HU Revista
Artigo Original

Meningite em crianças no Brasil de 2020 a 2024: análise epidemiológica de dados secundários

Meningitis in children in Brazil from 2020 to 2024: epidemiological analysis of secondary data

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Submetido: 01/05/2025
Aceito: 08/07/2025

RESUMO

Introduction: Meningitis is a serious disease with high morbidity and mortality rates, representing a significant public health concern. **Objective:** To analyze the epidemiological profile of meningitis cases in children in Brazil, between 2020 and 2024, and to compare the lethality of the disease between the regions of the country. **Material and Methods:** Descriptive study, with secondary data from the Notifiable Diseases Information System of the Unified Health System (SINAN), referring to children aged 0 to 9 years. Data were organized in Excel spreadsheets and analyzed using descriptive statistics. Lethality was calculated using Statistical Package for the Social Sciences (SPSS), and regional comparisons were performed using the chi-square test ($p < 0.05$). **Results:** A total of 20,197 cases were reported during the study period. After a decline from 2020 to 2021, cases increased in 2022 and 2023, with a decrease in 2024. The Southeast region reported the highest number of cases. Most cases occurred in males (57.9%) and children under 1 year of age (38.3%). White children accounted for 52.1% of cases, and 15.5% of records lacked information on race/ethnicity. Hospital discharge was the most frequent outcome (84.8%), and overall lethality due to meningitis was 4.9%, with higher rates in the North (13.5%) and Central-West (9.9%) regions. Viral meningitis was the most common etiology (54.0%), followed by bacterial (15.6%) and unspecified (19.8%). **Conclusion:** A recent increase in childhood meningitis cases was observed, along with regional disparities in morbidity and mortality indicators, highlighting the need for strengthened surveillance and improved data quality.

Keywords: Meningitis; Vaccine Preventable Diseases; Epidemiology.

ABSTRACT

Introdução: A meningite é uma doença grave, com altas taxas de morbidade e mortalidade, de grande relevância para a saúde pública. **Objetivo:** Analisar o perfil epidemiológico dos casos de meningite em crianças no Brasil, entre 2020 e 2024, e comparar a letalidade da doença entre as regiões do país. **Material e Métodos:** Estudo descritivo, com dados secundários do Sistema de Informação de Agravos de Notificação do Sistema Único de Saúde (SINAN), referente a crianças de 0 a 9 anos. Os dados foram organizados em planilhas Excel e analisados por estatística descritiva. A letalidade foi calculada no Statistical Package for the Social Sciences (SPSS) e as comparações regionais foram feitas pelo teste do qui-quadrado ($p < 0,05$). **Resultados:** Foram notificados 20.197 casos no período. Após queda entre 2020 e 2021, os registros aumentaram em 2022 e 2023, com queda em 2024. A região Sudeste concentrou a maioria dos casos. Predominaram os casos em meninos (57,9%) e em menores de 1 ano (38,3%). Crianças brancas representaram 52,1% dos casos, com 15,5% de raça/cor ignorada. A alta hospitalar foi o desfecho mais frequente (84,8%), enquanto a letalidade por meningite foi de 4,9%, com maiores taxas no Norte (13,5%) e Centro-oeste (9,9%). A meningite viral foi a etiologia mais comum (54,0%), seguida da bacteriana (15,6%) e não especificada (19,8%). **Conclusão:** Observou-se aumento recente nos casos de meningite infantil e desigualdades regionais nos indicadores de morbidade e mortalidade, reforçando a importância da vigilância epidemiológica e da qualificação dos registros.

Palavras-chave: Meningite; Doenças Preveníveis por Vacina; Epidemiologia.

INTRODUCTION

Meningitis is a disease characterized by inflammation of the meninges, the membranous layers that cover the brain and spinal cord.[1] Its etiology may be associated with several infectious agents, including bacteria, viruses, and other pathogens. However, other conditions may also trigger an inflammatory process in these protective layers of the central nervous system, such as medications and other medical conditions.[2]

The infection may develop rapidly, as in cases caused by viruses, which typically produce acute clinical conditions. Similarly, acute conditions may also occur via the bacterial route, caused by pyogenic bacteria, although with a slower progression. In contrast, in bacterial meningitis, the infectious agent varies according to age group, gender, and adverse clinical conditions.[2] Children under five years of age, for example, are at higher risk of pneumococcal meningitis compared to other populations, making it extremely important to understand this condition within this population subgroup.[3]

The high morbidity and mortality rates of meningitis, due to the severity it can reach, make this disease highly relevant to public health, requiring compulsory notification and mandatory investigation.[4] According to the World Health Organization (WHO), 20% of patients affected by bacterial meningitis develop complications, including neurodevelopmental sequelae. In addition, 10% may lead to death.[5]

It is estimated that approximately 100,000 deaths occur worldwide each year as a result of meningitis-related complications.[6] In 2019, there were approximately 236,000 deaths and 2.51 million incident cases of meningitis worldwide. The greatest burden was observed among children under five years of age, with 112,000 deaths and 1.28 million incident cases.[7]

Vaccination is the primary form of prevention for this disease, with early childhood being the ideal period for the administration of all recommended doses. This strategy has the greatest impact against meningitis, with specific vaccination schedules for each etiological agent.[8]

In spite of advancements in prevention, diagnosis and treatment protocols, outbreaks are observed in different regions, having impacts on both the individual´s and public health. Within this context, it is vital to understand the evolution of cases, to identify regional patterns and to analyse chronological trends of meningitis among children so as to supportively design interventions, to optimize immunization programs and to strengthen epidemiological surveillance measures. Thus, this study aims to provide current evidence so as to guide more effective preventive measures and to contribute to reduce impacts of meningitis in childhood. In order to do so, we aimed at analyzing the epidemiological profile of meningitis cases among children in Brazil between 2020 and 2024 and to compare the lethality of the disease across the different regions of the country.

MATERIAL AND METHODS

Study outline

This is a quantitative, descriptive study of secondary data about meningitis among children in Brazil.

Background

The study relied on data from the Department of Computing of the Brazilian Unified Health System (Datasus) via the Notifiable Diseases Information System (SINAN).

The SINAN is an information system that gathers data on notifications and investigations of diseases and conditions found on the national list of mandatory notifiable diseases, as defined by the Consolidation Ordinance # 5201 of August 15th 2024.[9] The data were obtained from April 15th to April 30th 2025.

Participants

All records of meningitis notifications to SINAN between January 2020 and December 2024 targeting children under ten years of age were included in the study.

Source of data and variables

The topic "epidemiological and morbidity" was selected to search for the data on the Datasus website, and, subsequently, the item "diseases and health problems under notification from 2007 onwards (SINAN)" was accessed. Then, on the following page, the disease "meningitis" was selected.

In addition to the variables concerning the place (Brazil, South, Southeast, North, Northeast and Central-West regions) and the year of diagnosis (2020-2024), the other variables analyzed were: gender (male, female, and unknown); age range (< 1 year, 1 to 4 years, and 5 to 9 years); race (white, black, Asian, brown, indigenous, and unknown/blank); etiology (MCC: meningococcemia; MM: meningococcal meningitis; MM+MCC: meningococcal meningitis + meningococcemia; MTBC: Mycobacterium tuberculosis; MB: bacterial meningitis; MNE: unspecified meningitis; VM: viral meningitis; MOE: meningitis due to other etiologies; HM: meningitis due to Haemophilus influenzae; MP: meningitis due to Streptococcus pneumoniae); and disease progression (discharge, death due to meningitis, death due to another cause, and unknown/blank).

Study size and bias

Since it is a population-based study using secondary census data, sampling was not performed. All available records were analyzed. There is a possibility of biased underreporting and inconsistencies in the completion of notification forms, such as missing data in some variables. Despite these limitations, SINAN is recognized as one of the main sources of public health information in Brazil and has been widely used in epidemiological studies.

Statical analyses

The collected data were organized in Microsoft Excel spreadsheets and the analysis was performed using descriptive statistics, with estimates of absolute and relative frequencies, presented in tables and graphs.

The lethality analysis was performed using SPSS' 22.0 version based on the number of deaths from meningitis divided by the total number of cases in each region, expressed as a percentage. Pearson's chi-square test was applied to check if the proportion of deaths among meningitis cases varied significantly across regions. To that end, a contingency table was constructed containing the number of cases with the outcome "death" and "non-death" for each region. The test assessed the association between the variable "geographic region" and the outcome of the cases, with a p-value < 0.05 considered statistically significant.

A descriptive analysis of the temporal distribution of meningitis cases was conducted based on the absolute and relative frequencies of records per year, from 2020 to 2024. The data were presented in a table and a line graph to illustrate annual variations in the number of cases.

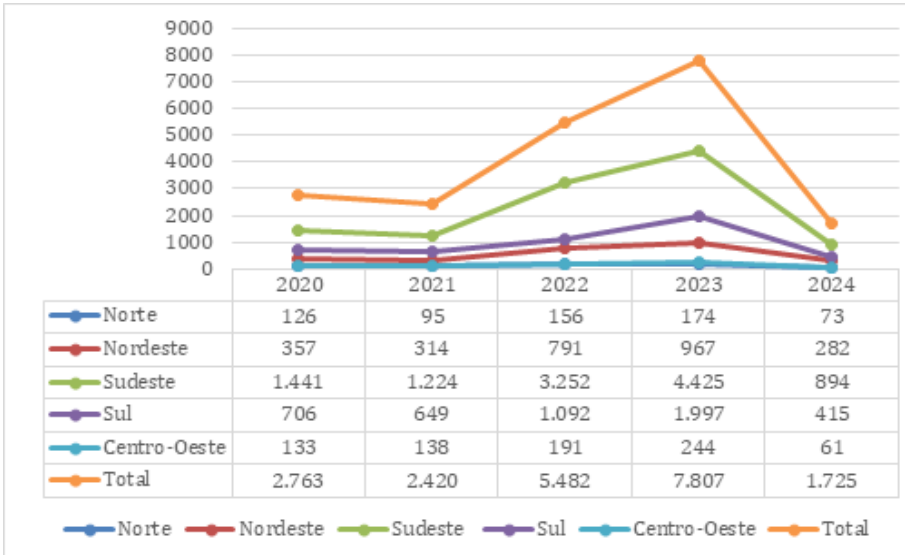
Considering the public, aggregated, and anonymous nature of the data, this study does not require approval by a Human Research Ethics Committee, in accordance with the resolution n. 510 of 2016 of the Brazilian National Health Council.[10]

RESULTS

Between 2020 and 2024, 20,197 cases of meningitis among children were reported in Brazil. The annual distribution presented fluctuations: 2,763 cases in 2020 (13.7%); 2,420 in 2021 (12.0%); 5,482 in 2022 (27.2%); 7,807 in 2023 (38.7%); and 1,725 in 2024 (8.5%). Between 2020 and 2021 a smaller absolute number of cases was observed, followed by a sharp increase in 2022 and 2023 (Figure 1). The reduction in 2024 records may be related to delayed data updates at SINAN.

Regionally, the Southeast concentrated the highest number of cases throughout the entire period, with a peak in 2023 (4,425 cases). The South and the Northeast presented the second largest number of cases, 1,997 and 967 respectively, while the North (174) and the Middle-West (244) registered lower absolute numbers and less expressive oscillations throughout time.

Among the 20,197 cases of meningitis in children registered in Brazil during the period analyzed, the predominance of the male sex was noted in all regions, accounting for 57.9% of the total of cases. The most affected age group was children under 1



	2020	2021	2022	2023	2024
Norte	126	95	156	174	73
Nordeste	357	314	791	967	282
Sudeste	1.441	1.224	3.252	4.425	894
Sul	706	649	1.092	1.997	415
Centro-Oeste	133	138	191	244	61
Total	2.763	2.420	5.482	7.807	1.725

Figure 1: Meningitis cases in children by Brazilian region, 2020-2024
Source: Notifiable Diseases Information System (SINAN), 2024.

year of age (38.3%), followed by children aged 1 to 4 years (36.6%). The distribution by race/color showed that white children accounted for 52.1% of cases, with a higher concentration in the Southeast and South regions, while brown children represented 29.0% of cases, especially in the North and Northeast regions. A relevant proportion of records did not report race/color (15.5%), highlighting a limitation of the data for this variable (Table 1).

With regard to the disease progression between 2020 and 2024, the majority (84.8%) were discharged from hospital, while 4.9% died from meningitis and 1.3% died from other causes (Table 2). Approximately 9% of records had unknown or unfilled progression. The Southeast region had the highest proportion of hospital discharges (56.9%), as well as the highest number of deaths from meningitis (46.2%).

As for etiology, viral meningitis (VM) was the most frequent, representing 54.0% of cases, with a significant predominance in the Southeast region (63.0% of VM cases). Next was bacterial meningitis (BM), accounting for 15.6% of records, and unspecified meningitis (UM), with 19.8% of the total. Other causes, such as meningococcal meningitis (MM), gram-positive

Table 1: Sociodemographic profile of meningitis cases among children according to the region of Brazil (2020-2024).

Variables	North		Northeast		Southeast		South		Central-West		Total	
Gender	n	%	n	%	n	%	n	%	n	%	n	%
Male	335	53,7	1.582	58,4	6.484	57,7	2.827	58,2	464	60,5	11.691	57,9
Female	289	46,3	1.126	41,5	4.747	41,8	2.032	41,8	303	39,5	8.492	42,1
Ignored	--	--	3	0,1	5	0,04	--	--	--	--	8	0,04
Age range												
< 1 year	223	35,7	961	35,5	4.011	35,7	2.173	44,8	374	48,8	7.742	38,3
1 to 4 years	197	31,6	936	34,5	4.454	39,6	1.587	32,7	223	29,1	7.397	36,6
5 to 9 years	204	32,7	813	30,0	2.767	24,7	1.098	22,6	170	22,1	5.052	25,0
Race												
White	76	12,2	289	10,7	6.118	54,4	3.837	79,0	195	25,4	10.515	52,1
Black	6	1,0	64	2,4	336	3,0	95	1,9	12	1,6	513	2,5
Amarela	--	--	05	0,2	46	0,4	16	0,3	3	0,4	70	0,3
Parda	483	77,4	1.950	71,9	2.638	23,4	375	7,7	421	54,9	5.867	29,0
Indígena	39	6,3	6	0,2	12	0,1	22	0,5	19	2,5	98	0,5
Ignored	20	3,2	397	14,7	2.086	18,6	514	10,6	117	15,3	3.134	15,5
Total	624	100	2.711	100	11.236	100	4.859	100	767	100	20.197	100

Source: Notifiable Diseases Information System (SINAN), 2024.

Caption: n - absolute number of cases; %: relative number of cases.

cocci meningitis (GPC), and tuberculous meningitis (TBM) showed lower proportions, ranging from 0.5% to 1.7% of the cases. Another observation is that 0.1% of the records did not have information on the etiological agent.

Table 3 shows the distribution of deaths and total cases of meningitis among children by each region of Brazil, allowing for the calculation of their respective case fatality rates. In order to verify whether the proportion of deaths among the cases had a significant variation across regions, Pearson's chi-square test was applied and revealed statistically significant differences ($\chi^2 = 275.31$; $p < 0.001$).

The Northern region was found to have the highest lethality rate (13.5%) followed by the Central-West region (9.9%), and North-East (8.6%). On the other hand, the South-East and South had the lowest rates, 4.1% and 2.9% respectively. The results indicate regional disparities concerning the meningitis outcomes among children.

DISCUSSION

This study analyzed the evolution of meningitis cases among children in Brazil between 2020 and 2024, highlighting important regional and temporal variable variants. A reduction was observed in the number of cases in 2020 and 2021, followed by a sharp increase in 2022 and 2023. In 2024, the number of notifications had a significant decline. Despite that, this reduction must be carefully interpreted, since the previous year data may still be incomplete due to a delay in the system updates.

The confirmation of the cases, most of the time, depends on laboratory tests, whose release may take time. It also requires the subsequent insertion of the results in SINAN. These factors make the data of 2024 even more likely to be reviewed, and a decline should not be inferred without the required data confirmation.

The results also highlight the predominance in the total number of cases in the South-East, followed

Table 2: Distribution of meningitis cases among children by etiological evolution according to the region of Brazil, 2020-2024.

	Central-West		Northeast		North		Southeast		South		Total	
Evolution	n	%	n	%	n	%	n	%	n	%	n	%
Ignored/blank	90	5,0	418	23,0	54	3,0	919	50,6	335	18,4	1.816	8,99
Discharge	582	3,4	2.012	11,7	467	2,7	9.742	56,9	4.313	25,2	17.116	84,77
Deaths from meningitis	76	7,6	233	23,4	84	8,4	459	46,2	141	14,2	993	4,92
Deaths from other cause	19	7,1	47	17,7	19	7,1	112	42,1	69	25,9	266	1,32
Etiology												
Ignored/blank	0	0	3	14,3	2	9,5	10	47,6	6	28,6	21	0,1
MCC	9	3,7	45	18,7	11	4,5	154	63,9	22	9,1	244	1,21
MM	14	4,1	47	13,9	21	6,2	192	56,6	65	19,2	339	1,68
MM+MCC	3	1,5	36	17,9	13	6,5	122	60,7	27	13,4	201	1,0
MTBC	4	3,5	25	21,9	13	11,4	42	36,8	30	26,3	114	0,56
MB	166	5,2	323	10,2	171	5,4	1.502	48,0	991	31,4	3.153	15,62
MNE	329	8,2	922	23,1	173	4,3	1.672	4,0	891	22,3	3.987	19,76
MV	159	1,4	1.129	10	170	1,5	6.877	63,0	2.572	24,0	10.907	54,05
MOE	15	11,3	27	20,4	14	10,6	47	35,6	29	22,0	132	0,65
MH	20	7,3	38	13,8	11	4,0	157	57,1	49	17,8	275	1,36
MP	48	5,9	114	14,1	25	3,1	449	55,4	174	21,5	810	4,01
Total	767	100	2.709	100	624	100	11.224	100	4.856	100	20.180	100

Source: Notifiable Diseases Information System (SINAN), 2024.

Caption: n: absolute number of cases; %: relative number of cases; Ign/blank: ignored/blank; MCC: Meningococcemia; MM: meningococcal meningitis; MM+MCC: meningococcal meningitis + meningococcemia; MTB: mycobacterium tuberculosis; BM: bacterial meningitis; UM: unspecified meningitis; VM: viral meningitis; MOE: meningitis due to other etiologies; HIM: haemophilus influenzae meningitis; SPM: streptococcus pneumoniae meningitis.

by the Southern and North-Eastern regions. These results confirm meningitis as a highly relevant concern for the public healthcare system, especially considering vulnerable infantile populations.

The increase observed in 2022 and 2023 may be connected with factors such as localized outbreaks, changes in epidemiological patterns, consequences of the Covid-19 pandemic, or increased surveillance and notification of cases.[6,11] On the other hand, the decrease in the number of cases in 2024 may indicate the impact of strategies for controlling or reducing the incidence of the disease, as much as the lack of data in the notification system mentioned previously.

The lower number of cases reported between 2020 and 2021 may be linked to the impacts of the COVID-19 pandemic on epidemiological surveillance systems. A study conducted in São Paulo showed a statistically significant drop in bacterial meningitis cases in these two years, coinciding with the period of more intense restrictive measures during the pandemic, and a subsequent increase in cases as these restrictions were eased.[12]

In relation to the country's regions, it was observed that the highest number of cases occurred in the Southeast and South regions of the country. This pattern may be associated with higher population density, the expansion of epidemiological surveillance systems, and greater laboratory diagnostic capacity.[9]

Table 3: Lethality rate of meningitis among children according to region in Brazil, 2020-2024

Region	Death from meningitis (n)	Total number of cases (n)	Lethality rate (%)
Central-West	76	767	9,9%
North-East	233	2709	8,6%
North	84	624	13,5%
South-East	459	11224	4,1%
South	141	4856	2,9%
Brazil	993	20180	4,9%

Source: The data source is the Brazilian Notifiable Diseases Information System of the Unified Health System (SINAN), 2024. Chi-square test: $\chi^2(4) = 275.31$, $p < 0.001$.

Urban concentration and inequalities in access to healthcare services may also have influenced this scenario.

In the South, factors such as seasonal climate, circulation of more aggressive bacterial serogroups, and localized outbreaks may have contributed to this increase.[13] In addition, better laboratory surveillance infrastructure in the South region may have led to higher case detection and notification.

Male children were the most affected by meningitis in the period analyzed, confirming the results of other studies.[14-16] Data from a research describing the epidemiological profile of bacterial meningitis and meningococcal disease in children treated at a Brazilian general hospital showed that 59.1% of cases occurred among males.[18]

Gender is a biological variable that affects the immune system functions. In infectious diseases, sex-based biological factors influence viral susceptibility, response to the virus, disease progression, and side effects of anti-infective or anti-inflammatory therapy. [18]

Although prevalence is still higher among white people, there is no clear evidence of racial differences in the diagnosis of meningitis. Studies indicate that effective vaccination against the main meningococcal serogroups has contributed to the reduction of cases in different contexts, as observed in the African meningitis belt. [19]

In terms of age, children under one year old were the most affected by this disease. In this regard, the analysis by Teixeira et al.[20] highlights that a late diagnosis worsens the prognosis as the disease progresses and emphasizes the importance of a highly diagnostic suspicion of meningitis, especially in cases of fever and nonspecific symptoms in children. Early diagnosis and recognition are a challenge for pediatricians in the emergency room - usually the primary setting of care - with the aim of avoiding serious complications such as sepsis, severe sepsis, and septic shock. [21]

During the COVID-19 pandemic, several factors negatively impacted the functioning of healthcare and epidemiological surveillance services, resulting in a reduction in underreporting of diseases such as meningitis. In 2019, the year before the pandemic, 7,918 cases of the disease were reported in children under 10 years of age in Brazil.[22] In contrast, reports fell to 2,763 cases in 2020 and 2,420 in 2021 - a reduction of more than 65% compared to the pre-pandemic period. This sharp decline cannot be solely interpreted as a real decrease in incidence, but probably reflects the collapse of healthcare services and failures in surveillance and reporting during the most critical periods of the pandemic.

Besides, childhood vaccination coverage has also been affected, especially against meningococcus, which may have contributed to the increase in cases among children aged 0 to 4 years, reflecting the impact of postponing or canceling routine medical appointments.[23] Despite the general reduction in bacterial meningitis, especially after the introduction of vaccines, children under the age of five years still account for most of the cases.[24,25]

By analyzing the most prevalent etiology, we observed viral meningitis as the most common in Brazil, corroborating data from the United Kingdom presented in a cohort study on pediatric meningitis in the age of conjugate vaccines. The results showed that, despite the introduction of these vaccines, viral meningitis remains the most prevalent form of the disease in the country. Therefore, the similarity between the findings from the United Kingdom and Brazil highlights the importance of continuing to monitor the viral causes of the disease.[26]

Viral meningitis is more common than bacterial meningitis, but it is associated with lower mortality rates and fewer complications.[27] In contrast, bacterial meningitis is more likely to be associated with an unfavorable prognosis and requires immediate treatment.[28,29]

Although vaccination is effective against pneumococcal disease, studies indicate limitations in the current coverage of the National Immunization Program. Researchers point out that the 10-valent vaccine (PCV10), currently used, does not protect against serotypes 3, 6A and 19A, which have increased in recent years. Replacement with the 13-valent vaccine (PCV13), which includes these serotypes, could significantly reduce the incidence of the disease, improve health indicators and generate savings for the public health system.[30] Similarly, analyses indicate that, although PCV10 has reduced hospitalizations and deaths, there has been a growth in infections by non-vaccine serotypes, which reinforces the need to review the vaccination policy.[31]

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