results support the urgent need for mandatory bioethanol labeling regulations, the banning of devices without automatic shutdown, and the inclusion of these injuries in national epidemiological surveillance.

These findings underscore the urgency of implementing prevention campaigns, regulating labeling for bioethanol containers, and establishing safety standards for domestic bioethanol use.

Conclusions

This prospective study establishes that burns caused by bioethanol fireplaces are not only on the rise but also present a complex and severe clinical profile, with a high frequency of prolonged hospitalization, infections, surgical procedures, and mortality.

The identified epidemiological pattern — accidents during ignition, injuries in the domestic environment, and involvement of critical anatomical areas — highlights the urgent need for regulatory and educational actions. The findings provide valuable input for the formulation of public health policies, safety regulations for device design, and clinical guidelines. From a clinical and preventive perspective, it is proposed to:

- Implement mandatory and visible warnings on products containing bioethanol.
- Require technical safety standards in the manufacture of decorative fireplaces.
- Develop educational campaigns about the risks of burns from volatile fuels.
- Include this category of injuries in burn epidemiological surveillance systems.

Only through a multisectoral and evidence-based response can the impact of this emerging public health phenomenon be mitigated. This study confirms that burns from bioethanol are an increasing, serious, and underreported phenomenon. The response must be comprehensive: medical, regulatory, and educational.

Future Research Directions

- Assess the impact of educational campaigns.
- Validate safety systems in fireplaces.
- Estimate the economic burden of treatment.

Limitations

- The sample is limited to an urban hospital setting.
- Follow-up post-discharge is not included.

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