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Original research article

Clinical characteristics of burns in hospitalized children and adolescents: A multicenter retrospective study

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Abstract

Background: Burns in children represent a significant public health issue due to their high frequency and potential for severe physical and psychological consequences. This study aims to describe the clinical characteristics of burns in hospitalized children and adolescents in the Republic of Srpska between 2018 and 2020.

Methods: A multicenter retrospective study was conducted, collecting data from the national e-base of the Agency for Certification, Accreditation and Quality Improvement of Health Care of the Republic of Srpska for patients aged ≤19 years hospitalized for burns. ICD-10 codes were used to identify burns, from which demographic and clinical characteristics were extracted.

Results: A total of 70 patients were identified, with a median age of 1 year [interquartile range (IQR3): 1–4 years]. The majority were children aged 0 to 9 years (84.3%), and 67.1% were boys. Most burns occurred during winter (34.3%), and the median hospital LOS was 6.5 days (IQR: 5–9 days). Scalds from hot liquids were the most common type (84.3%), primarily affecting the lower extremities (31.4%) and head and neck (25.7%). Statistically significant differences were observed in the causes of burns, affected anatomical regions, and age groups ($p < 0.05$). The burned body surface area ranged from less than 10% to 29% TBSA, with 61.4% having less than 10%, and no significant differences based on age, gender, or cause of hospitalization ($p > 0.05$).

Conclusion: Burns from hot liquids and contact burns are the main causes of injuries in hospitalized children aged 1 to 4 years in the Republic of Srpska, highlighting the need for targeted prevention strategies.

Keywords: Adolescents; Burns; Causes; Children; Epidemiology

Introduction

Burn injuries represent a major public health challenge, especially in pediatric populations, due to their potential to result in serious consequences (Toma et al., 2024). Burns in younger children are often associated with significant long-term physical and psychological consequences, as well as prolonged treatment and care (Duke et al., 2015). According to the literature, the largest percentage of those hospitalized due to burns are children aged 0 to 5 (Han et al., 2022). A burn is an injury to the skin and surrounding tissue caused by heat. They can occur due to exposure to hot liquids, hot solids (contact burns), or flames. Burns also include skin injuries (thermal burns) caused by electrical or chemical substances, ultraviolet radiation, radioactivity, as well as inhalation burns resulting from smoke or steam inhalation (European Burns Association, 2017; Peden et al., 2008).

The most common type of burn in childhood is thermal burns caused by hot liquids, which predominantly occur at home (Kawalec, 2018). The initial classification of burns in children considers two factors: the depth of the burn and the total body surface area (TBSA) affected. The severity and onset of a burn may also depend on the temperature and duration of contact (Krishnamoorthy et al., 2012; Yin, 2017). The ICD-10 classifies burns according to the extent of body surface involvement expressed as a percentage, coded from T31.0 to T31.9. According to this classification, burns are divided into those involving less than 10% TBSA (T31.0) and those involving 90% or more TBSA (T31.9) (ICD-10-CM, 2021).

Burn injuries disproportionately affect the world's poorest populations (Holden et al., 2020). Common risk factors for accidental burns include the age of the child, gender, environment, and characteristics of the parents. The risk of burns is highest in children under two years of age and among boys (Kawalec, 2018; Peden et al., 2008). Burns occurring in children up to five years of age are typically caused by exposure to hot liquids, whereas in older children, burns are more often associated with flames (Jeschke et al., 2020).

Children's skin is more susceptible to burns than that of adults. In some countries, water heaters are often set to 60 °C, which can cause serious burns to a child in just two and a half

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seconds, while it would take twice as long for an adult. By reducing the hot water temperature to the level recommended by safety experts, the time increases to three minutes for children. This additional time can mean the difference between life and death for a young child (WHO, 2009).

In England, there is a specialist burn injury database known as the Burn Injury Database, which is used to track the actual number of hospital admissions due to burn injuries. This database serves as an effective surveillance mechanism, aiming to improve the quality and efficiency of health services through Information and Communication Technology. Data shows that approximately 13,000 burns requiring hospital treatment occur each year in England and Wales (Stylianou et al., 2015).

In the Republic of Srpska, there is the Agency for Certification, Accreditation and Improvement of Health Care of the RS (RS ASKVA), which is a public institution with the role of conducting certification and accreditation processes of public and private health care institutions of all levels of health care, as well as monitoring and improving the quality of health care. RS ASKVA collection of data from public hospitals (PHs) of the secondary and tertiary level of health care (Agency for certification..., 2025). Coding of diseases and patient status is based on the International Statistical Classification of Diseases and Related Health Problems 10th revision (ICD-10), which, as with most diseases, is insufficient for burns and does not have a code to record important details such as the mechanism of the burn and the circumstances under which the burn occurred. Data on hospital morbidity, collected by the Institute for Public Health of the Republic of Srpska, are broken down by disease group and gender. Disease group XIX (injuries, poisonings, and some other consequences of external causes) is included in the data collection, but Chapter XX (External causes of morbidity and mortality) is excluded. Burns (X00–X19), as part of chapter XX, have a specific way of classification according to the external cause, which separates them from group XIX, for which there is no data (Public Health Institute of Republic of Srpska, 2022).

It is very difficult to assess the true extent of burns because they are so diverse that many sufferers do not seek medical help or are treated in private clinics or hospitals for which we do not have data. According to data from the Institute of Statistics from 2020, the number of children and adolescents aged 0 to 19 was 235,622, which is about 20% of the total population of the Republic of Srpska (Institute of Statistics – Republic of Srpska, 2021). This data could also explain the relatively lower frequency of burns compared to other countries in the surrounding area. In the Republic of Srpska, there are currently no registers of burns in children and adolescents, nor are there any previous studies or reports related to this issue, which prompted us to conduct this research. Therefore, the aim of this study was to describe the clinical characteristics of burns in children and adolescents who were hospitalized in public hospitals in the Republic of Srpska between 2018 and 2020.

Materials and methods

A multicentre retrospective study was conducted, in which data were collected from the national database of the Agency for Certification, Accreditation and Health Care Quality Improvement of the Republic of Srpska (RS ASKVA) in public hospitals (PHs) of the Republic of Srpska during the period from January 1, 2018, to December 31, 2020.

Data sources

RS ASKVA started operating in 2003, and data collection from 10 PHs of secondary and tertiary health care levels began in 2011. The aforementioned database collects information on all hospital admissions, discharges, including deaths, and patient transfers. The ASKVA RS platform has the ability to filter for each of the following elements: hospital, clinic, gender, age, date of admission, date of discharge, duration of treatment, discharge status, main diagnosis according to ICD-10, WHO, diagnostic and therapeutic group and coefficient (DTS) or category according to DRG (Diagnosis Related Groups – DRG), procedures, and additional diagnosis according to ICD-10, WHO (comorbidities). Data from PHs RS are centrally stored in RS ASKVA and access to them is provided with a special permit.

By analyzing data from the national e-database (RS ASKVA), we included all patients aged ≤19, of both genders, with at least one verified diagnosis of burns upon admission. Burns were identified using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), Chapter XX, External Causes of Morbidity and Mortality (V01–Y98), Other external causes of accidental injury (W00–X59) (ICD-10-CM, 2019). During the observed period, a total of 120 children and adolescents hospitalized due to burns were identified across seven public hospitals (PHs) in the Republic of Srpska.

The criteria for entering clinical characteristics of burns into the database were as follows: (1) Group of external causes of accidental injury: Exposure to smoke, fire, and flames (X00–X09), Exposure to hot liquids (X10–X12.9), and Exposure to hot solids (X15–X19.9); (2) Anatomical location from the group Burns and corrosion of the external body surface, specified by location (T20 – head and neck; T21 – trunk; upper limbs including shoulders, wrists, and hands – T22–T23); lower limbs including hips, ankles, and feet (T24–T25); multiple and unspecified body regions (T29–T32); (3) Percentage of Total Body Surface Affected (T31.0–T31.9%TBSA).

The search excluded all patients whose burn injuries were verified as intentional (violence, suicide, self-harm) and those resulting from assault by smoke, fire, and flames (X97); transport accidents (V01–V99); secondary explosions (W35–W40); exposure to electric current, radiation, and extreme ambient air temperature and pressure (W85–W99).

Additionally, socio-demographic data were included in the analysis: age (0–19 years), gender, hospital level, seasonal variation, duration of hospital stay in days, place of the burn, and outcome. The patients were categorized into age groups: children (aged <1, 1–4, 5–9) and adolescents (aged 10–14 and 15–19). After applying the inclusion criteria for the study, a total of 70 cases were identified for the final qualitative analysis, which were treated in five public hospitals in the Republic of Srpska (three at the secondary level – Bijeljina, Prijedor, and Trebinje, and two at the tertiary level of health care – the University Clinical Centre of the Republic of Srpska and the University Hospital in Foča).

Data analysis

The statistical analysis included descriptive statistics (frequency, percentage, mean value, standard deviation, median, interquartile range). The association between the causes of the burn and demographic characteristics was examined using Fisher's Exact Test, and the correlation assessed for comparison between groups. We performed the statistical analysis using SPSS software, version 25.0. The level of statistical significance was set at $p < 0.05$.

Ethical aspects

The preliminary research project was approved by the Ministry of Health and Social Protection of the Republic of Srpska (Number: 11/04-500-565/19 dated September 25, 2019), the Agency for Certification, Accreditation and Quality Improvement of Health Care of the Republic of Srpska (Number: 11/2,01-801/19 dated September 26, 2019), and the Ethics Committee for Research on Humans and Biological Material at the Faculty of Medicine of the University of Banja Luka (Opinion No. 18/4/20 dated February 7, 2020).

Results

During the observed period, a total of 70 children and adolescents with burns were identified in five public hospitals in the Republic of Srpska (31, 21, and 18 per year of observation). The median age was 1 years [interquartile range (IQR): 1–4 years]. Children aged 0–9 years (median 1 year, IQR: 1–1.5 years) were more frequently hospitalized (84.3%) than adolescents aged 10–19 years. There was a gender difference in hospitalization, with boys comprising 67.1% of the cases. The majority of patients were treated in tertiary-level healthcare institutions (82.9%). The distribution of burn injuries was examined according to the seasons, revealing that most patients suffered burns during winter (34.3%). Over the three-year period, a total of 649 hospital days were recorded due to burns (241/159/249 days per year), with a median length of hospital stay of 6.5 days (IQR: 5–9 days). The largest group of patients had a treatment duration of 8 to 14 days (52.9%). The place of origin of the burn was not recorded in 65 cases, while in 5 cases (7.1%), the home was noted. Most children and adolescents recovered during their hospital stay and were discharged home (95.7%). Socio-demographic characteristics of the patients treated for burns are presented in Table 1.

Table 2 shows the distribution of causes and sites of burns by age group. During hospital treatment, scalds from hot liquids were the most common type of burn across age groups, affecting children aged 0–9 years the most (n = 59, 84.3%). Contact burns and flame burns were equally represented in the overall sample (7.1%). The results indicated a statistically significant difference between the causes of burns and age groups ($p < 0.05$). Burns to the lower limbs were the most frequently identified injuries during hospital treatment, accounting for 31.4% across all age groups. Additionally, burns to the head and neck were the second most common, making up 25.7%, particularly in the group of children aged 1 to 4 years (18.6%). The proportion of burns to the upper limbs was 21.4%. A significant relationship was found between the affected anatomical regions and the age of the children, with those aged 0–9 years more prone to burns that led to hospitalization ($p < 0.05$).

According to the gender structure, there was no statistically significant difference concerning the causes of burns ($p = 0.426$) or the anatomical regions of the body affected by the burns ($p = 0.851$).

Table 1. Socio-demographic characteristics

Age in years (n = 70; M = 3.58 ± 4.84), median = 1 years (IQR3: 1–4 years)			
Children (n = 59; 84.3%) M = 1.7 ± 2.0, median = 1 years, (IQR0.5: 1–1.5)	<1 year 1–4 years 5–9 years	12 41 6	17.1 58.6 8.6
Adolescents (n = 11; 15.7%) M = 13.6 ± 2.6, median = 13 years, (IQR3: 12–15)	10–14 years 15–19 years	6 5	8.6 7.1
Gender			
Male		47	67.1
Female		23	32.9
Level of public hospital			
Secondary (n = 3 PH)		12	17.1
Tertiary (n = 2 PH)		58	82.9
Seasonal variation			
Spring		14	20.0
Summer		19	27.1
Autumn		13	18.6
Winter		24	34.3
LOS (day) M = 9.3 ± 16.8, median = 6.5 days (IQR4: 5–9 days)			
1–7		1	1.4
8–14		37	52.9
15–21		26	37.1
>22		6	8.6
Place of the burn			
Not specified		65	92.9
Home		5	7.1
Outcomes			
Recovery		67	95.7
Transferred to another hospital		1	1.4
Discharged at personal request		2	2.9

Note: n – number; IQR – Interquartile Range; M – mean value; SD – standard deviation; PH – Public hospital; LOS – length of hospital stay

Table 2. Causes and burn site according age group

	Group of children			Group of adolescents		Total	*p*-values
	<1	1–4	5–9	10–14	15–19		
Causes of burn injury							
Flame burns – flames (X00–X09)	0 (0.0%)	1 (1.4%)	0 (0.0%)	1 (1.4%)	3 (4.3%)	5 (7.1%)	$p = 0.01$[a]
Scalds – hot liquids (X10–X12.9)	10 (14.3%)	37 (52.9%)	6 (8.6%)	5 (7.1%)	2 (2.9%)	60 (85.8%)	
Contact burns – hot solids (X15–X19.9)	2 (2.8%)	3 (4.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (7.1%)	
Burn site							
Head and neck (T20)	1 (1.4%)	13 (18.6%)	0 (0.0%)	1 (1.4%)	3 (4.3%)	18 (25.7%)	$p = 0.005$[b]
Trunk (T21)	3 (4.3%)	9 (12.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	12 (17.1%)	
Upper limbs (T22–T23)	4 (5.7%)	10 (14.3%)	0 (0.0%)	0 (0.0%)	1 (1.4%)	15 (21.4%)	
Lower limbs (T24–T25)	2 (2.9%)	8 (11.4%)	6 (8.6%)	5 (7.1%)	1 (1.4%)	22 (31.4%)	
Multiple and unspecified body regions (T29–T32)	2 (2.9%)	1 (1.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (4.3%)	

Note: [a] Fisher's exact test (14.82; $p < 0.05$); [b] Fisher's exact test (26.90; $p < 0.05$); p-values statistically significant ($p < 0.05$)

The distribution of burn sites and causes is shown in Table 3. The most frequently affected anatomical location due to hot liquid scalds is the lower limbs (35.0%), followed by the head and neck (23.3%), the trunk, and the upper limbs. Different causes of burns can significantly damage various anatomical parts of the body ($p < 0.05$).

The percentage of burned body surface area in hospitalized children and adolescents ranged from less than 10% to 29% TBSA. Patients with TBSA <10% and 10–19% accounted for 61.4% and 30.0%, respectively. In terms of hospital treatment, according to the age groups, children younger than 1 year (83.3%) and those aged 1 to 4 years (56.1%) most often had less than 10% TBSA. There was no statistically significant difference between %TBSA in relation to age group, gender, and causes of hospitalization in children and adolescents ($p > 0.05$).

Table 3. Burn site distribution by causes

Burn site		Scalds	Contact burns	Flame burns	Total	*p*-value
Head and neck	*n*	14	0	4	18	$p = 0.01$
	%	23.3	0.0	80.0	25.7	
Trunk	*n*	12	0	0	12	
	%	20.0	0.0	0.0	17.1	
Upper limbs	*n*	10	4	1	15	
	%	16.7	80.0	20.0	21.4	
Lower limbs	*n*	21	1	0	22	
	%	35.0	20.0	0.0	31.4	
Multiple and unspecified body regions	*n*	3	0	0	3	
	%	5.0	0.0	0.0	4.3	

Note: *n* = number; Fisher's exact test (13.98; $p < 0.05$); *p*-values statistically significant ($p < 0.05$)

Discussion

Burn injuries remain a serious threat to the well-being of the pediatric population, leading to significant cosmetic and functional consequences. These injuries are frequently observed in preschool-aged children, particularly those between 0 and 4 years old (Alemayehu et al., 2020). In this study, 85.0% of burns were caused by scalding, which is consistent with previous research (Alemayehu et al., 2020; Arslan et al., 2013; Asena et al., 2019; Han et al., 2022). The primary cause of scalds was hot water. To mitigate this risk, practical strategies should be implemented, such as setting the water heater temperature below 50 °C, as children can suffer severe scalds at temperatures of 65–70 °C (Han et al., 2015).

During hospitalization, scalds from hot liquids were the most common type of injury across age groups, with children aged 0–9 years the most affected (84.3%), aligning with

previous findings (Alemayehu et al., 2020; Han et al., 2022). A study on unintentional injuries in the Republic of Srpska revealed that children aged 0 to 9 years were hospitalized more frequently, with the age group of 0 to 4 years being the most vulnerable (75.7%). In this group, burns represented the second leading cause of hospitalization (Jović et al., 2023). The analysis of data from this study identified contact burns and flame burns as other common causes, each accounting for 7.1%. Burns in children under five years are often attributed to their curiosity, lack of understanding of danger, and insufficient supervision by parents or guardians. Educating parents about home safety, promoting early medical intervention, and raising public awareness could significantly reduce the incidence of burns among children (Mohammed et al., 2021). The primary causes of contact burns were hot metal objects and stoves. In terms of gender distribution, boys were hospitalized more frequently due to burns (67.1%), which is consistent with previous findings (Arslan et al., 2013; Kawalec, 2018).

Research indicates that the first five years of childhood represent a high-risk period for burn exposure, with male children particularly susceptible (60.1%) (Asena et al., 2019). Our findings regarding burn incidence in hospitalized pediatric cases align with a study conducted in Turkey (Arslan et al., 2013). Most burns occur at home, even when children are under parental supervision, highlighting the crucial need for adequate supervision, which may be even more important than ensuring a safe environment (Kawalec, 2018).

The study also found that the frequency of burns affecting the head and neck, upper limbs, trunk, and lower limbs was higher among children up to 9 years old, with statistically significant data. A previous study by Amin and colleagues noted a 200% increase in head and neck burns during the COVID-19 pandemic, attributing this rise to children primarily being at home, the most common location for burn incidents (Amin et al., 2022).

The research indicated that the majority of hospitalized cases involved burns affecting less than 10% TBSA (61.4%), consistent with previous findings (Mohammed et al., 2021; (Tripathee and Basnet, 2017). There was no statistically significant difference between %TBSA and age groups. The average duration of hospital treatment for burns was approximately 9 days ± 16.88, consistent with earlier studies (Alemayehu et al., 2020; Ramli et al., 2021). The length of stay serves as a standard variable for evaluating progress and outcomes in burn care. Various factors can influence hospitalization duration, including accurate assessments of burn depth, improved infection control, regular dressing changes, and necessary surgical interventions, all contributing to reducing the length of stay (Ramli et al., 2021). Additionally, some studies have shown a statistically significant correlation between %TBSA and length of stay, suggesting that one hospital day is required for each percentage of TBSA affected (Johnson et al., 2011; Ramli et al., 2021).

Limitations of the study

Despite the limited sample size of hospitalized burn patients, the study findings provide valuable, though constrained, insights into the epidemiological characteristics of burns across different age groups. This highlights the necessity for enhanced data collection methodologies to yield more accurate and comprehensive outcomes. However, there are several limitations to this research, which are discussed below:

1. Retrospective design:
   - Due to the retrospective design, analysis was limited to previously collected data.
2. Limitations in data quality:
   - The analysis revealed that the database generally recorded only the primary diagnosis of burns, classified by %TBSA, without more detailed information on the causes that led to the burns, such as hot liquids, hot objects, and flames.
   - The lack of data on the mechanism of the burn, location, and activity of the patient hinders a complete understanding of the circumstances under which the burn occurred, and may have impacted the completeness of the reported number of hospitalized burn patients.
3. Exclusion of private healthcare institutions:
   - The study did not include patients treated in private healthcare facilities, which could affect the generalizability of the results.

Conclusion

Burn injuries pose a significant risk to the health and well-being of the pediatric population, particularly in children aged 0 to 4 years. The high incidence of scalding burns, primarily from hot water, highlights the urgent need for preventive measures. Education for parents on home safety, along with public awareness initiatives, is vital to reduce the occurrence of burns. The findings underscore the importance of adequate supervision, as many burn injuries occur at home, even under parental watch. A comprehensive approach that includes better data collection, targeted prevention strategies, and enhanced medical care can significantly mitigate the risks associated with burn injuries in children. However, effectively addressing this problem requires a multi-pronged approach. Data collection systems need to be improved to provide more precise and detailed data on the mechanisms, circumstances, and consequences of burns. This will allow for a better understanding of the risks and more effective targeting of prevention strategies. In addition, prevention campaigns should be targeted and tailored to specific risks, such as scalds from boiling water in the kitchen and bathroom. Activities should include practical advice on the safe handling of hot liquids, the installation of protective barriers, and keeping dangerous objects out of reach of children. It is also crucial to improve medical care for children with burns. This includes training medical staff in providing adequate first aid. Finally, it is necessary to establish cooperation between health professionals, educational institutions, the media, and parents to create a safe environment for children. Continued education, monitoring, and the evaluation of preventive measures are key to reducing the number of burns and improving the quality of life of the pediatric population.

Ethical aspects and conflict of interest

The authors have no conflict of interest to declare.

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