



## Hospital admissions and headache costs in children and adolescents in Brazil: An ecological study from 2013 to 2023

Giovanna Lourenço Cavagnoli<sup>1</sup>, Vitor Dias Espindola<sup>1</sup>, Emely Regina Messias<sup>1</sup>, Bruno Dias Queiroz<sup>2</sup>, Natalia Camila Correia Mendes<sup>3</sup>, Marcelo Alves de Souza<sup>1</sup>

<sup>1</sup>Federal University of Parana, Curitiba, Parana, Brazil

<sup>2</sup>Higher School of Sciences of the Santa Casa de Misericórdia de Vitoria, Vitoria, Espírito Santo, Brazil

<sup>3</sup>Cesumar University, Maringa, Parana, Brazil



Giovanna Lourenço Cavagnoli  
Email: giovanna.cavagnoli@ufpr.br

**Edited by:**  
Marcelo Moraes Valença

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Headaches during childhood and adolescence are highly prevalent in Brazil and influenced by factors such as gender and age. The diagnosis, particularly of migraines, poses significant challenges, while treatment often involves a combination of pharmacological interventions and lifestyle modifications. This ecological, descriptive, and comparative study retrospectively analyzed data on hospitalizations due to headaches among children and adolescents in Brazil between 2013 and 2023, using information from the Departamento de Informática do Sistema Único de Saúde (DATASUS). The analysis examined the number and costs of hospitalizations for migraines and other headache syndromes, focusing on variables such as region, age group, sex, and color/race. The study covered the entire national territory and assessed regional disparities. During the study period, Brazil reported 17,924 hospitalizations, with adolescents aged 15 to 19 years accounting for the highest prevalence (43.88%). Total expenditure reached BRL 6,499,792.90, with this age group incurring the highest costs. Findings underscored regional and gender disparities, with the Southeast region reporting the highest number of hospitalizations and a greater impact observed among females (62.3%). Understanding the epidemiological patterns of headaches in children and adolescents is critical for enhancing public health strategies, improving care delivery, and developing effective preventive measures.

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## Introduction

Headaches rank among the most common types of pain experienced during childhood and are broadly classified into primary headaches, such as migraines, and secondary headaches, which are associated with underlying conditions. These conditions may include vascular diseases, head trauma, infections, brain tumors, metabolic disorders, intracranial hypertension, or spinal issues (1). Within the pediatric population, this condition remains both underdiagnosed and undertreated. Migraines, in particular, are often underestimated in adolescents, leading to significant disability and a marked reduction in quality of life (2). Research on this topic primarily links adolescent headaches to factors such as gender, age, mood disorders, parental anxiety, and geographical residence (3).

Population-based studies investigating the prevalence of headaches in children remain scarce, particularly in Brazil. A 1996 randomized cross-sectional study involving 538 children aged 10 to 18 years in Porto Alegre, Brazil, revealed a one-year headache prevalence of 82.9%, with 72.8% of cases classified as tension-type headaches and 9.9% diagnosed as migraines (4). A subsequent study in São Paulo in 2015 reported a headache prevalence of 38.2% among adolescents, identifying associated factors such as female sex, low educational attainment, common mental disorders (CMDs), vision problems, back pain, and sinusitis. Addressing headaches as a public health issue requires a thorough understanding of their underlying causes, associated factors, and coping strategies, which can guide the prioritization and organization of healthcare services (3).

Diagnosing migraines in children presents unique challenges, as symptom descriptions can vary throughout adolescence. A comprehensive evaluation of headache characteristics—including location, type, intensity, and associated symptoms—is critical (5). Migraine symptoms often include moderate to severe pain episodes accompanied by sensitivity to light, sound, and strong odors, as well as nausea and exacerbation with physical exertion. Relief typically occurs during rest. Neurological examinations in children are usually normal, with neuroimaging reserved for cases involving seizures, recent trauma, changes in pain patterns, or neurological abnormalities. Other diagnostic tools, such as lumbar punctures or electroencephalography, are only indicated under specific circumstances (1). Recognizing and managing migraines in pediatric populations is therefore crucial, given their high prevalence and significant impact on this group (6).

Genetic, biological, psychological, and environmental factors strongly influence childhood headaches and must be considered when determining appropriate therapeutic strategies (2). Migraine treatment during childhood is typically categorized into acute and preventive approaches. Pharmacological options may include NSAIDs, paracetamol, triptans, dopamine antagonists, amitriptyline, and topiramate. Preventive strategies emphasize lifestyle modifications and

cognitive-behavioral therapy (CBT), aiming to alleviate symptoms while managing stress and promoting healthy living (6).

Identifying the epidemiological characteristics of headaches in Brazilian children and adolescents is essential for understanding their prevalence, enabling early diagnosis, and pursuing effective treatments. This study provides significant insights into prevention strategies, resource management, and quality of care, contributing to public health advancements in Brazil.

## Methodology

This is an ecological, descriptive, comparative study with a cross-sectional, population-based design and a retrospective approach. The data were obtained in May 2024 through the analysis of secondary, publicly available data from the Departamento de Informática do Sistema Único de Saúde (DATASUS), which sources its information from the Sistema de Informações Hospitalares do SUS (SIH/SUS). Consequently, approval from the Research Ethics Committee was not required, in accordance with CNS Resolution 196/96.

In this study, data collection from DATASUS was conducted using the category of SUS hospital morbidity by place of hospitalization, from 2008 onwards, across Brazil by region and federation unit. The time frame for data analysis spanned from January 2013 to December 2023. The study analyzed the number and costs of hospital admissions for headaches in the pediatric population, aged 0 to 19 years. It encompassed the entire national territory of Brazil, followed by a comparative analysis between regions. The variables selected for this study included: Brazilian region, federation unit, age group, sex, color/race, year, average length of stay, and the mean and total costs of hospitalizations and deaths related to migraine (ICD G43) and other syndromes associated with cephalic pain (ICD G44). This study thus aims to answer the following research question: What is the epidemiological profile and associated costs of hospitalizations for headaches in children and adolescents in Brazil over the past 10 years?

**Inclusion criteria:** Data on hospitalizations for migraines and other cephalic pain syndromes from January 2013 to December 2023, referring to children and adolescents aged 0 to 19 years, of both sexes, across all Brazilian regions (Southeast, South, Midwest, North, and Northeast). **Exclusion criteria:** Data prior to 2013, studies unrelated to the theme, and duplicate records. The variables were analyzed both individually and in an integrated manner, and the results were organized using Microsoft Excel software.



The theoretical analysis presented in this study was based on both free and paid-access publications available through the U.S. National Library of Medicine (PubMed) and the Scientific Electronic Library Online (SciELO) databases. The search strategy employed the following health sciences descriptors: (migraine) AND (children) AND (pediatric) AND (headache) AND (epidemiologic study) AND (adolescents).

## Results

Between 2013 and 2023, there were 17,924 hospitalizations for migraines and other cephalic pain syndromes among the pediatric population (ages 0 to 19) in Brazil. The Southeast region accounted for the highest number of cases (6,423), followed by the Northeast (5,367), South (3,801), North (1,282), and Midwest (1,052). Regarding age groups, adolescents aged 15 to 19 years were the most affected, with 7,866 hospitalizations. This was followed by children aged 10 to 14 years (5,643), 5 to 9 years (3,380), 1 to 4 years (901), and infants under 1 year (134) (Figure 1).

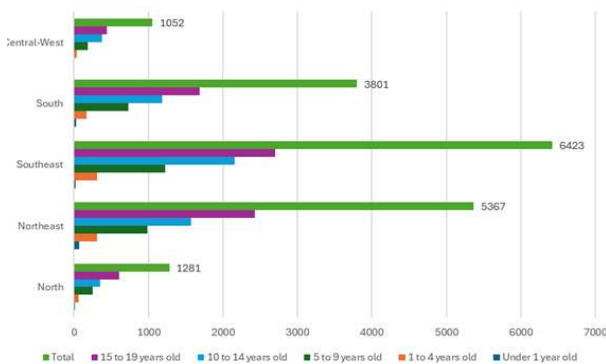


Figure 1. Total hospitalizations for migraine and other cephalic pain syndromes by region and age group in individuals aged 0 to 19 years, from 2013 to 2023. Source: Prepared by the authors based on sociodemographic data obtained from: Ministério da Saúde - Sistema de Informações Hospitalares do SUS (SIH/SUS).

In terms of the chronology of hospitalizations, the years with the highest number of cases were, in descending order: 2023 (2,092), 2019 (1,925), 2018 (1,857), 2017 (1,833), and 2022 (1,791). Across all years, females consistently accounted for the majority of hospitalizations for migraines and other cephalic pain syndromes, totaling 11,166 cases. In comparison, the male population recorded 6,758 cases for the same conditions (Figure 2).

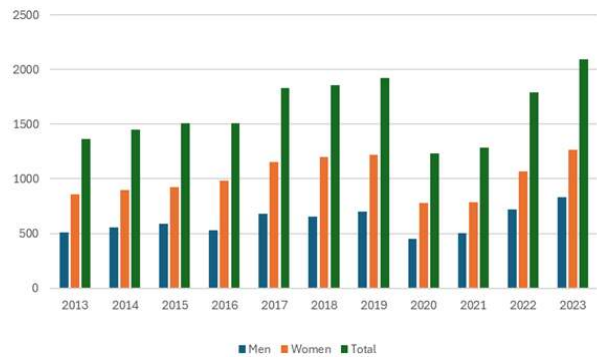


Figure 2. Total hospitalizations for migraine and other cephalic pain syndromes by year of care and sex in individuals aged 0 to 19, from 2013 to 2023. Source: Prepared by the authors based on sociodemographic data obtained from: Ministério da Saúde - Sistema de Informações Hospitalares do SUS (SIH/SUS).

For the color/race variable, the brown population recorded the highest number of hospitalizations for migraines and other cephalic pain syndromes across all age groups, totaling 7,774 cases. This was followed by the white population with 6,407 cases, the black population with 402 cases, the yellow population with 331 cases, and the indigenous population with 18 cases. Lastly, 2,992 records had missing information on this variable (Figure 3).

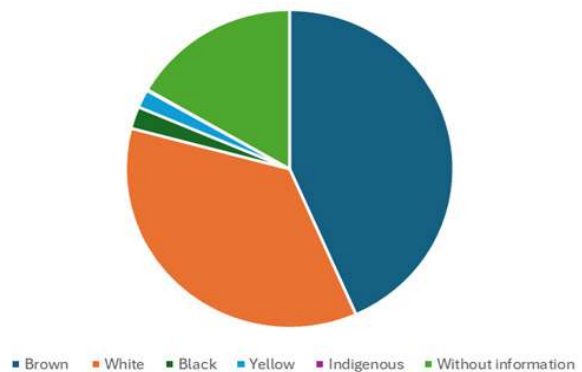


Figure 3. Total hospitalizations for migraine and other cephalic pain syndromes by color/race in individuals aged 0 to 19, from 2013 to 2023. Source: Prepared by the authors based on sociodemographic data obtained from: Ministério da Saúde - Sistema de Informações Hospitalares do SUS (SIH/SUS).



During the analyzed period, the Northeast region reported the highest average length of stay at 4.2 days, with Sergipe recording the highest average among the Federation Units at 5.3 days. In contrast, the Central-West region had the lowest average length of stay at 2.7 days, with Goiás registering 2.1 days. The national average was 3.5 days. The age group under 1 year old had the highest average hospitalization (5.9 days).

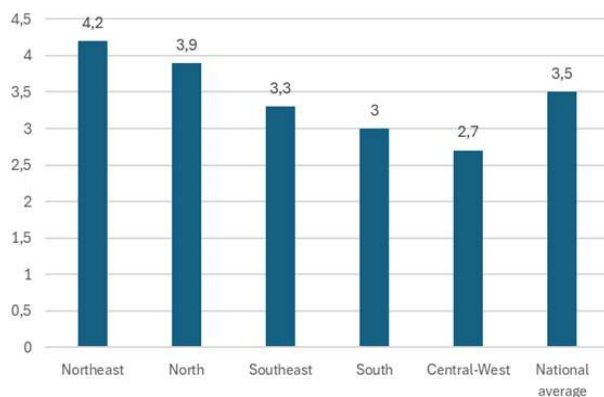


Figure 4. Average length of stay of hospitalizations for migraine and other cephalic pain syndromes by region in men and women aged 0 to 19 in the period from 2013 to 2023. Source: Prepared by the authors based on sociodemographic data obtained from: Ministério da Saúde - Sistema de Informações Hospitalares do SUS (SIH/SUS).

Regarding average expenses per hospitalization, the Northeast region recorded the highest value at 481.37 reais, followed by the South (348.16 reais), Southeast (326.31 reais), North (215.30 reais), and Central-West (209.67 reais) regions. The national average was 362.59 reais. Among age groups, infants under 1 year incurred the highest expenses, with an average of 1,833.84 reais per hospitalization. The total expenditure for hospitalizations between 2013 and 2023 amounted to 6,499,792.90 reais.

The Northeast region accounted for the highest expenses, totaling 2,583,970.62 reais, followed by the Southeast with 2,095,878.02 reais, the South with 1,323,348.06 reais, the North with 276,019.91 reais, and the Central-West with 220,576.29 reais. The Federation Unit that allocated the most funds for hospitalizations was São Paulo, with 1,408,116.76 reais. The age group with the highest expenses was between 15 and 19 years old, totaling 2,657,559.55 reais.

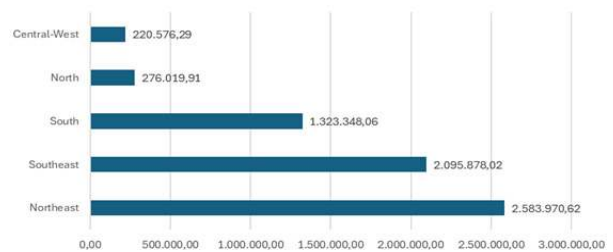


Figure 5. Total value of hospitalizations for migraine and other cephalic pain syndromes by region in men and women aged 0 to 19 in the period from 2013 to 2023. Source: Prepared by the authors based on sociodemographic data obtained from: Ministério da Saúde - Sistema de Informações Hospitalares do SUS (SIH/SUS).

During the analyzed period, 30 deaths related to migraines and other cephalic pain syndromes were reported among children and adolescents. The Northeast region recorded the highest number of cases, with 17 deaths, of which 7 occurred in the state of Ceará.

## Discussion

Data analysis revealed that, between 2013 and 2023, there were 17,924 hospitalizations for migraine and other cephalic pain syndromes within the pediatric population in Brazil. According to Lagman and Lay(7), migraine is frequently diagnosed late, leading children to undergo years of unnecessary investigations. This situation imposes a significant burden on patients, their families, and the healthcare system, resulting in recurrent hospitalizations, laboratory and imaging tests, and emergency room visits. In this context, it was found that the total expenditures during the analyzed period amounted to 6,499,792.90 reais in Brazil, with the age group of 15 to 19 years accounting for the highest expenses, totaling 2,657,559.55 reais.

Rastogi and Reena (8) assert that intense headache is the primary symptom driving individuals to seek care in primary care or urgent and emergency services. According to Victor, Hu, Campbell, Buse, and Lipton (9), the prevalence of migraine increases throughout childhood and adolescence, rising from 5% among children aged 5 to 10 years to approximately 15% among adolescents. In comparison, the present study found that of the 17,924 hospitalizations, 43.88% occurred in the age group of 15



to 19 years (7,866 hospitalizations), while 31.48% were in the 10 to 14 years age group (5,643 hospitalizations). Therefore, the pre-adolescent and adolescent age group accounts for 75.36% of the total hospitalizations. In contrast, infants, preschoolers, and school-aged children (0-9 years) represent 24.63% of the hospitalizations, with a total of 4,415 cases. These findings support the hypothesis that adolescents are the most significantly affected by these conditions.

Regarding migraine in the pediatric population, Winner (10) points out that the episodic syndromes associated with migraine can be categorized into three areas. The first includes recurrent gastrointestinal disorders, which are further subdivided into cyclic vomiting syndrome and abdominal migraine. The second category is benign positional vertigo, while the third encompasses benign paroxysmal torticollis. According to Youssef and Mack (1), patients aged 5 to 10 years with migraine typically present with bilateral frontal headaches, nausea, abdominal pain, vomiting, photophobia, phonophobia, and a need for sleep. Given this, these symptoms may have contributed to the search for medical care and, consequently, to the hospitalization of the 3,380 children in the age group of 5 to 9 years.

A population-based study conducted in 2015 (3) estimated the prevalence of headache among adolescents (15 to 19 years) in the city of São Paulo at 38.2%, with 32.8% reporting general headaches and 7.8% specifically suffering from migraines. Furthermore, when comparing the five Brazilian regions, a higher number of hospitalizations for migraine (ICD G43) and other cephalic pain syndromes (ICD G44) was observed in the Southeast region, accounting for 35.83% of hospitalizations (6,423 cases), followed by the Northeast (29.94%), South (21.2%), North (7.15%), and Central-West (5.86%) regions. These findings may be attributed to the greater availability of resources and access to healthcare services in the Southeast region compared to the other regions, as well as to lifestyle changes, such as reduced sleep duration, excessive screen time, and poor dietary habits.

Based on the data analysis, it was observed that individuals identifying as brown accounted for 43.37% of hospitalization cases in Brazil. This contrasts with a study conducted among residents of São Paulo (3), where black individuals (43.3%) were the most affected, followed by white (39.6%), brown (35.9%), and other racial groups (24.7%). These findings highlight the variations that emerge when analyzing data at different levels, such as cities, states, regions, or countries, and emphasize the need for separate analyses in each context.

Regarding sex, Vikelis and Rapoport (11) reported that in Greece, men are affected three times more than women in cases of cluster headache. However, another study (12)

indicates that in childhood and early adolescence, both boys and girls are equally likely to be affected by migraine. In late adolescence, however, the prevalence of migraine is higher among girls, with a ratio similar to that observed in adults. In comparison to the findings of other authors, the present study revealed that females accounted for a higher number of hospitalizations for migraine and other cephalic pain syndromes between 2013 and 2023, representing 62.3% of the cases (11,166), compared to 37.7% in the male population (6,758 cases).

Throughout the analyzed period, slight variations in the number of hospitalizations were observed, with an overall upward trend over time. However, the years 2020 and 2021 experienced a sharp decline in the number of records, a trend likely associated with the COVID-19 pandemic, which may have resulted in increased difficulties in accessing health services.

Another factor to consider in this study is the directly proportional relationship between the average length of stay and the average expenditure. During the analyzed period, the Northeast region recorded the highest average length of stay (4.2 days), which was accompanied by the highest average expenditure (481.37 reais), resulting in a total expenditure of 2,583,970.62 reais. In contrast, the Central-West region reported the lowest average length of stay (2.7 days) and the lowest average expenditure (209.67 reais), with a total cost of 220,576.29 reais.

In terms of age, the group under 1 year old exhibited the highest average length of stay (5.9 days) and the highest average expenditure, approximately 1,833.84 reais per hospitalization. Nationally, the average length of stay across regions was 3.5 days, with an average expenditure of 362.59 reais. Regarding the number of deaths, the Northeast region accounted for 56.6% of the total, a notable finding, considering that the region also exhibits the highest expenditure and the longest average length of stay.

The present study was conducted using secondary data collected from the DATASUS platform, which gathers, processes, and disseminates information on patients within the public health system. Consequently, limitations of this cross-sectional epidemiological study include underreporting, inaccuracies in the completion of care/hospitalization forms, and the absence of data on cases from the supplementary health network. Nevertheless, the reliability and relevance of these data are underscored, highlighting their usefulness for the purposes of this study.

Given the limited number of publications on migraine and other cephalic pain syndromes in children and adolescents in Brazil, this study holds significant importance. It underscores the need for further investigations to better understand the impact of headaches in the country.



Ultimately, this research provides valuable sociodemographic data for studies in neurology and cephaliatry, while also highlighting the vulnerabilities associated with the occurrence of headaches in children and adolescents. The findings aim to encourage action from government agencies, advocating for the improvement of public policies focused on social security, ensuring continued access to comprehensive care, and implementing prevention and health promotion strategies.

## Conclusion

In conclusion, the study identified a total of 17,924 hospitalizations for migraine and other cephalic pain syndromes within the pediatric population. The Southeast region reported the highest number of hospitalizations, with 6,423 cases, representing 35.83% of the total. The age group most affected was between 15 and 19 years, with 7,866 hospitalizations (43.88%). Females comprised the majority of hospitalizations, accounting for 11,166 cases (62.3%). The racial/ethnic group with the highest number of hospitalizations across all age groups was brown, with a total of 7,774 cases. The trend in hospitalizations demonstrated a general increase, although a significant decline occurred during the COVID-19 pandemic. The total healthcare expenditures amounted to 6,499,792.90 reais, with the under-1-year age group incurring the highest costs (1,833.84 reais) and the longest average duration of hospitalization (5.9 days), substantially exceeding the national average of 3.5 days. Finally, 30 deaths related to migraine and other cephalic pain syndromes were recorded among children and adolescents, with the highest incidence in the Northeast region, which accounted for 17 deaths.

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Giovanna Lourenço Cavagnoli  
<https://orcid.org/0009-0009-1484-6166>  
 Vitor Dias Espindola  
<https://orcid.org/0000-0002-3605-4639>  
 Emely Regina Messias  
<https://orcid.org/0009-0001-9087-7337>  
 Bruno Dias Queiroz  
<https://orcid.org/0000-0002-1781-1278>  
 Natalia Camila Correia Mendes  
<https://orcid.org/0009-0002-7698-6315>  
 Marcelo Alves de Souza  
<https://orcid.org/0009-0005-7270-2196>

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