



# Time trend of hospitalization due to burn, in the age group of 0-14 years, in Brazil, 2012-2022

## *Tendência temporal de internação por queimadura, na faixa etária 0-14 anos, no Brasil, 2012-2022*

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### ■ ABSTRACT

**Introduction:** Burns are tissue injuries caused by contact with heat sources. They represent a global public health problem. They have major impacts on children. The severity and intensity of burns are related to the etiological agent and their consequences are a major obstacle for the patient. **Method:** The study analyzed data on hospital admissions for burns in children from 2012 to 2022, using information from SIH-SUS. Hospitalization rates per 100,000 inhabitants were calculated for each year, considering dependent variables. The researchers used standardized coefficients and simple linear regression to analyze the data. **Results:** Data from 91,091 hospitalizations for burns in children, 0-14 years old, were included. There was stability in the general hospitalization rate (mean rate 17.963;  $\beta=0.119$ ;  $p=0.163$ ). In females there was an increasing trend (mean rate 14.346;  $\beta=0.169$ ;  $p=0.029$ ); in males, there was stability (mean rate 21.426;  $\beta=0.069$ ;  $p=0.504$ ). Females behaved with stability in all age groups; the male with an increase in the range 0-4 years (mean rate 42.264;  $\beta=0.613$ ;  $p=0.003$ ), stability in the range 5-9 years (mean rate 14.189;  $\beta=-0.21$ ;  $p=0.867$ ) and reduction in the range 10-14 years (mean rate 9.871;  $\beta=-0.328$ ;  $p=0.007$ ). The South Region demonstrated an increasing trend (mean rate 26.952;  $\beta=1.091$ ;  $p=0.001$ ). **Conclusion:** There was stability in the general hospitalization rate. The female sex tended towards increase and the male towards stability. There was stability in Brazilian regions, except in the South.

**Keywords:** Epidemiology; Hospitalization; Burns; Pediatrics; Accident prevention.

### ■ RESUMO

**Introdução:** Queimaduras são lesões teciduais causadas pelo contato com fontes de calor. Representam um problema de saúde pública global. Em crianças causam grandes impactos. A gravidade e intensidade das queimaduras estão relacionadas ao agente etiológico e suas consequências são um grande obstáculo para o paciente. **Método:** O estudo analisou dados de internações hospitalares por queimaduras em crianças de 2012 a 2022, utilizando informações do SIH-SUS. Foram calculadas taxas de internações por 100.000 habitantes para cada ano, considerando variáveis dependentes. Os pesquisadores utilizaram coeficientes padronizados e regressão linear simples para analisar os dados. **Resultados:** Incluíram-se dados de 91.091 internações por queimaduras em crianças, 0-14 anos. Verificou-se estabilidade na taxa geral de internações (taxa média 17,963;  $\beta=0,119$ ;  $p=0,163$ ). No sexo feminino houve tendência de aumento (taxa média 14,346;  $\beta=0,169$ ;  $p=0,029$ ); no masculino de estabilidade (taxa média 21,426;  $\beta=0,069$ ;  $p=0,504$ ). O sexo feminino comportou-se com estabilidade em todas as faixas etárias; o masculino com aumento na faixa 0-4 anos (taxa média 42,264;  $\beta=0,613$ ;  $p=0,003$ ), estabilidade na faixa 5-9 anos (taxa média 14,189;  $\beta=-0,21$ ;  $p=0,867$ ) e redução na faixa 10-14 anos (taxa média 9,871;  $\beta=-0,328$ ;  $p=0,007$ ). A Região Sul demonstrou tendência de aumento (taxa média 26,952;  $\beta=1,091$ ;  $p=0,001$ ). **Conclusão:**

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Article received: November 23, 2023.  
Article accepted: April 30, 2024.

Conflicts of interest: none.

DOI: 10.5935/2177-1235.2024RBCP0907-EN

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Houve estabilidade na taxa geral de internações. O sexo feminino tendeu ao aumento e o masculino à estabilidade. Houve estabilidade nas regiões brasileiras, exceto no Sul.

**Descritores:** Epidemiologia; Hospitalização; Queimaduras; Pediatria; Prevenção de acidentes.

## INTRODUCTION

Burns are tissue injuries resulting from various sources capable of producing heat<sup>1</sup> and are a global public health problem responsible for approximately 180,000 deaths/year in low- and middle-income countries and considered the fifth cause of death in the world<sup>2</sup>. In children, burns are responsible for negative impacts due to their severity, management difficulties, potential mortality, and physical and psychological consequences, both for the victim and their family environment<sup>3</sup>.

They have different etiologies, including scalds, flames, electrical voltage, acidic or basic chemicals, and ultraviolet radiation<sup>4</sup>, responsible for small burns, easily treated, or high-grade injuries, with irreversible consequences<sup>5</sup>. The organism responds locally or systemically, the first due to direct damage to the tissue, while the second results from indirect damage, that is, several physiological mechanisms try to contain the injury<sup>6</sup>. The severity and degree of injuries are directly related to the etiological agent, the intensity of the heat, the location affected, and the exposure time<sup>7,8</sup>.

In childhood, burns are the second most common cause of accidents, the fifth cause of non-fatal pediatric injuries<sup>2,9</sup>, and the third cause of death<sup>9</sup>. More than 111 thousand children are hospitalized due to accidents or unintentional injuries, such as burns, which cause around 3.6 thousand deaths/year<sup>10</sup> and represent approximately 6% of deaths among the age groups from 0 to 14 years old<sup>11</sup>.

Younger children are more vulnerable to domestic accidents such as burns due to less motor coordination caused by physical immaturity, heightened curiosity, and greater dependence on parents and caregivers<sup>12</sup>. Males have an increased risk in all age groups, with 1.5 boys for every girl suffering from burns, and 53.4% of boys, from the first year of life, have twice the chance of suffering injuries<sup>13</sup>. This higher proportion may be associated with behavior and cultural factors, which determine greater freedom for boys, who expose themselves to risky games<sup>14,15</sup>.

In the United States of America (USA), burns are the fourth leading cause of death from trauma<sup>3,16</sup> and, in children under 16 years of age, according to the National Burn Repository, hospitalizations account for 20%<sup>17</sup>. In Brazil, around 1 million people

suffer accidents involving burns and only 100,000 seek medical help after the incident<sup>18</sup>.

Financial costs vary depending on the extent of the injury, length of stay, number of interventions, and treatment method<sup>19</sup>. Treating burns requires a great economic burden, according to clinical and surgical management, which includes a trained multidisciplinary team, and long hospitalization time, associated with procedures, medications, and equipment<sup>20</sup>.

In the USA, the direct costs of caring for children suffering from burns are more than US\$211 million, between 3000 and 5000 dollars/day, and corresponds to approximately 23% of the total cost of treatment<sup>2</sup>. In Brazil, approximately R\$450 million was spent on hospitalizations due to burns in the last decade<sup>21</sup>. However, there are not enough studies that evaluate details of the cost of hospitalization of burn victims<sup>22</sup>. A study that analyzed 180 burn patients for 5,207 days estimated that the direct daily treatment costs were US\$1,330.48 and the total hospitalization cost was US\$39,594.90<sup>19</sup>. Furthermore, burn survivors spend less than non-survivors and, between direct and indirect costs, each patient costs US\$88,218<sup>19,22</sup>.

In addition to the financial cost, burns have social costs from indirect causes such as unemployment, prolonged care, emotional trauma, and family assistance<sup>2</sup>. The stigma caused by burns is considered an obstacle by patients, as it interferes with self-perception and self-esteem and leads victims to feelings of self-depreciation<sup>23</sup>. Approximately half of burns occur in children and adolescents, which has individual and social consequences<sup>24</sup>.

According to the World Health Organization, burn injuries are more frequent in underdeveloped countries, given that there is more medical care among children of lower socioeconomic status and that public policies, prevention measures implemented by the government, and low social, economic, and cultural factors are reasons for the higher prevalence in these locations<sup>2,24</sup>.

Therefore, knowing the temporal trend of hospitalizations for pediatric burns in all Brazilian regions could contribute to the planning of public policies aimed at preventing and reducing social and financial costs for hospital admissions.

## OBJECTIVE

Thus, the objective of the study was to investigate the temporal trend of hospitalizations for pediatric burns, in the age group from 0 to 14 years, in Brazil, between 2012 and 2022.

## METHOD

This is an ecological time series study with information regarding hospital admissions for pediatric burns in Brazil. The data were obtained from the public domain website Hospital Information System of the Unified Health System (SIH-SUS), available at the Information Technology Department of the Unified Health System (DATASUS). Information about hospital admissions in the SUS is stored based on data from the Hospital Admissions Authorization (AIH). The data were exported in comma-separated values (CSV) format and saved in an Excel spreadsheet to calculate the rates.

Population demographic information was collected on the website of the Brazilian Institute of Geography and Statistics, using the 2000 and 2010 censuses, in addition to their intercensal estimates. Data from 91,091 children of under 14 years of age, both sexes, residing in the Brazilian regions (North, Northeast, South, Southeast, and Central-West), victims of burns (International Statistical Classification of Diseases and Problems Related to Health T20-T32) between the years 2012-2022. The variables analyzed were sex (male and female), age group (< 1 year; 1 – 4 years; 5 – 9 years and 10 – 14 years), region (North, Northeast, South, Southeast, and Central-West) and years analyzed (2012-2022).

The variables used in the study that fall into the dependent category were: general hospitalization rate, hospitalization rate by sex, age group rate by sex, and region. The independent variable was the years used for the study.

For each year of the period under study, the rates of hospitalizations for burns were calculated according to the dependent variables, for every 100,000 inhabitants based on the ratio between the total number of hospitalizations for pediatric burns and the population referring to sex, age group/sex, and regions.

To analyze the temporal trend study of hospitalizations for pediatric burns, standardized coefficients and the method of simple linear regression, using the Statistical Package for the Social Sciences (SPSS) version 20.0. In this method, standardized hospitalization rates were considered dependent variables and the years of the study period as an independent variable, obtaining a model estimated according to the formula  $Y = b_0 + b_1X$ , where  $Y =$

standardized coefficient,  $b_0 =$  mean coefficient of the period,  $b_1 =$  mean annual increment and  $X =$  year. The analysis of behavior (increase, decrease, or stability) and the mean annual variation in the hospitalization coefficient was carried out based on the evaluation of the value of the regression coefficient ( $\beta$ ). The statistical significance considered was  $p \leq 0.05$ .

As it is a research with secondary data, in the public domain and free access, following Resolution of the National Health Council (CNS) no. 466, of December 12, 2012, and under the guidelines and standards of Resolution 510/2016 of the National Health Council, Article 1, Sole Paragraph, Items II, III and V, there was no need for approval by the Ethics and Research Committee.

## RESULTS

Data from 91,091 hospital admissions due to burns in children aged 0 to 14 years, in Brazil, between 2012 and 2022 were analyzed. There was a trend towards stability in the general hospitalization rate in Brazil, with an initial rate of 18.51 and a final rate of 18.73 hospitalizations/100,000 inhabitants (mean rate 17.963;  $\beta = 0.119$ ;  $p = 0.163$ ).

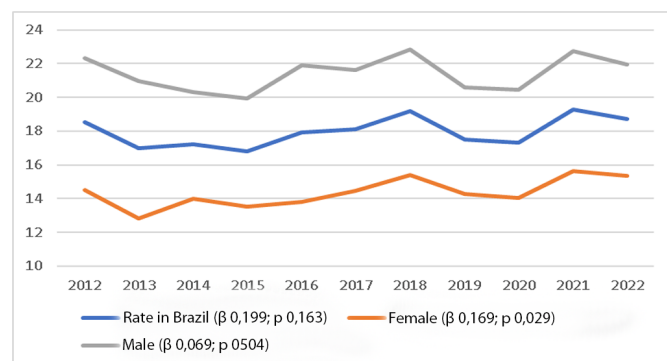
Concerning stratification by sex, the same stability behavior was observed in males (mean rate of 21.42;  $\beta = 0.069$ ;  $p = 0.504$ ). The male hospitalization rate started at 22.33/100,000 inhabitants and, at the end of the period, reduced to 21.95/100,000 inhabitants, resulting in a 1.7% reduction. In females, the behavior was an increase (mean rate 14.346;  $\beta = 0.169$ ;  $p = 0.029$ ) in hospitalizations/100,000 inhabitants, with an initial rate of 14.53, ending the study period with 15.35/100,000 inhabitants, characterizing 5.5% increase (Table 1, Figure 1).

Table 1 presents the mean rate, the coefficient of determination ( $R^2$ ), the mean annual variation ( $\beta$ ), the value of  $p$ , and the trend stratified by sex, age group, and region.

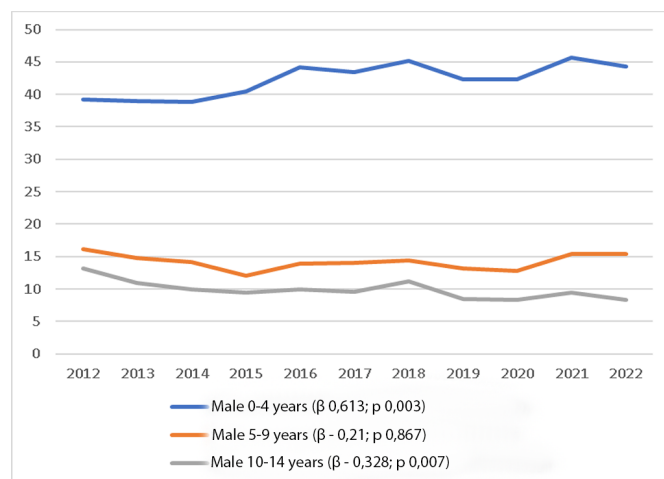
When analyzing the male age group, there was a tendency for an increase in hospitalizations in the age group of 0 to 4 years (mean rate 42.264;  $\beta = 0.613$ ;  $p = 0.003$ ), with an initial rate of 39.23 and a final rate of 44.31, representing an increase of 13%. In the age groups of 5 to 9 years and 10 to 14 years, there was stability (mean rate 14.189;  $\beta = -0.21$ ;  $p = 0.867$ ) and reduction (mean rate 9.871;  $\beta = -0.328$ ;  $p = 0.007$ ) in hospitalizations per 100,000 inhabitants, respectively (Table 1; Figure 2). In the age groups by female sex, there was a stable trend in all age groups. In the age group 0-4 years, there was an increase of 11.5%, with an initial rate of 28.14 and a final rate of 31.38 hospitalizations/100,000 inhabitants, with stable behavior (Table 1; Figure 3).

**Table 1.** Temporal trend of hospitalizations due to burns, in the age group 0-14 years, in 2012-2022, according to sex, age group, and regions.

Variables	Mean Rate	R (*)	R2 (†)	B (§)	95% CI	p-value	Trend
<b>General Rate</b>	17,963	0.451	0.204	0.119	(-0.580; 0.295)	0.163	Stability
<b>Sex</b>							
Masculine	21,426	0.226	0.051	0.069	(-0.155; 0.293)	0.504	Stability
Feminine	14,346	0.654	0.427	0.169	(0.021; 0.316)	0.029	Increase
<b>Female Age Group</b>							
4 years	29,281	0.698	0.488	0.407	(0.093; 0.722)	0.170	Stability
5 - 9 years	9,614	0.286	0.082	0.084	(-0.127; 0.294)	0.393	Stability
10 - 14 years	5,684	0.195	0.038	0.034	(-0.095; 0.163)	0.565	Stability
<b>Male Age Group</b>							
4 years	42,264	0.798	0.637	0.613	(0.265; 0.962)	0.003	Increase
5 - 9 years	14,189	0.057	0.003	-0.210	(-0.300; 0.257)	0.867	Stability
10 - 14 years	9,871	0.754	0.569	-0.328	(-0.543; -0.113)	0.007	Reduction
<b>Regions</b>							
South	26,952	0.861	0.741	1,091	(0.605; 1.577)	0.001	Increase
Southeast	13,748	0.615	0.378	0.172	(0.006; 0.338)	0.440	Stability
Midwest	23,689	0.004	0.000	0.006	(-1.133; 1.146)	0.990	Stability
North	12,267	0.082	0.007	-0.022	(-0.226; 0.182)	0.600	Stability
North East	19,881	0.638	0.407	-0.291	(-0.557; -0.026)	0.350	Stability

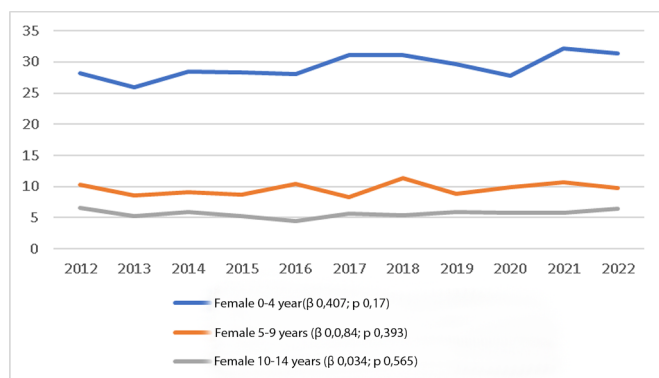
**Figure 1.** Temporal trend of hospitalization for burns in Brazil, in the age group 0-14 years, between 2012 and 2022, according to general rate and sex.

Regarding hospitalizations by region, an increase was observed in the South Region (mean rate of 23.952;  $\beta=1.091$ ;  $p=0.001$ ), with 23.28 hospitalizations/100,000 inhabitants in the initial period of the study and 30.21/100,000 inhabitants in the final period, reflecting a 29.8% increase. The other regions showed stability behavior: North Region (mean rate 12.267;  $\beta=-0.022$ ;  $p=0.600$ ), Northeast Region (mean rate 19.881;  $\beta=-0.291$ ;  $p=0.035$ ), Southeast Region (mean rate 13.748;  $\beta=0.172$ ;  $p=0.44$ ) and Central-West Region (mean rate 23.689;  $\beta=0.006$ ;  $p=0.99$ ). The Central-West Region

**Figure 2.** Temporal trend of hospitalization for burns in Brazil, among males, according to age group.

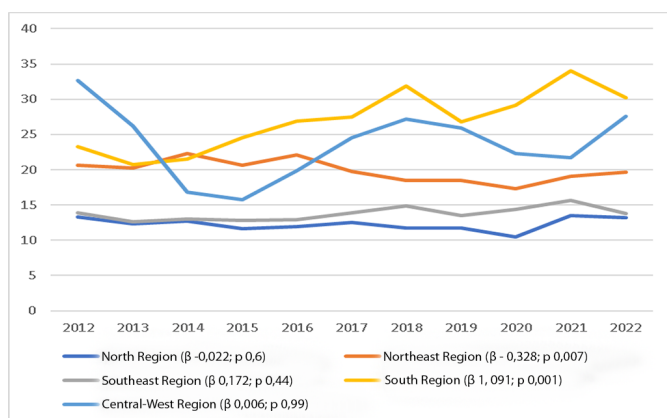
had the highest mean rate of hospitalizations per 100,000 inhabitants at the beginning of the studied period, with a value of 32.68/100,000 inhabitants.

The lowest mean rate of hospitalizations per 100,000 inhabitants, in the initial period of the study, was obtained by the North Region, with a value of 13.29/100,000 inhabitants. At the end of the study period, except for the South Region, which showed



**Figure 3.** Temporal trend of hospitalization for burns in Brazil, among females, according to age group.

an increase in the mean hospitalization rate per 100,000 inhabitants, all regions behaved similarly with stability in mean hospitalization rates (Table 1, Figure 4).



**Figure 4.** Temporal trend in the hospitalization rate for burns in Brazil, in the age group 0-14 years, between 2012 and 2022, according to regions.

## DISCUSSION

Studies on pediatric hospitalizations in the age group 0-14 years by region in Brazil are scarce. The study under discussion verified a temporal trend of stability in hospitalizations for pediatric burns in Brazil during the analyzed period. On the other hand, a study of hospital admissions in Brazil in children under 14 years of age, between 2008 and 2015, showed a downward trend in hospitalizations<sup>25</sup>, with a reduction of 28.14% for males and 22.2% for females, demonstrating behavior that diverges from the current study.

The stability trend found in the present study can be explained by the adoption of prevention measures such as the National Policy for Reducing Morbidity and Mortality from Accidents and Violence (2001), the ban on the sale of liquid alcohol to the general population

(2002) and the creation of Accident and Violence Prevention Centers in the Unified Health System (2004)<sup>25,26</sup>. Together, such actions receive support for the promotion of safe and healthy behaviors and environments<sup>25</sup>, supporting stability and a possible decrease in the trend of hospitalizations over the years.

When analyzing the hospitalization rate for males, a stable behavior was observed during the period studied, which differs from the literature, which shows an increase in hospitalizations for males, with 61.4% of hospitalizations due to burns in the age group of 0-14 years in the regions of Brazil in males between 2008-2015<sup>25</sup>, as well as 69.4% of male admissions to Burn Treatment Centers in children aged 7-12 years in the period 2011-2014<sup>18</sup>. The observed behavior may be a reflection of educational measures<sup>25,26</sup> associated with the child's learning about the notion of danger, in addition to gaining strength and agility according to their psychomotor development<sup>27</sup>.

As for females, there was a tendency for the general rate to increase, with statistically significant data. In the literature, similar behavior occurred only in the South Region, with a 23.25% increase in hospitalizations due to burns<sup>25</sup>. The increase in the rate of female hospitalization can be associated with domestic accidents and domestic or self-inflicted violence<sup>18</sup>, since, due to the complex interaction between family habits, cultural norms, socioeconomic environment, and secular behaviors<sup>16</sup>, females are often more likely to collaborate with household chores, susceptible to greater contact with potentially flammable chemical substances.

Both males and females showed increases in the general rate of hospitalizations in 2021. This increase may be associated with the COVID-19 pandemic period, which encouraged children to remain at home, in which childhood burns predominantly occur<sup>17</sup>, as well as other accidents, most of which are unintentional and avoidable<sup>28</sup>.

Furthermore, with the COVID-19 pandemic, in 2020, the sale of 70° GL ethyl alcohol in one-liter packages<sup>29</sup> was authorized for the hygiene of hands, surfaces, and objects; the sale of alcohol with a strength greater than 54° GL was prohibited since 2002<sup>25</sup>. Alcohol, among flammable agents, was the one that caused the most burns in Brazil<sup>10,25</sup> and with the ban on its sale, there was a considerable reduction in these accidents, however, the resumption of sales increased incidence again<sup>8</sup>.

There was a tendency towards stability in all age groups among females. Among males, there was an increasing trend in the age group of 0-4 years, with statistically significant data. This increase in this age group corroborates the literature, which shows that



the highest rates occurred in preschool children aged 1-4 years, with 57.05% of hospitalizations, and mostly in males, with an incidence of 63.04%<sup>26</sup>.

The increase in male hospitalizations in the 0-4 age group may be related to increased curiosity and intellectual and cognitive development not accompanied by the motor development of children at this age<sup>25</sup>, associated with the greater freedom provided to them<sup>12,18</sup>. Pediatric burns are the second most frequent cause of accidents and the third cause of death among 0-14 years old<sup>11</sup>.

Concerning hospitalizations by region, the South Region was the only one that presented statistically significant data, demonstrating an increase in the rate of hospitalizations for pediatric burns, with an increase of 29.8% in hospitalizations during the study period. The other regions showed stable behavior. Therefore, the present study is in line with a similar study that demonstrated an increase in hospitalizations for pediatric burns in the South Region, in both sexes (males  $p=0.050$ ; females  $p=0.033$ )<sup>25</sup>.

This fact may be related to the increase in notifications and better access to specialized services that include rigor in hospitalizations in the pediatric age group and availability of beds in the Burn Treatment Unit (BTU) of Hospital Infantil Joana de Gusmão (HIJG) in Florianópolis, which is the only pediatric BTU in southern Brazil<sup>25,28</sup>. Furthermore, it is pertinent to highlight that some regions, such as the North, have large territorial extensions, which can make access between the population and hospital care difficult, as well as there are no units specialized in highly complex burns<sup>25</sup>.

Regarding limitations, as the data were collected from hospital admission records available in DATASUS, underreporting of hospitalizations due to burns or erroneous notifications in the system may have occurred. Furthermore, since DATASUS presents information relating to the Unified Health System, hospitalizations for pediatric burns that occurred in the private network were not included in the study analysis.

This study contributed to the identification of the temporal trend in hospitalization rates for burns in the period 2012-2022 in the regions of Brazil in the age groups of 0-14 years through the analysis of age group, sex, and regions. In the literature, there is only one temporal trend study on hospitalizations for pediatric burns by region, hence the relevance of this study, when comparing hospitalization rates for burns between Brazilian regions. Furthermore, the data found can contribute to the development of public health policies, aiming at prevention and care at secondary and tertiary levels for the populations studied.

## CONCLUSION

In the period 2012 to 2022, there were 91,091 hospitalizations due to burns in children aged 0-14 years in Brazil. Most of these occurred in the male population 60.97% ( $n=55,539$ ) and in the age group 0-4 years 62.33% ( $n=56,778$ ). During the period studied, there was a stable trend in hospital admissions for burns in Brazil in the population aged 0-14 years in males and an increase in females.

Females behaved with stability at all ages, while males showed an increase in the 0-4 age group, stability in the 5-9 age group, and a reduction in the 10-14 age group.

The regions behaved with stability in hospital admissions for pediatric burns, except for the South Region, which showed an increase.

## COLLABORATIONS

- LP** Analysis and/or data interpretation, Conception and design study, Data Curation, Investigation, Methodology, Project Administration, Writing - Review & Editing.
- CSB** Analysis and/or data interpretation, Conception and design study, Conceptualization, Data Curation, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Writing - Original Draft Preparation, Writing - Review & Editing.
- ACN** Final manuscript approval, Formal Analysis, Supervision, Validation, Visualization, Writing - Review & Editing.
- NON** Final manuscript approval, Formal Analysis, Software, Supervision, Validation, Visualization, Writing - Review & Editing.

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