

# Burn Injury Patterns in Emergency Department Visits

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## Abstract

Every year, medical attention is needed for 1.1 million burn injuries in the United States with costs of care accumulating up to \$10 billion annually. The burns can range in severity from first degree to third degree and may be the result of various hazards such as fire, electricity, chemicals, or the sun. The goal of this study was to assess the trends of burn injuries and severities by patient demographic factors. A total of 7,145 patients presenting to the emergency department meeting the criteria of burn injuries (ICD-10 codes: T29, T30, and T31) were extracted from the United States 2019 National Hospital Ambulatory Medical Care (NHAMCS) survey, compiled by the Center of Disease Control and Prevention (CDC). The data was analyzed using descriptive analysis and chi-square tests with an alpha significance level at 0.05. Adults 61 and older reported most burn injuries with fire being the most common cause in this group, while those between the ages of 46-60 years reported the least. There were no significant differences between males and females in the severity of burns, whereas there were differences in the type of burns. Whites accounted for the highest number of burn related injuries, whereas Asians demonstrated the least. The racial disparity suggests the importance of addressing equity in prevention, access, treatment, and care. In addition, it is necessary to implement age-specific interventions and targeted educational programs to address vulnerabilities among different age groups.

## Keywords

Emergency care, Thermal injury, Patient demographics, Burn severity, Trauma management, Burn treatment, Acute burns, Burn epidemiology.

## INTRODUCTION

Emergency departments (EDs) in the United States (U.S.) care annually for over 400,000 patients with burn related injuries. Approximately 3275 of these result in death. Burns are one of the most common household injuries, especially among children. There are three primary types of burns: first, second, and third-degree. Each degree is based on the severity of damage to the skin, with first-degree being the most minor and third-degree being the most severe. The types of burns include chemical burns, electrical burns, fires, including flames from matches, candles, and lighters and excessive sun exposure. This research will study the burn related patterns in the United States by patient characteristics such as patient age, race, sex and other demographic characteristics.

Patients' race is associated with a widespread disparity amongst burn injuries. The emergency department visit rate for burns from 1993 to 2004 in the US was 62% greater among black than white subjects (340 vs. 210 per 100,000, respectively) [1]. An individual can also be more susceptible to burns based on their ethnicity. Asians are associated with the highest workplace burns, whereas Caucasian males present with

more severe flame burns that in most cases were accidents in nature that came from alcohol, drugs, or accelerants [2]. The trend by the type of burn can also be seen within the patient's socioeconomic status. There is a higher risk for burn injury associated with lower-income populations [3]. Lower income populations tend to be mostly of ethnic minorities. The Burn Model System, which collects patient reported outcomes after a burn injury, identified disparities with burn victims between race/ethnicity, gender and age [4]. The results within the epidemiology and risk factors from the database are able to paint a clearer picture on the types of burns that patients were more prone to by race based on their demographics. There are many challenges that come with identifying the racial disparities including gaps present within patient centered care to address undertreated pain, inadequate healthcare screening, and lower quality care in the medical system [5].

When it comes to age, it appears that pediatrics and older adults have a higher incidence of sustaining burn injuries than any other age groups in the US. The American Burn Association and the National Burn Registry show that pediatric burn injuries are most common among those 5 years



old and younger [6]. The most common pediatric burn etiologies are scalds, fire/flame, and water tap. The second most common etiology of pediatric burns are contact burns. Ethnicity also plays a role when it comes to pediatric burns with children of color being more prone to burn injuries at a younger age [7]. They also have a higher probability of sustaining more severe burn injuries as well. Another factor that can contribute to the incident rates of pediatric burns are those who have attention deficit/hyperactivity disorders. It is shown that children who do have ADHD have a higher risk of sustaining a burn injury as compared to those who do not have ADHD [8]. This can be due to the impulsivity and vigilant defects that are caused from this disorder. As it pertains to the older population, burn injuries are more common in those who are 60 years of age or older. Flame burn was the most common etiology of the burns [9]. Overall, men had a higher incidence rate of sustaining burn injuries than women. The older population raises concerns for recovery and severity of the burns. However, the majority of adults that are admitted to the emergency department with burn injuries are discharged after evaluation and treatment [10].

Burn injuries are also influenced by the patients' gender with women depicting more severity and a higher proportion distribution to the arms and legs. Burn-injured women had significantly increased odds of in-hospital mortality compared to men. Higher rates of female mortality in trauma and burn-injured patients have been reported in multiple instances [11]. Female burn patients suffer higher mortality compared to men and are less likely to receive surgery [12], and the risk of death was correlated with lower socioeconomic status. Women have a higher frequency of being burned at home, and men have a higher frequency of being burned at work [13]. Men suffered more burns with hot liquids and fire burns which had higher reports of suspected influence of alcohol/other substances. According to gender similarities in abbreviated injury scores, a higher proportion of men were transferred to higher levels of care and a higher proportion of women were treated and discharged [14]. Severe burns caused by electricity are common work-related injuries of middle-aged men [15].

Job related burn injuries are prevalent and are dependent on the nature of the job and the tools used to perform it. Amongst electric utility workers between the years 1995-2004 electric burns were most prevalent, followed by thermal, and to a lesser extent chemical [16]. In a study looking at non-fatal occupational burn injuries treated in U.S. emergency departments, younger workers were found to have higher rates of occupational burns than older workers [17]. Almost a third of all work-related burns were thermal burns, followed by chemical and electrical/radiation burns. Accommodation and food services, followed by manufacturing, construction, welders, and electricians, indicated high incidence of burn injuries [18]. Injuries were mostly due to fire and flames, followed by electrical, hot liquids, and vapors. In all cases, the more body surface area involved in the injury the more severe it is and the more likely it is to result in fatality.

This study aims to investigate the relationship between demographic factors, types of burns, and burn severity among patients seeking treatment for burn-related injuries in the emergency department.

## METHODS

A retrospective analysis of data was conducted to examine burn-related injuries in patients presenting to the emergency department (ED). A total of 7,145 patients meeting the inclusion criteria for burn-related injuries, as identified by ICD-10 codes T29, T30, and T31, were extracted from the United States 2019 National Hospital Ambulatory Medical Care (NHAMCS) survey. Prior to analysis, the

data was thoroughly checked for integrity. Subsequently, the data was exported into the Statistical Package for Social Sciences software (SPSS®) for further examination. Descriptive analysis was employed to assess the overall distribution of burn types and severity among the patient cohort. Additionally, chi-square tests were performed to explore any significant associations between variables, using an alpha significance level set at 0.05 to determine statistical significance.

## RESULTS

Figure 1. Frequency of Burn Types

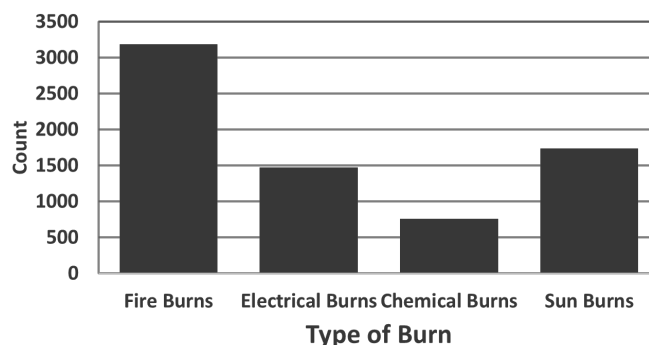


Figure 2. Frequency of Burn Severity

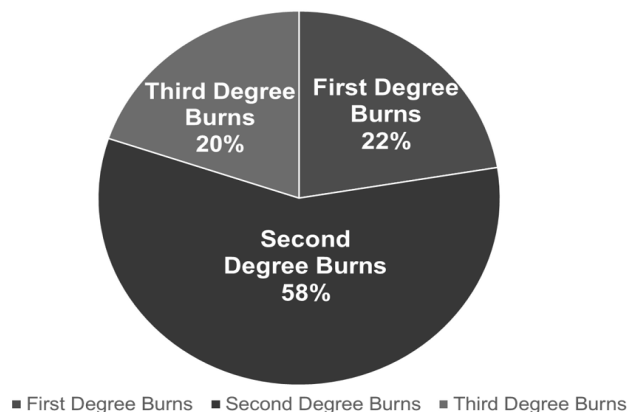
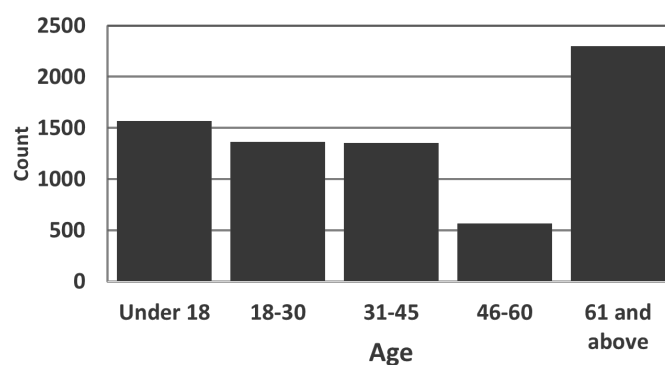


Figure 3. Patient Age



### Type of burn and severity

The study examined the types of burns and their corresponding severity, categorized into first, second, and third-degree burns, reflecting on the distribution of burn-related injuries in the emergency department (ED) visits. Among the reported cases, second-degree burns accounted for the highest proportion (57.8%), followed by first-degree burns (22.4%), and third-degree burns (19.8%). Fire burns

**Table 1:** Influence of Patient Demographics on Burn Type and Severity.

Demographic variable	Frequency	Percentage	Types of burns significance(p)	Severity of burns significance(p)
<b>Age</b>				
Under 18	1569	22.0	<0.001	<0.001
18-30	1361	19.0		
31-45	1353	18.9		
46-60	564	7.9		
61 and above	2298	32.2		
<b>Sex</b>				
Female	3175	44.4	0.025	0.183
Male	3970	55.6		
<b>Race</b>				
White	3174	44.4	<0.001	<0.001
Black	1558	21.8		
Asian	825	11.5		
Hispanic	1085	15.2		
Other	503	7.0		
<b>Type of Payment</b>				
Medicaid	2894	40.5	<0.001	<0.001
Private Insurance	1719	24.1		
Self pay	1705	23.9		
Other	827	11.6		
<b>Region</b>				
Northeast	1693	23.7	<0.001	0.002
Midwest	1529	21.4		
South	2329	32.6		
West	1594	22.3		
<b>Types of Burns</b>				
Fire Burns	3186	44.6	n/a	<0.001
Electrical Burns	1468	20.5		
Chemical Burns	758	10.6		
Sun Burns	1733	24.3		
<b>Severity</b>				
First Degree	1599	22.4	<0.001	n/a
Second Degree	4129	57.8		
Third Degree	1417	19.8		

emerged as the most common type of burn (44.6%), followed by sunburns (24.3%), and electrical burns (20.5%). Chemical burns were the least prevalent (10.6%). Statistical analysis revealed a significant relationship between the type of burn and its severity ( $p < 0.001$ ). Fire burns were more frequently associated with all degrees of burns, whereas, chemical burns had the lowest association. These findings highlight the prominence of second-degree burns and fire burns in burn-related injuries seen in the ED.

### Age

The study revealed insights into the relationship between age and the type of burns sustained by individuals. Adults aged 61 and older emerged as the age group most commonly afflicted by burn-related injuries, accounting for a substantial 32.2% of reported cases. Notably, children under the age of 18 also demonstrated heightened vulnerability to burns, representing 22.2% of the cases. In contrast, individuals aged 46 to 60 years exhibited a lower likelihood of experiencing burn-related injuries, with only 7.9% of cases reported in this age category. Further analysis of the data indicated a statistically significant relationship between age and the type of burn sustained ( $p < 0.001$ ). Moreover, patients aged 46 to 60 years were found to be the least likely age group to suffer from chemical burns, whereas patients aged 61 years and above faced a higher risk for fire, electrical, chemical, and sun burns. This study also explored the association between age and the severity of burns. Patients aged 61 and above were at a heightened risk of suffering from first, second, and third-degree burns, indicating a greater susceptibility to more severe burn injuries in this age group. Following this group, patients

under the age of 18 were more likely to experience first and second-degree burns, suggesting a relatively lower incidence of severe burns in this younger age cohort.

### Gender

Upon analyzing the data, it was observed that more males were reported to have sustained burn injuries compared to females; however, the difference in numbers was relatively modest, still significant, with approximately an 11% variation between the two groups. In addition, males also exhibited a higher likelihood of sustaining all types of burns when compared to their female counterparts. The study also examined the relationship between gender and the severity of burns. Although males were reported to have a greater number of cases for all degrees of burns, but it did not reveal a significant relationship between gender and burn severity ( $p = 0.183$ ).

### Race

The study uncovered significant associations between race and both the type and severity of burns experienced by patients. Patient race played a crucial role in burn-related injuries, with white individuals exhibiting the highest likelihood of sustaining such injuries (44.4%). Results revealed a significant relationship between race and the severity and type of burns ( $p < 0.001$ ). Patients identifying as white suffered the most across all degrees and types of burns. While black patients followed the whites in terms of fire, electrical, and sun burns, the Asians had the most chemical burns after the white patients.

## Type of payment

The study uncovered noteworthy patterns regarding the payment methods utilized by patients for emergency department (ED) visits. Medicaid emerged as the primary mode of payment for burn-related injuries, surpassing private insurance, self-pay, Medicare, and other payment options. Results indicated a strong relationship between the type of payment and race. White patients were more likely to use both Medicaid and private insurance, whereas, black, Asian, and Hispanic patients relied on Medicaid alone more frequently as their payment method.

## Region

The study examined variations in the frequency, type, and severity of burns across different regions. Frequency of burns showed significant regional disparities, with the South reporting the highest prevalence, while the Northeast, West, and Midwest had relatively similar rates. There was a significant relationship between the region and the type and severity of burn sustained with residents in the southern states being more likely to suffer from fire burns, while those in the Northeast primarily experienced electrical and chemical burns. Chemical burns were equally prevalent in the Northeast and West regions, while sun burns were more common in the Midwest. While patients in the south suffered from all degrees of burns, the residents in the Northeast experienced more first and second-degree burns, and those in the west had a higher incidence of third-degree burns.

## DISCUSSION

Burn-related injuries are a significant public health concern, and understanding the factors associated with these injuries is crucial for effective prevention and management strategies. The study findings revealed significant associations between demographic factors and burn-related injuries. Age was a critical factor influencing burn susceptibility, with older adults (61 and above) reported to have the highest frequency of burn-related injuries, which may be attributed to various factors, including increased frailty and reduced mobility. In contrast, patients aged 46-60 years showed a lower likelihood of burn injuries, indicating a potential awareness of safety measures in this group. Gender also played a role in burn injuries, with males more frequently experiencing burns than females. This observation highlights the need for gender-sensitive burn prevention strategies and targeted interventions to address different risk profiles in both male and female populations. The study also showed variations in burn prevalence across racial groups. This disparity suggests the importance of considering racial differences in burn prevention efforts and ensuring equitable access to burn care and treatment. Regional disparities in burn-related injuries were also evident in the study. Understanding regional variations can aid in tailoring burn prevention efforts to address specific risk factors prevalent in different geographical areas.

The variations in the severity and type of burn sustained emphasizes the importance of fire safety measures and targeted educational campaigns to reduce the incidence of fire-related burn injuries. Similarly, there were significant payment disparities in accessing burn-related healthcare services. Tailored strategies and policies should be implemented to ensure equitable access to quality care and comprehensive coverage for all patients, regardless of their racial background and payment methods.

## LIMITATIONS

The data analyzed was derived from the United States 2019 National Hospital Ambulatory Medical Care survey, which may not capture

all burn injury cases or encompass the entire population. To further enhance our understanding of burn-related injuries, future research could explore other relevant factors not covered in this study, such as socioeconomic status, comorbidity, and occupation.

## CONCLUSION

This study provides a valuable insight into the association between demographic factors, types of burns, and burn severity among patients with burn-related injuries visiting the emergency department. The findings highlight the importance of targeted interventions to prevent and reduce burn injuries, and to promote better care in all groups. By addressing the identified disparities, healthcare professionals and policymakers can work together to raise awareness, provide education, and enhance injury management.

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