Original Research Article

EPIDEMIOLOGICAL PROFILE OF MENINGITIS IN THE STATE OF PARÁ, AMAZONIA BETWEEN THE YEARS 2018 AND 2022

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ABSTRACT

Objective: Analyze the epidemiological profile of meningitis in the state of Pará, Amazon, from 2018 to 2022. **Methodology:** This is an ecological, retrospective, and descriptive-exploratory study, using data from the Information System for Notifiable Diseases (SINAN), made available on the website of the Department of Information of the Brazilian Unified Health System (DATASUS). **Results:** In the state of Pará, from 2018 to 2022, 1,680 cases were confirmed. The absolute number of cases per year was 508 (30%) in 2018. Males were the most affected with 966 cases (57.5%), and the age group of 20-39 years had the highest number of cases with 584. Regarding race, parda (mixed race) remains in first place with 1,472 cases. In terms of disease progression, the number of cases with a discharge is leading with 1,309, followed by the etiology, MV, and MB, which have the highest number of cases with a discharge. **Conclusion:** It can be inferred that the study in the state of Pará is essential for data collection and information regarding the disease, subsequently highlighting the main profiles and characteristics of the disease. Furthermore, the research proves to be important as the highest number of disease notifications occurred in the years 2018, 2019, and 2022.

Keywords: *Meningitis; Epidemiology; Health surveillance system*

1. INTRODUCTION

Meningitis is a disease of public health relevance, whose pathophysiology involves inflammation of the leptomeninges, characterized by an abnormal concentration of leukocytes in the cerebrospinal fluid (CSF). The meninges, the target of this process, are a set of three membranes: the dura mater, arachnoid, and pia mater, which cover the Central Nervous System (CNS), including the brain and spinal cord [1]. This process is triggered by infectious agents (viruses, bacteria, fungi, and parasites) as well as non-infectious agents (neoplasms and medications), which bypass the immune system and settle in the meninges [2].

Viral and bacterial meningitis are the most relevant in public health due to their magnitude, the severity of cases, and the potential to cause outbreaks [3]. Viral meningitis is frequently caused by the HSV-1, HSV-2, and VZV viruses [4]. Following the introduction of vaccines in the 1960s, cases caused by the poliovirus gave way to an increasing incidence of non-polio enterovirus infections, which have seen a global increase of 12% to 46%, now being the

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main etiological agent [1]. Internationally, in the United States, approximately 11 new cases of meningitis per 100,000 inhabitants arise, with viruses being the cause [5].

Bacterial infection is primarily caused by Neisseria meningitidis, the causative agent of meningococcal disease (MD), although there are other important microorganisms [4]. These agents were responsible for over 50% of the 250,000 deaths from meningitis worldwide in 2019. In the bacterial form, one out of every 10 infected individuals progress to death, and one out of every five develops severe complications [6]. Worldwide, meningococcal meningitis has five groups that infect only humans. These groups account for 500,000 cases per year, with approximately 50,000 deaths in 2019 [7]. In 2021, 1.2 million cases were reported, affecting about 2 people per 100,000 inhabitants [5].

Nationally, a total of 393,941 suspected cases were reported between 2007 and 2020, of which 265,644 were confirmed, with various etiologies. The viral form had the highest prevalence with 121,955 cases, followed by the bacterial form with 87,993 cases, of which 26,436 cases were caused by DM. During this period, there were 5,581 deaths, resulting in a case fatality rate of 21% [8]. In Brazil, in 2020, there were 7,444 registered cases of meningitis, with 774 deaths. In the following year, 2021, there were 6,912 new cases and 797 deaths. In 2022, 5,856 cases were reported with 712 deaths [9].

The Northern region of the country is considered an endemic area for infectious diseases. Between 2009 and 2018, there were 53,132 reported cases of meningitis in the country, with the Northern region accounting for 3,202 cases. Among these cases, the state of Pará accounted for over 50% of the notifications, with 1,797 cases [2]. In Pará, between 2010 and 2020, there were 4,426 cases of meningitis reported. The year 2018 had the highest absolute number of cases, with 515 cases (11.63%), while 2020 had the lowest absolute number, with 147 cases (3.32%). Bacterial meningitis was the most prevalent form. Regarding mortality, there were 54 deaths from the disease in Pará in 2018, 58 deaths in 2019, and 27 deaths in 2020 [10].

In the state, among the health regions, the Metropolitan I region has the highest incidence of cases, with 3,579 registered, accounting for 82.38% of the total. In this region, between the years 2010 and 2019, the municipality of Belém had the highest number of reported meningitis cases. These data can be justified by the fact that the state of Pará is the most populous in the northern region, representing approximately 45.5% of the population, and it facilitates diagnosis as it has a center for the study and diagnosis of infectious diseases [10].

This study aims to analyze the epidemiological profile of meningitis in the state of Pará, from 2018 to 2022.

2. MATERIAL AND METHODS

Ecological study, retrospective, descriptive-exploratory, using secondary data from the Public Health Surveillance System (SINAN), available at the website (https://datasus.saude.gov.br/) of the Department of Informatics of the Unified Health System of Brazil (DATASUS).

The study was conducted in the state of Pará, which belongs to the Northern region of the country. The state is composed of the following Health Regions: Araguaia, Baixo Amazonas, Carajás, Lago de Tucuruí, Metropolitana I, Metropolitana II, Metropolitana III, Rio Caetés, Tapajós, Tocantins, Xingu, Marajó I, and Marajó II. It has a territorial area of 1,245,870.704 km2 and a population of 8,116,132 people [11].

After collection, the information was tabulated and presented in tables and graphs, aiming to quantify and describe the epidemiological profile of the data available in DATASUS. The study utilized the variables of year of first symptom, notifying municipality, race, disease progression, etiology, age group, and gender.

As inclusion criteria included all confirmed cases of meningitis in the state of Pará, as well as the period from 2018 to 2022. As exclusion criteria, blank notifications and those outside the analysis period were removed.

Due to the nature of the study, which involved searches in publicly available databases (DATASUS), where no research or manipulation with human subjects occurred, the study was exempted from registration and evaluation by the Research Ethics Committee/National Commission of Ethics in Research - CEP/CONEP system.

3. RESULTS AND DISCUSSION

The historical series, using the variable "year of first symptom" and "notification municipality," allowed us to observe that there was a significant increase in cases in the years 2018, 2019, and 2022. However, there was a reduction in the number of cases in 2020 and 2021 (Table 1).

Table 1 - Historical series of meningitis cases recorded in the state of Pará, 2018 to 2022.

County	Year				
	2018	2019	2020	2021	2022
Araguaia	15	10	9	8	9
Baixo Amazonas	12	14	10	8	4
Carajás	19	8	2	6	11
Lago de Tucuruí	15	8	5	4	3
Metropolitana I	403	359	204	158	241
Metropolitana II	2	2	0	1	2
Metropolitana III	2	5	5	0	10
Rio Caetés	8	1	1	1	1
Tapajós	1	0	0	1	2
Tocantins	4	2	2	2	3
Xingu	23	21	3	4	8

Marajó I	1	1	0	0	0
Marajó II	3	11	2	0	0
Total	508	442	243	193	294

Source: Notifiable Diseases Information System - Sinan Net

In 2018, there were a total of 508 cases, followed by 442 in 2019, 243 in 2020, 193 in 2021, and 294 in 2022, totaling 1,680 cases. The Metropolitan Region I, in the state of Pará, had the highest number of reported cases with 1,365, followed by Xingu with 59, Araguaia with 51, Baixo Amazonas with 48, Carajás with 46, Lago de Tucuruí with 35, and Metropolitan Region III with 22 cases. The proportion per year is shown below (Table 2).

Table 2 - Proportion of total meningitis cases per year, 2018 to 2022.

Year	*f*	f_0
2018	508	30%
2019	442	27%
2020	243	15%
2021	193	11%
2022	294	17%

Source: Notifiable Diseases Information System - Sinan Net

Later on, regardless of gender, it was noted that the male audience had a higher number of cases, with a total of 966, while the female audience had 714 cases, resulting in a combined total of 1680 cases (Table 3).

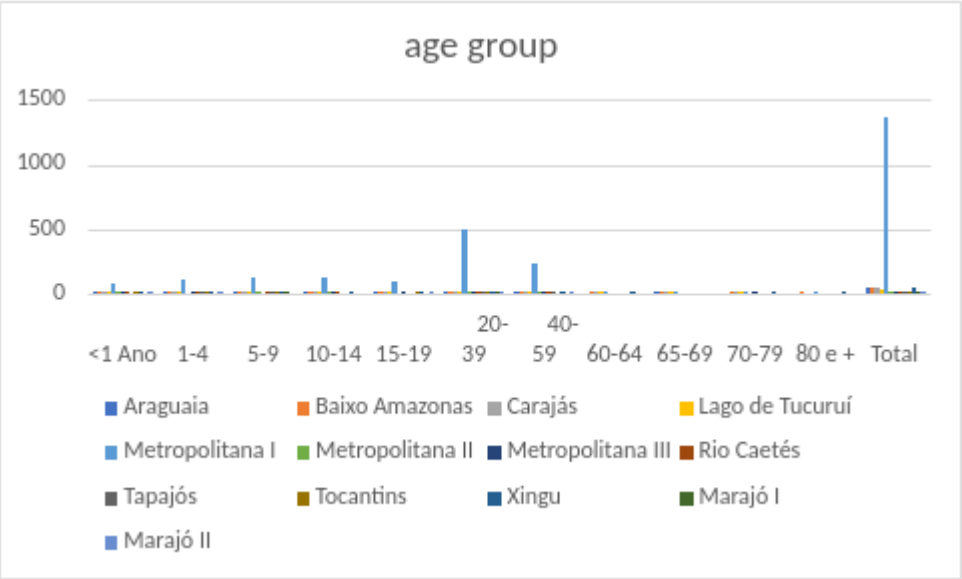
Table 3 - Total Meningitis Cases in Males and Females between 2018 and 2022

	Masculine	Feminine	Total
	966	714	1680
Proportion	57,5%	42,5%	100%

Source: Notifiable Diseases Information System - Sinan Net

Regarding the age group variable, there was a higher notification rate among the age groups of 20-39 years with a total of 584 cases, 40-59 years with 289 cases, 10-14 years presenting 166 cases, 5-9 years with 159 notifications, 1-4 years with 152, and <1 year having a total of 127 cases between 2018 and 2022, as described in Graph 1.

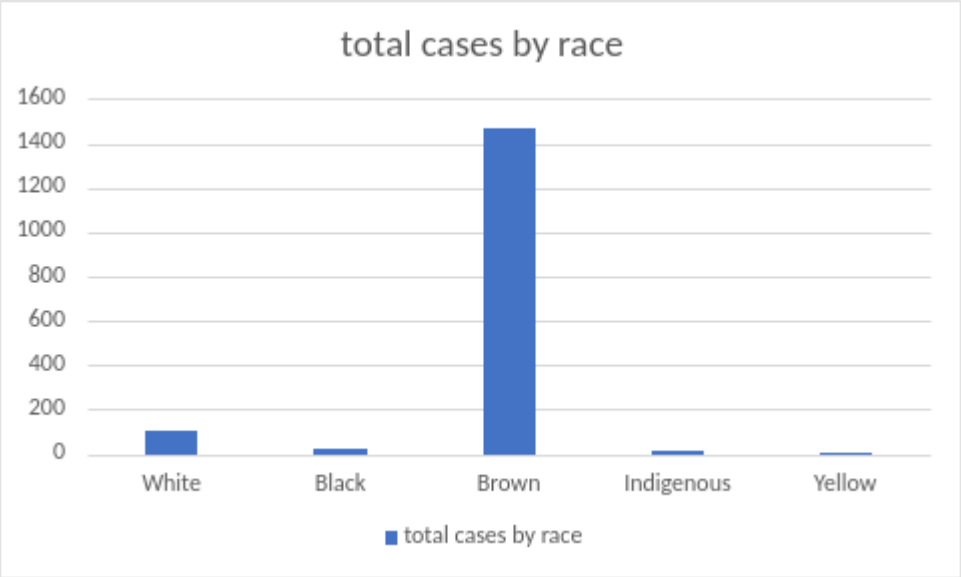
Graph 1 - Confirmed cases by age group



Source: Notifiable Diseases Information System - Sinan Net

The variable "race" was an important finding for describing the subject, where "parda" (mixed race) had a high number of meningitis cases with 1,472 cases, followed by "branca" (white) with 106 cases, "preta" (black) with 23 cases, "indígena" (indigenous) with 10 cases, and "amarela" (yellow) with 6 cases. The distribution of notifications is shown in column graph format, as shown in graph 2.

Graph 2 - Total of confirmed cases by race



Source: Notifiable Diseases Information System - Sinan Net

Subsequently, according to the disease progression, there was a higher proportion of cases in an upward trend, with a total of 1,309 cases, accounting for 83%. This was followed by death due to meningitis with 219 cases (14%) and death due to other causes with 54 cases (3%), as shown in Table 4.

Table 4 - Total cases according to disease progression from 2018 to 2022

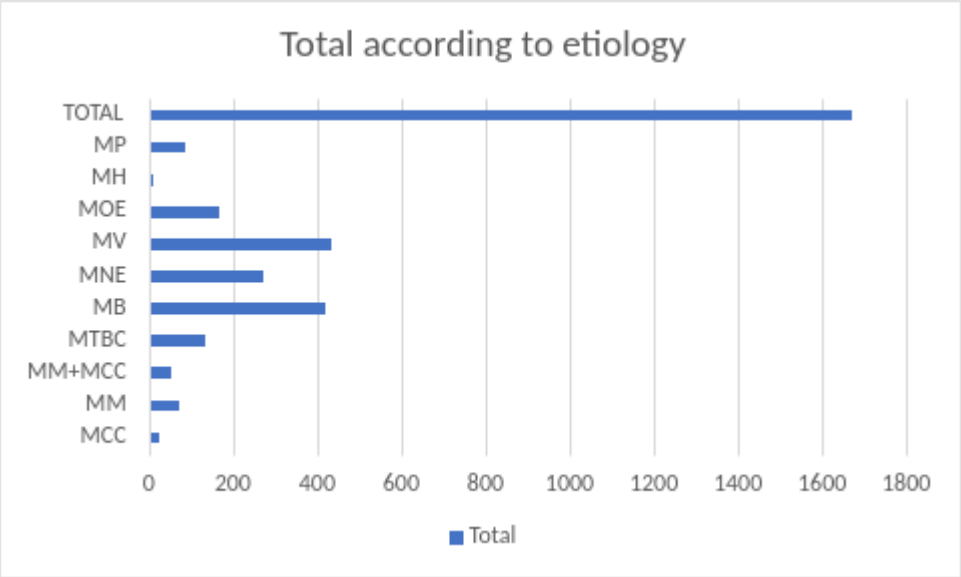
Disease evolution	*f*	f_0
High	1.309	83%
Death from meningitis	219	14%
Death from another cause	54	3%
Total	1.582	100%

Source: Notifiable Diseases Information System - Sinan Net

Following this, the etiology of the disease revealed an increasing number in Viral Meningitis (VM) = 432 cases, Bacterial Meningitis (BM) = 420, Unspecified Meningitis (UM) = 270, Meningitis due to Other Etiologies (MOE) = 169, Tuberculous Meningitis (TM) = 132, Pneumococcal Meningitis (PM) = 87, Meningococcal Meningitis (MM) = 72, Meningococcal Meningitis + Meningococcemia (MM+MCC) = 54, Meningococcemia (MCC) = 23, and

Haemophilus Meningitis (HM) = 10, with a total of 1669 cases between 2018 and 2022, as described in graph 3.

Graph 3 - Meningitis by etiology between 2018 and 2022.



Source: Notifiable Diseases Information System - Sinan Net

According to conducted studies, the state of Pará had the highest number of meningitis cases, estimated at 50%, thus being the main contributor to the hospitalization rate in the field of infectiology, accounting for 4.7% of hospitalized individuals. The fatality rate of this disease in analyzed data from the Northern Region was 12.81%. Depending on the causative agent, this number varies from 15.00% to 17.10%, with bacterial meningitis being the most common [12].

Considering this, analyzing the increasing numbers of meningitis cases in recent years, it can be observed that major urban centers like Metropolitan Region I are among the most affected in terms of the number of cases of the disease, totaling 1,365 cases. This can often be attributed to socioeconomic living conditions in which individuals find themselves, as well as the structure of the affected city. The capital of Pará, in particular, has the highest concentration of households, with a recorded population of 1,492,745 people according to the Brazilian Institute of Geography and Statistics (IBGE). These factors play a crucial role in the transmissibility of meningitis [10].

Therefore, these data presented corroborate with the studies conducted by Cruz (2020), where it is more likely to find epidemiological bulletins with predominant cases of infectious diseases in large capitals and urban centers, highlighting that the disease depends not only on the etiological agent for meningeal inflammation, but also on sociodemographic conditions. An example of this is the high incidence of Meningitis in recent years, where the three highest incidences were in the years 2018 (30%), 2019 (27%), and 2022 (17%) respectively, while there was a reduction in 2020 and 2021 [1].

The mixed race predominates with 91%. The age group with the highest prevalence was between 20 and 39 years, accounting for approximately 35% of cases. Males were the most affected, representing around 57.5% of the cases. In light of this, the high incidence of meningitis in men is related to their role as primary providers within the family, as they are more exposed to infectious agents. Additionally, they face difficulties in seeking healthcare due to their daily routines. Consequently, the challenges in adhering to therapeutic measures, prevention, and promotion contribute to an increase in the mortality rate [13].

Regarding the high rate of cases in the urban area, it is due to the search for appropriate treatments that can only be found in major centers and Brazilian capitals. These locations provide adequate support and necessary resources to combat this disease, such as the use of intravenous antibiotics, hospital beds for patient admission and care. Consequently, due to the lack of these resources, individuals from rural areas are moving in search of prophylaxis. Following this line of reasoning, there has been a significant increase in the number of cases, reaching 83%, accompanied by a mortality rate of 14% and subsequently a 3% mortality rate due to other causes [14].

The high complexity of bacterial meningitis is a global public health problem, and its late diagnosis leads to severe and potentially irreversible sequelae for the patient, contributing to a high morbidity and mortality rate. It is worth noting that N. meningitidis and S. pneumoniae are responsible for 80% of cases of bacterial meningitis, affecting 4 to 6 cases per 100,000 adults annually. Among them, even the cases of survival still result in permanent sequelae in the lives of those who were infected [5].

Furthermore, in adults, 44% of cases of bacterial meningitis present the classical triad of symptoms, which includes mental alterations, neck stiffness, and fever. Currently, this triad is being replaced by a tetrad with the inclusion of headache. While not all patients exhibit these symptoms, at least two of them will be present in 95% of cases. As for diagnostic confirmation, it relies on the analysis of cerebrospinal fluid (CSF), but early treatment of suspected cases is crucial [15-16].

Consequently, the role of Epidemiological Surveillance (ES) is of utmost importance, given that it performs control, monitors disease cases, evaluates the vaccination coverage of the territory, and identifies suspected cases through active search in the territory in order to investigate secondary cases. In this way, the definition of cases can be classified as: suspected, confirmed, and discarded, which are directed to SINAN through the completion of the compulsory notification form, with the purpose of maintaining disease control in the municipality. This notification must not exceed 24 hours, and in cases of death, immediate communication must be made to the responsible authority [17].

In order to elucidate the importance of vaccination, prevent illness and disease outbreaks, it is of utmost relevance to emphasize adherence to the vaccination schedule, which starts at 3 months of age with the first dose of the Meningococcal C vaccine and concludes between 11 and 12 years of age with the completion of the 4-dose cycle, including 2 booster doses recommended by the Ministry of Health. In addition to the pneumococcal vaccine, which requires two doses at 2 and 4 months of age, with a booster at one year old [16].

Immunizations play a fundamental role in prevention. Currently, we have polysaccharide and conjugate vaccines, which have scientific evidence of their efficacy against subtypes A, C, W, and Y. In this way, the conjugate vaccine elicits an immune response, primarily in the adult, young, adolescent, and pre-adolescent population, creating a memory within the immune system. Thus, the adherence to these immunobiologics reduces the incidence of

new cases of the disease. According to the etiology of the disease from 2018 to 2022, MV 432 and MB with 420 cases lead with a total of 852 cases. Therefore, it is of utmost importance to follow the vaccination schedule, respecting the specificities of each age group [18].

Thus, health education is crucial to reduce the spread of the disease through actions focused on proper hand hygiene, food hygiene, and environmental cleanliness. It involves guidance to avoid contact with infected individuals, raising awareness about the importance of vaccination, and providing instructions for quality treatment for those who already have the disease. Treatment should be initiated as soon as possible, respecting the differences in dosage, interval, and duration for children and adults. The therapy is carried out using ampicillin, penicillin, and ceftriaxone according to the specific needs of each patient, including adults, children, and the elderly [19].

4. CONCLUSION

Considering the outlined results of the epidemiological profile of meningitis in the state of Pará, it is observed that Metropolitan Region I is the most affected by the disease. This can be attributed to its larger population and number of households, as well as the socioeconomic conditions of the individuals. These factors are considered important for the transmissibility of the disease. Additionally, there is the migration of cases from rural areas to the capital in search of prophylaxis. This information is consistent with other studies that relate the predominance of infectious diseases to living conditions. Furthermore, it was identified that between 2018 and 2022, the male gender (966 cases) had a higher number of cases compared to the female gender (714 cases). This data can be linked to the fact that men often serve as financial providers and are more exposed to infectious diseases, making it challenging to apply therapeutic measures. This is a concerning factor since bacterial meningitis presents classic and debilitating symptoms of the triad, and delayed diagnosis leads to irreversible consequences. It has a high morbidity and mortality rate, and diagnosis is made through cerebrospinal fluid analysis.

Another relevant factor is that in the years 2020 (243 cases) and 2021 (193 cases), there was a reduction in meningitis cases compared to other years, as 2018, 2019, and 2022 had 508 cases, 442 cases, and 294 cases, respectively. This decrease can be attributed to the COVID-19 pandemic, during which extensive measures were implemented to contain the virus, such as social distancing, hand washing, mask-wearing, and the use of hand sanitizers. These measures reduced the circulation of various pathogens, which may have contributed to the decrease in cases. Additionally, another factor contributing to the reduction in cases is the implementation of the ACWY antimeningococcal vaccine for adolescents since 2017 through the National Immunization Program (NIP). Adherence to the vaccination schedule with the Meningococcal C vaccine is also important, starting with the first dose at three months of age and completing the cycle between 11 and 12 years with the fourth dose of the vaccine. Additionally, the pneumococcal vaccine with two doses at two and four months and a booster at one year of age further contribute to reducing cases.

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