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EPIDEMIOLOGICAL ANALYSIS OF DENGUE IN CHILDREN AND ADOLESCENTS IN BRAZIL: REPORTED CASES (2019-2023)

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ABSTRACT

Introduction: Dengue is an infectious disease transmitted by the *Aedes aegypti mosquito*, affecting mainly tropical regions. Between 2019 and 2023, the incidence of the disease in children in Brazil increased significantly, aggravated by the circulation of the DENV-1 and DENV-2 serotypes. Child vulnerability, associated with factors such as developing immune systems and socioeconomic conditions, makes the epidemiological analysis of dengue in this group essential. **Objectives:** The general objective of this study was to analyze the epidemiology of dengue in children in Brazil between 2019 and 2023. Specific objectives included investigating the relationship between age and disease severity, incidence by sex and region, and the number of hospitalizations for dengue. **Methodology:** This is a retrospective and descriptive epidemiological study with a quantitative approach, using secondary data from DATASUS and SINAN. Probable and confirmed cases of dengue in children and adolescents (0-19 years) were analyzed using the ICD-10 Morbidity List. The data were submitted to statistical analysis and association tests (Chi-square) to verify the correlation between variables. **Results:** In the period analyzed, 1,501,372 probable cases of dengue among children and adolescents were recorded, with 1,251,126 confirmations. The Northeast had the highest hospitalization rate (28.8%), while the Southeast had the highest incidence of cases. The DENV-3 serotype predominated in the North and the DENV-4 in the South. The mortality rate was 0.28%, with higher lethality in the age group of children under 1 year old. **Conclusion:** The study revealed the regional heterogeneity and severity of dengue in children in Brazil. Differences in disease incidence and severity require effective public policies, including vector control, expansion of health infrastructure, and educational campaigns. Continuous monitoring of serotypes and investment in prevention are essential to reduce the impact of dengue on the Brazilian child population.

Keywords: Dengue. Epidemiology. Incidence. Pediatrics.

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INTRODUCTION

Dengue is an infectious disease caused by viruses of the genus Flavivirus, being transmitted mainly by the *Aedes aegypti* mosquito. This disease is characterized by high fever, muscle and joint pain, severe headache, and skin rashes. In more severe cases, it can progress to hemorrhagic dengue or dengue shock syndrome, which present higher risks, especially among children (Oliveira *et al.*, 2024; Sá Junior; Silva; Carijó, 2022; Rios, 2024).

The etiology of dengue involves four distinct serotypes of the virus: DENV-1, DENV-2, DENV-3, and DENV-4. This characteristic is of particular concern, as subsequent infection with a different serotype can increase the risk of more severe forms of the disease (Almeida, 2022; Souza *et al*., 2024).

Among children, the epidemiology of dengue has shown that the predominant serotypes can vary over time and according to the region. In recent outbreaks in Brazil, DENV-2 and DENV-1 have been the most frequently identified serotypes. DENV-2, in particular, is known to be associated with more severe forms of the disease, including dengue hemorrhagic fever, which poses a greater risk to children's health (Lima-Camara, 2024; Medeiros, 2024).

Children, especially those under five years of age, are a vulnerable group due to factors such as the still-developing immune system and the possibility of rapid dehydration in cases of severe dengue (Oliveira *et al*., 2024; Silva *et al*., 2024).

In summary, dengue is a viral disease with multiple serotypes, and infection in children is a significant public health concern. Knowledge about the etiology of dengue and the predominant serotypes is essential for the development of prevention and control strategies aiming to protect the most vulnerable groups and reduce the impact of the disease on Brazilian children (Camargo *et al*., 2022).

This period, spanning from 2019 to 2023, is marked by a series of epidemiological, social, and environmental factors that influence the dynamics of virus transmission, as well as the effectiveness of prevention and control strategies (Barcellos *et al*., 2024). In 2019, Brazil was already facing a worrying epidemiological scenario, with a considerable increase in dengue cases. Climatic conditions, urbanization, and the lack of adequate basic sanitation contributed to the proliferation of *Aedes aegypti*, favoring the transmission of the virus (Ferreira *et al*., 2023; Barboza *et al*., 2023).

The period of 2020 and 2021 brought new challenges due to the COVID-19 pandemic, which significantly impacted dengue-related public health activities. The restrictions imposed to contain the spread of the coronavirus affected both awareness

campaigns and vector control actions (Elidio *et al*., 2024). On the one hand, social distancing and reduced traffic may have decreased mosquito exposure; on the other hand, the interruption of public health activities has hindered initiatives to combat dengue (Dias *et al*., 2021).

In 2022, Brazil experienced one of the most severe dengue outbreaks in the last decade, with a significant increase in the number of cases, particularly among children. Epidemiological data showed that the child age group, especially children under the age of five, had alarming rates of hospitalization and serious complications (Ramos *et al*., 2021). Climate variations, such as increased rainfall and high temperatures, have created an environment conducive to the proliferation of *Aedes aegypti*, directly reflecting on dengue statistics. (Cardoso *et al.,* 2024).

In the year 2023, efforts to control dengue fever and reduce the impact on children continued to be a priority. Vaccination initiatives have begun to be implemented in some regions, offering a new perspective in the fight against the disease (Lira *et al*., 2021). The introduction of specific vaccines against dengue represents a significant advance, but it also brings challenges, such as the population's adherence and the need for robust awareness campaigns (Gurgel-Gonçalves; Olive tree; Croda, 2024).

The situation of dengue among children in Brazil between 2019 and 2023 highlights the need for a deeper understanding of the factors that contribute to the vulnerability of this population. (Ribeiro *et al*., 2020). Inadequate access to health services, lack of information on prevention, and lack of knowledge of vector control measures are barriers that must be overcome (Gomes *et al*., 2024).

The epidemiological analysis of dengue in children in recent years should not be restricted only to the number of cases and hospitalizations. Dengue can affect not only children's physical health but also their mental health and social development, creating a vicious cycle that perpetuates vulnerability. Therefore, control strategies must consider not only the clinical aspect but also the social and emotional dimensions of the disease (Almeida *et al*., 2024).

Efforts to mitigate dengue among children require a multidisciplinary approach involving health professionals, educators, sociologists, and community representatives (Sampaio *et al*., 2023).

The fight against dengue is a shared responsibility that requires a continuous commitment from all sectors of society. The role of children in building a healthier future is undeniable, and protecting them from dengue should be a priority on public health and social policy agendas in Brazil (Aguiar *et al*., 2024).

The epidemiological analysis of children with dengue between 2019 and 2023 is of paramount importance due to the growing impact of this disease on Brazilian public health, especially with regard to the child population. Dengue is a viral infection transmitted by the *Aedes aegypti* mosquito, which has proven to be a constant threat, with recurrent outbreaks and high incidence rates.

We justify this work based on several factors. Firstly, dengue not only affects children's physical health but also has significant social and emotional implications, impacting their families and communities.

Understanding the epidemiology of the disease in this age group is essential to develop more effective intervention strategies aimed at dengue prevention and control. In addition, the period from 2019 to 2023 was marked by additional challenges, such as the COVID-19 pandemic, which influenced the dynamics of dengue control and prevention. The analysis of the demographic, socioeconomic, and environmental characteristics of the most affected areas allows the identification of the most vulnerable populations and the formulation of appropriate public policies.

The objective of the present study is to analyze the epidemiology of dengue in children in Brazil between 2019 and 2023, to analyze reported cases, hospitalizations, and deaths from dengue in children and adolescents in Brazil. Its specific objectives are to study the relationship between children's age and dengue severity, analyzing the frequency of hospitalizations and severe complications, such as dengue hemorrhagic fever; to investigate the incidence by sex, age, and regions, and to demonstrate the numbers of children hospitalized for dengue in Brazil.

METHODOLOGY

RESEARCH DESIGN

This is a retrospective and descriptive epidemiological survey, with a quantitative approach, in line with the proposal of classification of the different types of epidemiological studies outlined. It will be carried out based on the analysis of secondary data made available by the Department of Informatics of the Unified Health System (DATASUS). The selection of specific cases was carried out using the ICD-10 Morbidity List, covering classic dengue (A90) and hemorrhagic fever due to the dengue virus (A91).

LOCATION OF THE RESEARCH

The survey was carried out in Brazil, which is the largest country in Latin America, being the 5th largest in the world in terms of territory. The 2022/2023 Demographic Census showed that the current Brazilian population is 203 million, 62 thousand, and 512 people.

INCLUSION AND EXCLUSION CRITERIA

The period analyzed comprises from January 2019 to December 2023, focusing on the population of Brazilian children and adolescents, distributed in the following age groups: children under 1 year old, 1 to 4 years old, 5 to 9 years old, 10 to 14 years old, and 15 to 19 years old. Records that do not contain information about region and age will be excluded, as well as cases in which the service was carried out in 2018 although the notification was processed in 2019. For analysis, notifications of probable and confirmed cases of dengue, registered in the Notifiable Diseases Information System (SINAN), will be used, given the obligation of weekly notification of the disease, with deaths requiring immediate notification.

DATA COLLECTION

The data were obtained from DATASUS, referring to dengue cases among children. In the years 2019 to 2023 in Brazil.

DATA ANALYSIS

The data will be grouped in spreadsheets and graphs and submitted to quantitative and percentage analysis. The software used to prepare the graphs will be Microsoft Excel 2013 for Windows. For bibliographic research, the following databases will be used: PubMed (via Medical *Literature Analysis and Retrievel System Online* - Medline), *Scientific Electronic Library Online* (SciELO), Virtual Health Library of the Ministry of Health, website of the Ministry of Health, and Latin American and Caribbean Literature on Health Sciences (LILACS).

ETHICAL ISSUES

The research was submitted for approval by the Research Ethics Committee (CEP) of Unoeste. Every study can somehow generate risks to the participants, whether directly or indirectly. In the case of this research, there is no violation of legal and ethical standards. The procedures adopted in this research comply with the Criteria of Ethics in Research with Human Beings according to Resolution No. 466/2012 and CNS Resolution No. 510/2016 of the National Health Council. None of the procedures used pose risks to their dignity. All information collected in this study is strictly confidential. As this is an analysis of secondary data, the waiver of the Informed Consent Form will be requested.

STATISTICAL ANALYSIS

For data analysis, the Action Stat software was used, a statistical system that uses the R language and works in an integrated way with Excel, using an easy and friendly interface.

To verify the existence of an association between the regions of Brazil and the variables related to dengue (type of dengue, final classification, age group, hospitalization, and gender), the Chi-square test was used, which is suitable for qualitative (categorical) variables. The level of significance adopted was 5% (p-value ≤ 0.05).

Graphical representations with percentage frequencies were also constructed for a better understanding of the data.

RESULTS

In the period under review, there were 1,501,372 possible cases of dengue in children and young people aged 0 to 19 years in Brazil. This value includes all notifications, with the exception of situations in which the disease has been eradicated. Of 229,559 notifications, 229,559 do not have confirmation criteria in the registry, while 20,687 cases were classified as under investigation. Thus, of the total number of records, 1,251,126 are categorized as confirmed cases of dengue due to their clinical or laboratory characteristics, according to the criteria established by the Ministry of Health to direct epidemiological surveillance.

With the data collected, it is expected to provide subsidies for the creation of more effective public policies to combat dengue, focusing on the protection of children and the reduction of transmission of the virus. The results could also enrich the body of scientific knowledge about dengue, paving the way for future research and interventions.

ASSOCIATION TEST – CHI-SQUARE TEST

The Chi-square test was used to verify whether there is an association between dengue-related variables and the regions of Brazil. The Chi-square test is used to verify the existence of an association between pairs of categorical variables. To interpret the test result, a significance level of 5% ($p \leq 0.05$ □ significant test) was adopted.

The test considers the following hypotheses:

H0: The variables are independent.

Ha: The variables are dependent.

If the p-value is lower than the adopted significance level (α), hypothesis H0 is rejected, and it is concluded that the variables are dependent. If it is greater than the level of significance, *H0 is not rejected,* and it is concluded that the variables are independent.

In this case, all the results found were significant, as all p-values were below 0.05:

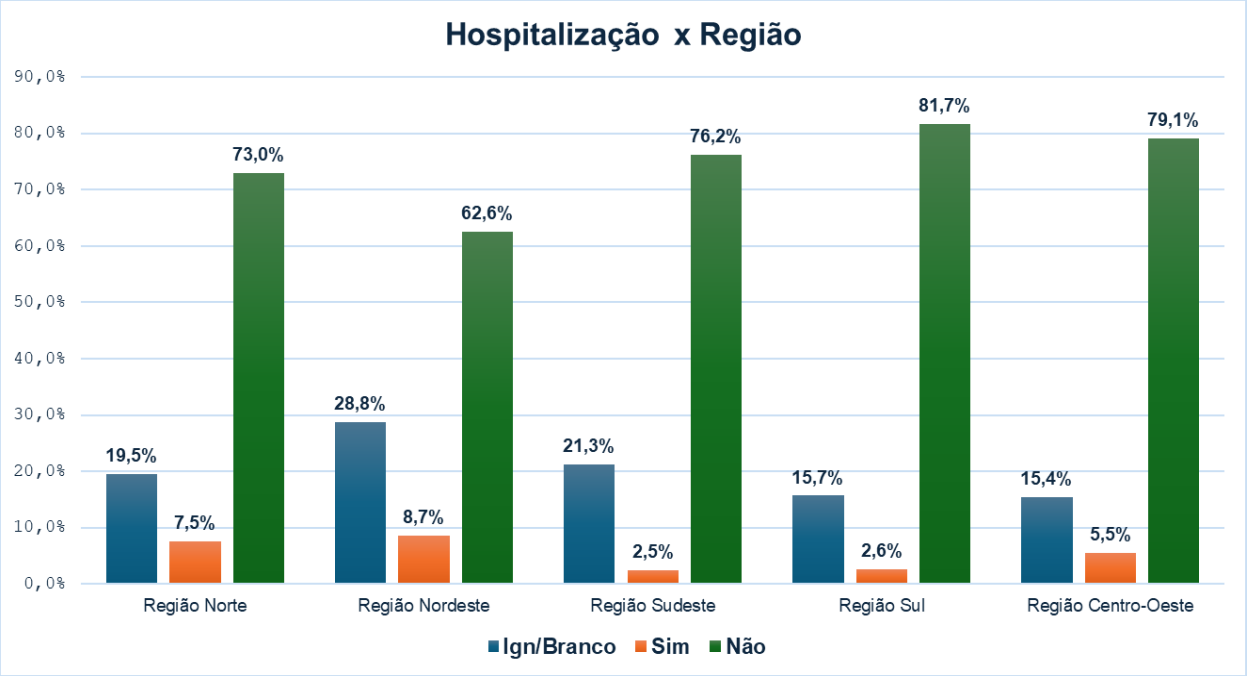
Table 1. Association test – Chi-square test

CROSSINGS	P-VALUE
REGION X HOSPITALIZATION	< 0.0001
CLASSIFICATION OF DENGUE X REGION	< 0.0001
CLASSIFICATION OF DENGUE X STATE	< 0.0001
SEROTYPE X REGION	< 0.0001
AGE GROUP X REGION	< 0.0001
REGION X SEX	< 0.0001

* <0.0001 means that the p-value is very close to 0. **Source:** Author (2025)

Bivariate graphs of the tested relationships were constructed for visual analysis of the joint behavior of the variables:

Graph 1. Hospitalized Dengue Patients by Regions

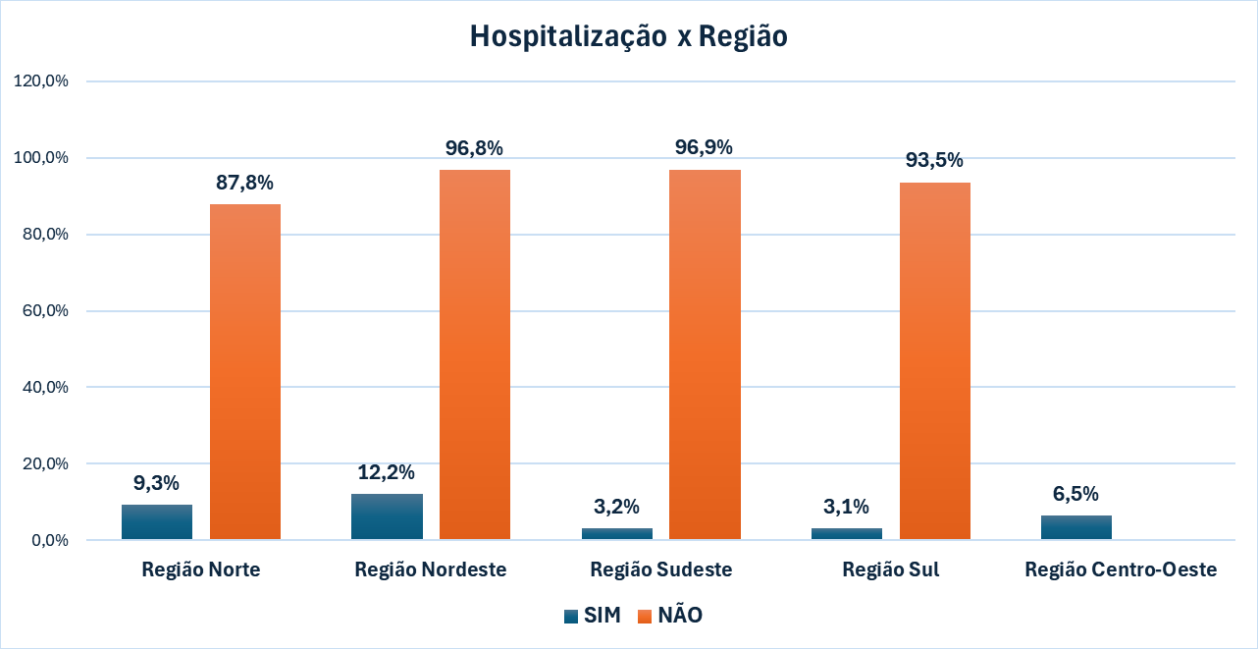


Source: Author (2025)

It is noted that, when comparing the regions, the Northeast Region had the lowest (62.6%) percentage of persons who were not hospitalized or were hospitalized and the highest percentage (28.8%) of hospitalization.

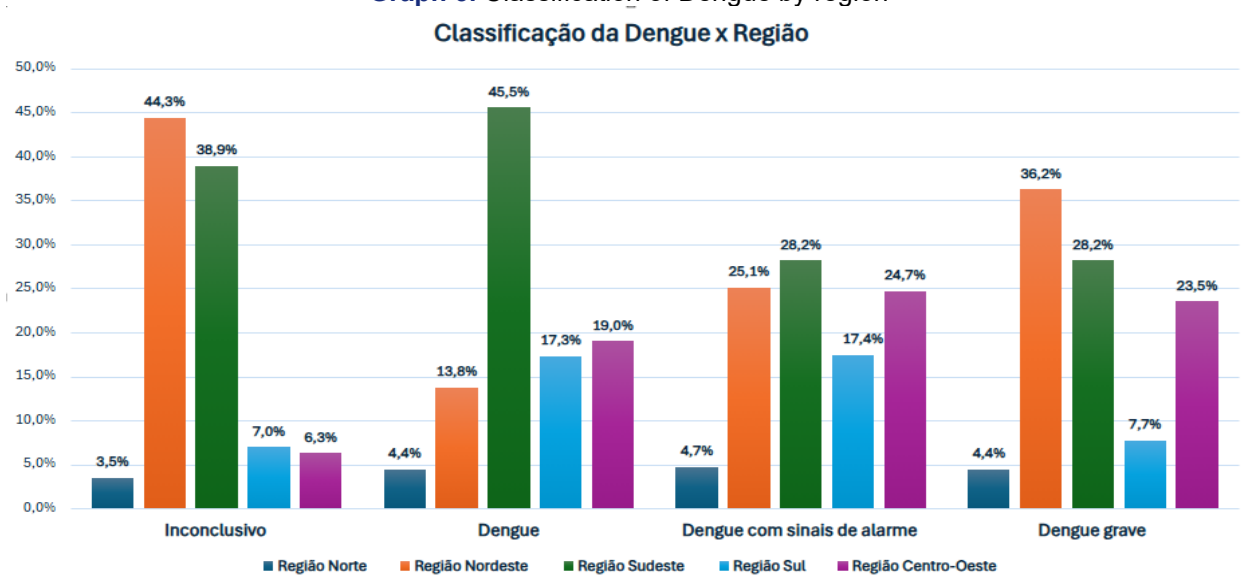
Another graph option was built, excluding the "Ign/White" option, for better visualization of the "Yes" and "No" options within the regions:

Graph 2. Hospitalization by Regions



Source: Author (2025)

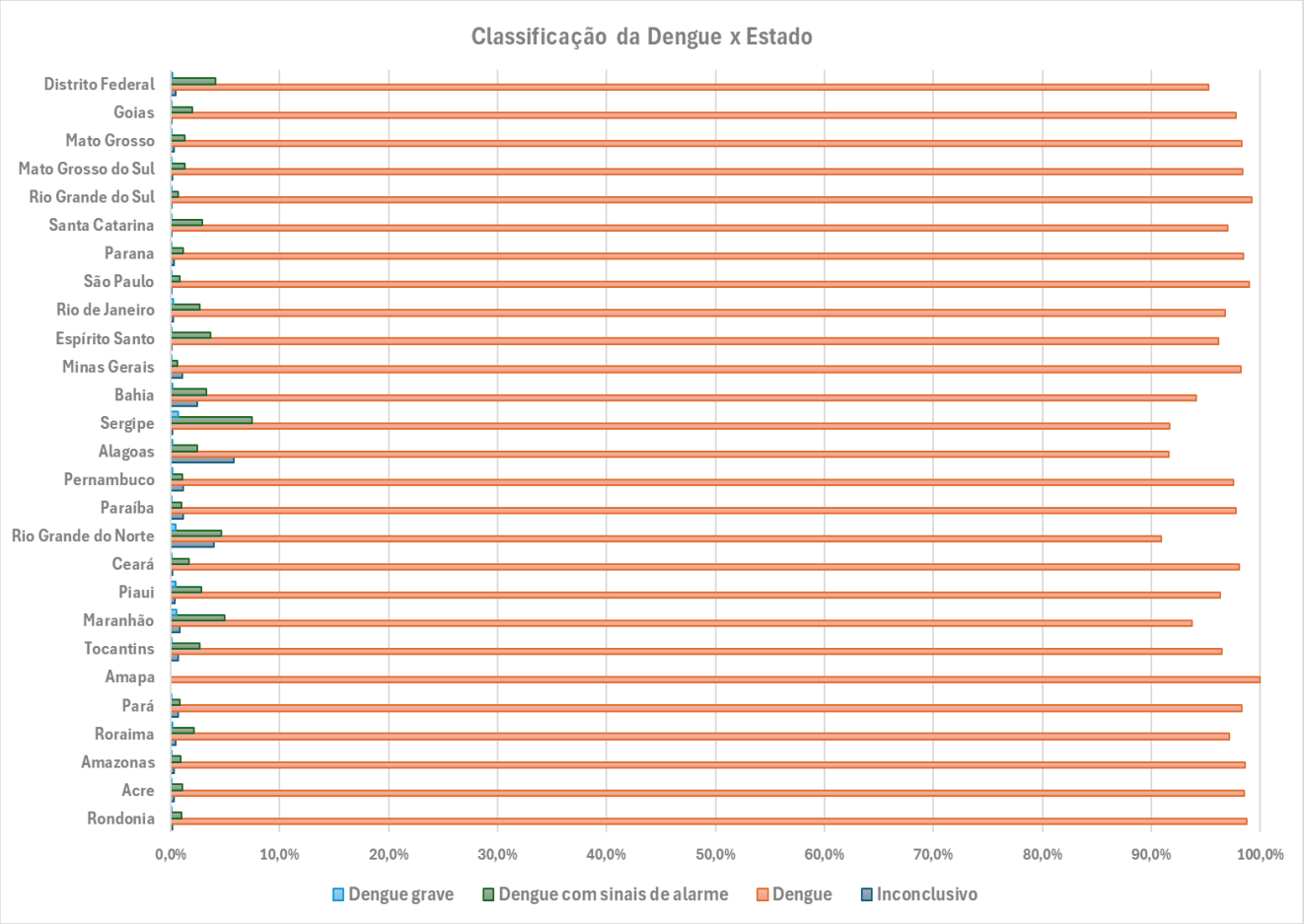
Graph 3. Classification of Dengue by region



Source: Author (2025)

Regarding the Dengue x Region Classification, as shown in the graph below, the Northeast and Southeast regions had the highest percentages of inconclusive results and severe dengue. It can be seen that the North Region had the lowest percentages in all categories. In the category "dengue with alarm signs", the Northeast, Southeast, and Midwest regions had the highest percentages, with similar values. And finally, in the "Dengue" category, the Southeast region was the one with the highest percentage, with almost half of the total results. Now, still considering the dengue classification data, an analysis was carried out considering the states, as follows:

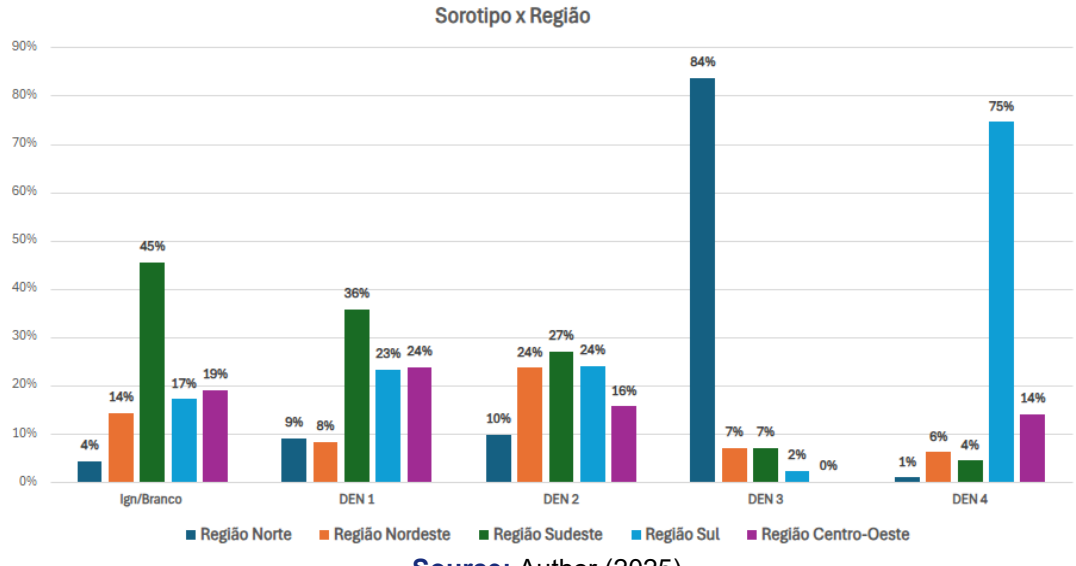
Graph 4. Classification of Dengue by States



Source: Author (2025)

All states presented very high percentages, between 90% and 100%, for the "Dengue" category. However, some states that had different results regarding "Dengue with alarm signs" (green bar) stand out when compared to the others, such as, for example, the states of Sergipe, Rio Grande do Norte, and Maranhão.

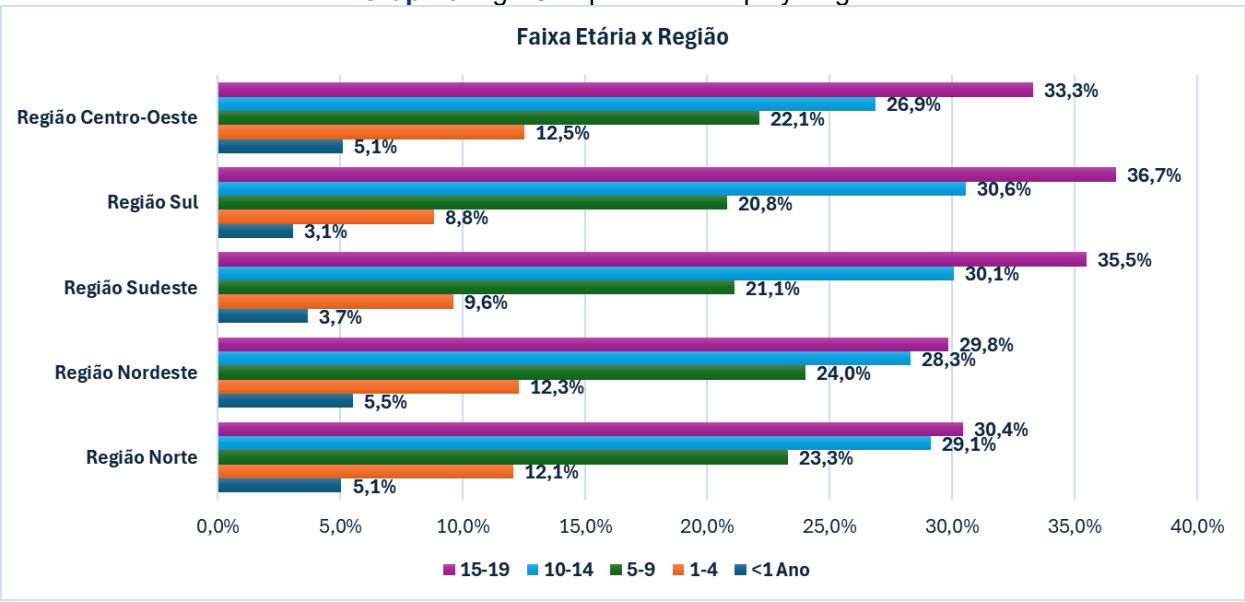
Graph 5. Dengue serotype by region



Source: Author (2025)

The graph presents the data of Serotype x Region, It is noted that in relation to Dengue type 3, there is a prevalence in the North Region, while Dengue type 4 prevails in the South Region. In the other types, Dengue types 1 and 2, the percentages were more balanced, with a slight superiority in the Southeast Region.

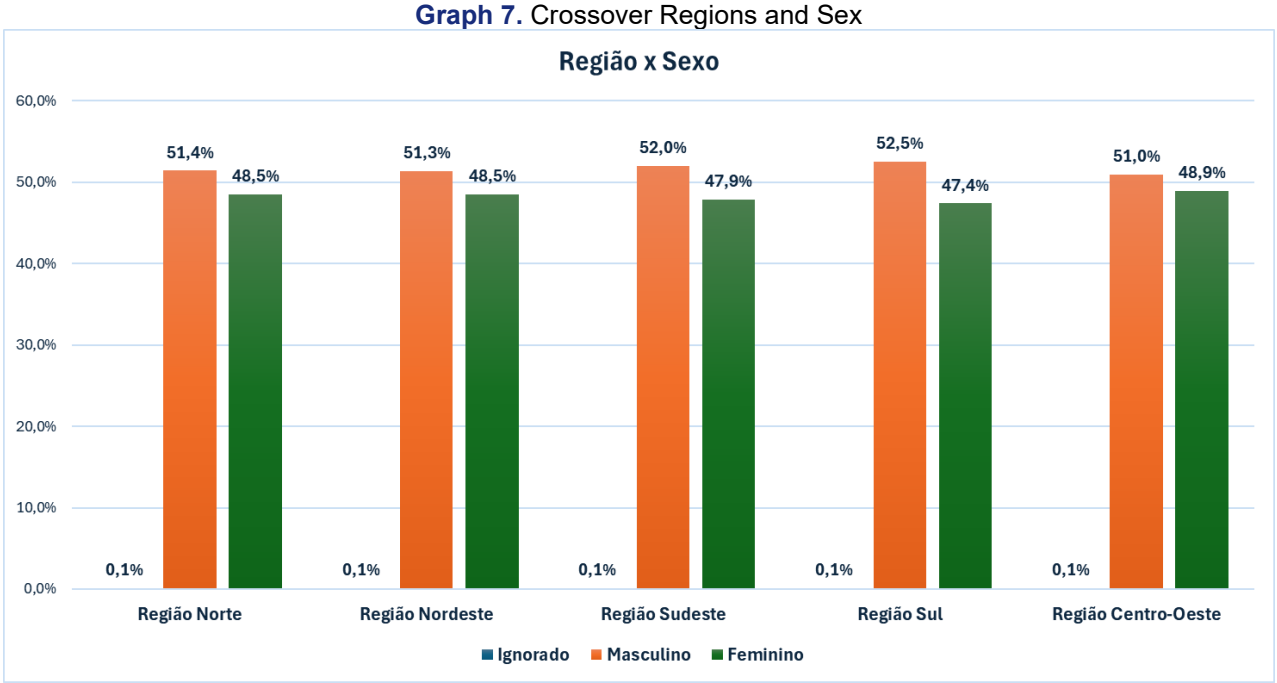
Graph 6. Age Group Relationship by Region



Source: Author (2025)

The graph shows the relationship between Age Group and Region. It is observed that in all regions, the highest percentages are from the largest age groups: 15-19 and 10-14. The percentages decrease as the age group decreases.

Graph 7. Crossover Regions and Sex



Source: Author (2025)

As shown in the graph, in all regions the proportions are similar, with the male sex prevailing by a small difference.

Table 2. Hospital death rate of (0, 19 years) from 2019-2023 by regions

Region	2019	2020	2021	2022	2023	Total
Total	0,26	0,30	0,23	0,29	0,31	0,28
North	0,28	0,14	0,51	0,22	0,09	0,25
Northeast	0,22	0,38	0,06	0,33	0,48	0,27
Southeast	0,22	0,45	0,58	0,49	0,30	0,33
South	0,24	0,08	0.00	0,07	0,14	0,11
Midwest	0,47	0,24	0,25	0,24	0,35	0,31

Source: Author (2025)

Regarding the number of deaths in hospitals, from 2019 to 2023, 172 deaths were recorded in Brazilians aged 0 to 19 years, 82 of which were caused by classic dengue and 90 by hemorrhagic fever. Thus, the mortality rate in the hospital is 0.14% for classic dengue and 2.4% for hemorrhagic fever. In the last five years, the hospital mortality rate among Brazilian children and adolescents increased among children under 1 year of age (0.58%), while it decreased among those aged 10 to 14 years (0.19%). The case fatality rate increased last year, in 2023, reaching 0.31%. In Brazil, the case fatality rate was highest in the Southeast, followed by the Midwest, North, and Northeast. On the other hand, the South Region recorded the lowest rate, with 0.11%.

DISCUSSION

The results obtained, based on robust statistical analyses and graphical representations, highlight the relevance of regional, age, and social factors in the dynamics of dengue in Brazil, providing subsidies for specific interventions and more effective public health strategies. This study brought to light how regional, sociodemographic, and epidemiological aspects are deeply interconnected, reinforcing the complexity of disease management in the Brazilian context.

The use of the Chi-square test, which revealed significant associations ($p < 0.0001$) between variables such as hospitalization, dengue classification, serotype, age group, and sex about the regions of Brazil, highlights the direct influence of regional factors on the epidemiological behavior of the disease. These findings are in line with recent literature, as reported by Teixeira (2022), who points out that climatic, socioeconomic, and health characteristics of Brazil are determinants of regional differences in dengue transmission.

Regions such as the Northeast, marked by high population density in urban areas, inadequate sanitary infrastructure, and hot and humid climate favorable to the proliferation of the *Aedes aegypti* vector, are more susceptible to the severity of cases, especially

hospitalizations. In the Southeast, in turn, the higher demographic density and intense urban mobility contribute to the maintenance of a high case load, corroborating the results of this study.

The analysis revealed that the Northeast and Southeast had the highest percentages of severe and inconclusive cases, while the North Region had the lowest percentages in all the categories analyzed. Amaral *et al*. (2021) highlight that, although the Northeast and Southeast have the highest incidence and severity, these results also reflect differences in the capacity for notification and management of cases. Brazil, especially in the North and Northeast regions, has experienced an increase in dengue cases, with annual fluctuations and variations in the number of notifications. According to Almeida (2022), the analysis of the epidemiological profile shows that dengue incidence rates, although cyclical, maintain an increasing trend with notable outbreaks.

In the North, the lower incidence may be related to underreporting, often associated with geographical barriers and limitations in health infrastructure, such as restricted access to laboratory diagnostics and hospital support. This scenario requires greater government attention to expand health coverage and response capacity in the most isolated and vulnerable regions.

The diversity of circulating serotypes also showed regional variations. The predominance of serotype 3 in the North Region and serotype 4 in the South Region reflects differences in the dynamics of viral transmission. In the Southeast, serotypes 1 and 2 stood out, with a more balanced distribution.

According to Fonseca *et al*. (2021), the simultaneous circulation of multiple serotypes is associated with a higher risk of recurrent outbreaks and more severe cases, especially in densely populated areas. The prevalence of serotype 3 in the North can be attributed to the more recent introduction and the lower previous exposure of the population to the virus, while the dominance of serotype 4 in the South may represent changes in the epidemiological pattern that deserve further investigation. These findings reinforce the importance of continuous monitoring to anticipate and mitigate the impacts of future epidemics.

Another important aspect was the analysis of the age group. The data showed that adolescents, especially in the 10-14 and 15-19 age groups, had the highest percentages of cases in all regions analyzed. Lima *et al*. (2021) suggest that the higher incidence in adolescents can be explained by behavioral factors, such as greater exposure in outdoor environments, including schools, recreational spaces, and public transportation, where interaction with mosquito-infested areas is greater. In addition, the immune pattern of these

groups, which often includes primary infections, may contribute to greater susceptibility and severity of the disease. These results highlight the need for educational interventions aimed at these groups, such as school prevention campaigns, use of repellents, and elimination of breeding sites.

Regarding gender, the data indicated a slight predominance of cases in males in all regions, although the difference is small. According to Almeida *et al*. (2021), this pattern can be attributed to behavioral factors, such as men's greater involvement in outdoor activities, including work and leisure, which increases exposure to the vector.

However, the similarity in percentages between the sexes suggests that vulnerability to dengue is widely shared, which reinforces the need for universalized prevention strategies.

The findings confirmed significant associations between regional variables and indicators such as hospitalization, clinical classification, predominant serotype, and age group. The Northeast and Southeast stood out with the highest percentages of severe cases, hospitalizations, and diagnostic inconclusions, reflecting challenges in the early detection and management of the disease. The predominance of hospitalizations in the Northeast (28.8%) can be explained by structural characteristics, such as precarious sanitary conditions and limitations in health services. In the Southeast, the higher population density contributes to the intensified circulation of the virus, increasing the absolute number of cases.

This data reflects the structural and social vulnerability of these regions, indicating that health systems need to be strengthened to deal with epidemic peaks and reduce the impact of the disease. Public policies aimed at expanding access to rapid diagnosis, early clinical management, and awareness campaigns are essential to mitigate hospitalizations and deaths.

CONCLUSION

It should be noted that, in 2020, there was a significant reduction in dengue notifications. This may indicate a decrease in the incidence of the disease. Impacted by the COVID-19 pandemic and its impacts on the health system and the demand for medical care.

Although there are restrictions related to the research, such as possible underreporting and registration failures, the information collected by the study is reliable. The Ministry of Health is a valuable source for epidemiological monitoring and the foundation of public health policies. Dengue prevention and control actions, which include

community awareness, the fight against the mosquito that transmits the mosquito, and execution, are essential to prevent and control dengue fever and are essential to minimize the effect of this disease on children and young people.

Briefly, this study emphasizes the importance of a unified and complete strategy to combat dengue to reduce the occurrence of accidents. This data reinforces the need for educational campaigns aimed at children and adolescents, emphasizing preventive measures such as the use of repellents and the elimination of breeding sites. These differences reinforce the importance of continuous monitoring of serotypes since the emergence of new types can increase the risk of severe epidemics due to secondary infection by different serotypes.

This finding suggests that while behavior may slightly influence exposure, vulnerability to infection is similar between boys and girls. Prevention strategies should, therefore, be universalized, addressing both groups equally. Among the most worrying results is the rate of hospitalizations and deaths. Although the absolute numbers of deaths were not highlighted in the data, the severity of cases in specific regions, such as the Northeast and Southeast, require special attention. This scenario reflects the need for investments in health infrastructure, including rapid diagnostics and adequate hospital support, especially in more vulnerable regions.

In summary, the results of this study highlight the regional heterogeneity and demographic differences in the epidemiology of dengue in children and adolescents in Brazil. These findings emphasize the importance of targeted public health approaches that consider regional and demographic specificities. Policies that integrate epidemiological surveillance and control efforts.

REFERENCES

1. Aguiar, G. R. F., & et al. (2024). Common arboviruses and the kidney: A review. *Brazilian Journal of Nephrology, 46*(3), e20230168. https://doi.org/10.1590/2175-8239-JBN-2023-0168en

2. Almeida, I. F. de. (2021). *Characterization of the temporal profiles of dengue transmission in the municipalities of six Brazilian states, 2010-2019* [Dissertação de mestrado, Escola Nacional de Saúde Pública Sergio Arouca, Fundação Oswaldo Cruz]. Repositório Arca. https://www.arca.fiocruz.br/handle/icict/47348

3. Almeida, L. M. de, & et al. (2024). Usefulness of minimally invasive autopsy in the diagnosis of arboviruses to increase the sensitivity of the Epidemiological Surveillance System in Ceará, Brazil. *Epidemiology and Health Services, 33*, e2024008. https://doi.org/10.1590/S2237-96222024V33E2024008.en

4. Almeida, V. S. M. (2022). *Epidemiological profile of dengue in Brazil from 2014 to 2020* [Trabalho de conclusão de curso, Escola Bahiana de Medicina e Saúde Pública]. Repositório Bahiana. https://repositorio.bahiana.edu.br/jspui/bitstream/bahiana/6885/1/Vitor%20Sallenave%20Moreira%20Almeida%20-%20Perfil%20epidemiol%C3%B3gico%20da%20dengue%20no%20Brasil%20no%20per%C3%ADodo%20de%202014%20a%202020%20-%202022.pdf

5. Amaral, M. B. do. (2021). *Spatial analysis of the relationship between dengue and the density of Aedes aegypti (Diptera: Culicidae) females, at the peak of the epidemic in the municipality of Santos, SP, from 2012 to 2018* [Dissertação de mestrado, Faculdade de Saúde Pública, Universidade de São Paulo]. Repositório USP. https://www.teses.usp.br/teses/disponiveis/6/6142/tde-13042022-132402/

6. Barboza, M. A., & et al. (2023). Cross-sectional epidemiological study of dengue case notifications in the Northeastern States of Brazil from 2011 to 2021. *The Brazilian Journal of Infectious Diseases, 27*(Suppl. 1), 103536. https://doi.org/10.1016/j.bjid.2023.103536

7. Barcellos, C., & et al. (2024). Climate change, thermal anomalies, and the recent progression of dengue in Brazil. *Scientific Reports, 14*(1), 5948. https://doi.org/10.1038/s41598-024-56044-y

8. Camargo, F. de A., & et al. (2022). A mathematical model for accessing dengue hemorrhagic fever in infants. *Trends in Computational and Applied Mathematics, 23*(1), 101–115. https://doi.org/10.5540/tcam.2022.023.01.00101

9. Cardoso, R. L., & et al. (2024). Dengue in Brazil: A systematic review. *Revista Foco, 17*(3). https://doi.org/10.54751/revistafoco.v17n3-079

10. Dias, C. B. F., & et al. (2021). Influence of climatic factors on the dengue panorama in Brazil in the period 2018-2019. *Ibero-American Journal of Humanities, Sciences and Education, 7*(5), 124–135. https://doi.org/10.51891/rease.v7i5.1180

11. Elidio, G. A., & et al. (2024). Primary health care: The greatest ally in the response to the dengue epidemic in Brazil. *Revista Panamericana de Salud Pública, 48*, e47. https://doi.org/10.26633/RPSP.2024.47

12. Ferreira, T. B., & et al. (2023). Epidemiological profile of dengue in Brazil in 2022. *The Brazilian Journal of Infectious Diseases, 27*, 103564. https://doi.org/10.1016/j.bjid.2023.103564

13. Fonseca, D. de S. R., & Garcia, R. A. (2021). Zoning of the areas with the highest propensity to become ill with dengue in the intra-urban region of Montes Claros (MG) based on socio-environmental and geostatistical variables. *Geographia, 23*(50). https://doi.org/10.22409/GEOgraphia2021.v23i50.a40698

14. Gomes, J. P. M., & et al. (2024). Relationship between air temperature and dengue incidence: A time series study in Minas Gerais, Brazil (2010-2019). *Cadernos de Saúde Pública, 40*(3), e00076723. https://doi.org/10.1590/0102-311XPT076723

15. Gurgel-Gonçalves, R., Oliveira, W. K. de, & Croda, J. (2024). The greatest dengue epidemic in Brazil: Surveillance, prevention, and control. *Journal of the Brazilian Society of Tropical Medicine, 57*, e002032024. https://doi.org/10.1590/0037-8682-0113-2024

16. Lima-Câmara, T. N. (2024). Dengue is a product of the environment: An approach to the impacts of the environment on the Aedes aegypti mosquito and disease cases. *Brazilian Journal of Epidemiology, 27*, e240048. https://doi.org/10.1590/1980-549720240048

17. Lima, M. A. O., & et al. (2021). Spatial distribution of dengue, chikungunya and Zika and socioeconomic determinants in a municipality in Bahia. *Journal of Medical and Biological Sciences, 20*(4), 551–559. https://doi.org/10.9771/cmbio.v20i4.38344

18. Lira, L. F., & et al. (2021). Incidence of dengue in Brazil: Comparative analysis between São Paulo and Alagoas. *Brazilian Journal of Health Review, 4*(6), 24410–24426. https://doi.org/10.34119/bjhrv4n6-066

19. Medeiros, E. A. (2024). Challenges in controlling the dengue epidemic in Brazil. *Acta Paulista de Enfermagem, 37*, eEDT012. https://doi.org/10.37689/acta-ape/2024EDT012

20. Oliveira, C. C. da S., & et al. (2024). Dengue vaccine vs. circulating serotype: A discussion of vaccination coverage according to the epidemiology of the regions of Brazil. *JRG Journal of Academic Studies, 7*(14), e14951. https://doi.org/10.55892/jrg.v7i14.951

21. Ramos, A. L. B. M., & et al. (2021). The efficiency of actions to combat dengue in primary health care in Brazil. *Brazilian Journal of Health Review, 4*(3), 10575–10595. https://doi.org/10.34119/bjhrv4n3-079

22. Ribeiro, A. C. M., & et al. (2020). Socio-environmental conditions related to the permanence of dengue in Brazil-2020. *Health and Environment Journal, 11*(2), 326–340.

23. Rios, A. N. (2024). *Temporal and spatial modeling of the spread of dengue in Brazil* [Tese de doutorado, Faculdade de Medicina, Universidade de São Paulo]. Repositório USP. https://doi.org/10.11606/T.5.2024.tde-07052024-114310

24. Sá Júnior, E. B., Silva, M. V. F. da, & Carrijo, A. F. (2022). Epidemiological profile of dengue in Brazil between 2014 and 2022 and socio-environmental aspects. *Annals of the University Week and Scientific Initiation Meeting, 1*(1). (ISSN: 2316-8226)

25. Sampaio, B. R., & et al. (2023). Monitoring the evolution of the death rate from dengue hemorrhagic fever in Brazil during the period from 2018 to 2023. *The Brazilian Journal of Infectious Diseases, 27*, 103495. https://doi.org/10.1016/j.bjid.2023.103495

26. Silva, J. C., & et al. (2024). Dengue cases in Brazil: Evolution of reported cases in the last 10 years. *Research, Society and Development, 13*(8), e10713846640. https://doi.org/10.33448/rsd-v13i8.46640

27. Sousa, S. C. de, & et al. (2024). Space-time dispersion of dengue occurrence in epidemic and non-epidemic years in a municipality in the metropolitan region of Belo Horizonte, MG, 2011 to 2017. *Brazilian Journal of Epidemiology, 27*, e240023. https://doi.org/10.1590/1980-549720240023

28. Teixeira, S. T., & et al. (2022). Dengue cases that occurred in the state of Roraima between the years 2017 and 2021. *Health Sciences: Challenges and Potentialities in Research, 1*, 82–88. https://doi.org/10.37885/221010468