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Epidemiological analysis of bacterial meningitis in the State of Amapá in the years 2013 to 2018

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Abstract

Meningitis is an infectious disease characterized by the inflammatory process of the arachnoid and pia mater meninges and cerebrospinal fluid. Its main bacterial etiological agents are Neisseria meningitidis, Streptococcus pneumoniae and Hemophilus influenzae. The present study aimed to carry out an epidemiological analysis of bacterial meningitis in the State of Amapá, in the years 2013 to 2018. This is a descriptive documentary, cross-sectional study with data obtained through the Information System for Notifiable Diseases (SINAN). The results show that, in the studied period, 26 cases of bacterial meningitis occurred. The agents Streptococcus pneumoniae and Neisseria meningitidis were responsible for 38% and 35% of the occurrences, respectively, while 27% of the cases were classified only as bacterial meningitis. The state capital, Macapá, was responsible for the largest number of confirmed cases (81%) and, regarding seasonality, the month of July had the highest occurrence (23%). Of the total cases assessed, 54% occurred in males and 46% in females, and the main age group affected was children less than one year old (38%). As for the evolution of the disease, 65% of people were discharged, while 27% died of meningitis. It is concluded that although the majority of cases evolved to discharge, the percentage of patients who died of meningitis highlights the need for health actions aimed at both the most affected age group and the others, due to the rapid evolution that the disease presents.

Keywords: Epidemiology. Bacterial meningitis. Compulsory Notification.

INTRODUTION

Meningitis is characterized as infections that affect the meninges - membranes that surround the brain and spinal cord, dura mater, arachnoid and pia mater - and can also affect the cerebrospinal fluid (CSF), located in the space between the arachnoid and the pia mater, which is the subarachnoid space, and has functions related to the maintenance of homeostasis, supply of nutrients to the nervous tissue, and acts as a buffer for the brain and spinal cord[1,2].

The clinical picture of this disease is usually characterized by intracranial hypertension (headache, nausea, vomiting, and reduced level of consciousness), associated with evidence of meningeal irritation (stiff neck, Kernig's sign and Brudzinski's sign), and the classic picture of acute infection (including high fever)[3]. The laboratory diagnosis is made mainly through the analysis

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of CSF, by physical chemical examination (color and appearance) and chemocytological analysis, which allows cellular distinction, and biochemical measurements such as glucose, lactate, proteins, among others[2]. CSF culture, blood, and scraping of petechial lesions can also be performed, as well as direct bacterioscopy, agglutination by latex, and Polymerase Chain Reaction (PCR)[1].

The morbidity and lethality rates presented by the disease can reach 100% if there is no adequate treatment and, even if there is treatment, serious consequences can occur. In the long run, neurological sequelae are considered common, namely: hearing loss, mild or severe developmental changes such as cerebral palsy and mental retardation. Complications resulting from meningitis can also be acute[4].

Meningitis is part of the National List of Compulsory Notification Diseases, according to Ordinance No. 204, of February 17, 2016[5]; therefore, all outbreaks and clusters of cases or deaths must be reported immediately[6,7].

The etiology of meningitis can be divided into: infectious (caused by bacteria, viruses, fungi and parasites) and non-infectious (trauma, for example). Infectious meningitis, especially those caused by bacteria and viruses, are the most important from the point of view of public health, as they have a higher prevalence, the potential to produce outbreaks and, in the case of bacterial meningitis, a greater severity[2,6,7].

Actions aimed at the epidemiological surveillance of meningitis are fundamental for the adoption of prevention and control strategies and for the detection of epidemics in a timely manner. The main pathogens that cause bacterial meningitis are *Neisseria meningitidis, Streptococcus pneumoniae* and *Hemophilus influenzae*[8].

Meningitis is considered an endemic disease in Brazil, with high rates of morbidity and lethality, making studies that address the epidemiological aspects of bacterial meningitis necessary for a better understanding of its behavior in the country and its states. At the local level, in Amapá, there was a lack of literature in this segment, which is a concern for the public health of the micro-region. Considering the exposed elements, this study aimed to carry out an epidemiological analysis of bacterial meningitis in the State of Amapá, between the years 2013 and 2018.

MATERIALS AND METHODS

This study is characterized as a descriptive documentary study, of a transversal nature - since the study, analysis, recording and interpretation of the facts of the physical world was carried out without the interference of the researcher, in which the analyzed data were collected over a period of defined time9 - with data obtained through the Notifiable Diseases Information System (SINAN) on cases of bacterial meningitis that occurred in the State of Amapá, in the years 2013 to 2018. The variables analyzed were month and year of notification, municipality of residence, etiology and evolution of the disease, age group, and sex of the people affected. Inclusion criteria were reported and confirmed cases of bacterial meningitis (with confirmed etiology, but no description of the agent), meningococcal meningitis and pneumococcal meningitis in the period from 2013 to 2018, and as exclusion criteria, cases belonging to meningitis of other etiologies and in years not corresponding to the period covered in the research.

After collection, all data were tabulated using Microsoft Excel Software, and separated according to their classification into: notified cases, confirmed cases, and case evolution. Data analysis was performed comparatively with other studies found in the literature referring to other states in the country, due to the absence of similar studies in the state.

This research covered the State of Amapá, located in the extreme north of Brazil, west of the Amazon River, with a territorial extension of 142,814.585 km2, divided into 16 municipalities. The estimated population of the state of Amapá is 829,494 inhabitants in 2018, according to the Brazilian Institute of Geography and Statistics (IBGE)[10].

RESULTS

143 cases of suspected meningitis were reported across the territory of the State of Amapá in the years 2013 to 2018, corresponding to 17.2 reported cases/100,000 inhabitants. The municipalities responsible for the highest number of notifications were Macapá, with 97 cases, and Santana, with 20 cases (table 1).

Out of 143 notified cases, 74 cases were confirmed and classified as Bacterial Meningitis (7), Meningococcal Meningitis (9), Pneumococcal Meningitis (10), Unspecified Meningitis (32) and Meningitis of another etiology (16).

The incidence coefficient of Bacterial Meningitis, went from 0/100,000 inhabitants to 0.24/100,000 inhabitants in 2018, which indicates the beginning of notifications of cases of meningitis without the identification of the causative agent, only as Bacterial Meningitis. While the incidence coefficients of Meningococcal and Pneumococcal Meningitis remained the same, except for the year 2016, when the incidence of pneumococcal meningitis was higher (Figure 1).

The agents Streptococcus pneumoniae and Neisseria meningitidis were responsible for 38% and 35% of the occurrences, respectively, while 27% of the cases were classified only as bacterial meningitis (table 2). No cases of meningitis by the bacterium Hemophilus influenzae were confirmed in the period and places covered in the study.

The municipality of Macapá, capital of the state, was responsible for the largest number of confirmed cases, with 21 cases (81%), followed by Laranjal do Jari, with 2 cases (7%) (table 3). For the assembly of these data, the municipality of residence of the affected people was informed in the investigation form.

As for seasonality, the month of July had the highest occurrence of cases, with a total of 6 cases (23%), followed by March, June, and September with 4 cases each (15%) (table 4).

The male gender was predominant in the years 2013, 2014 and 2018, while the female gender presented higher numbers in the years 2015, 2016, and 2017 (figure 2). Of the total cases evaluated, 14 (54%) occurred in males, and 12 (46%) in females.

Regarding the distribution according to the age group, the largest number of cases was concentrated in children less than one year old (38%), followed by adults aged between 40 and 59 years (15%) (table 5).

As for the evolution of the disease, 65% of people were discharged, while 27% died from Meningitis, and 4% died from other causes (figure 3).

Table 1- Meningitis notifications by year and city of residence in the State of Amapá in the period from 2013 to 2018.

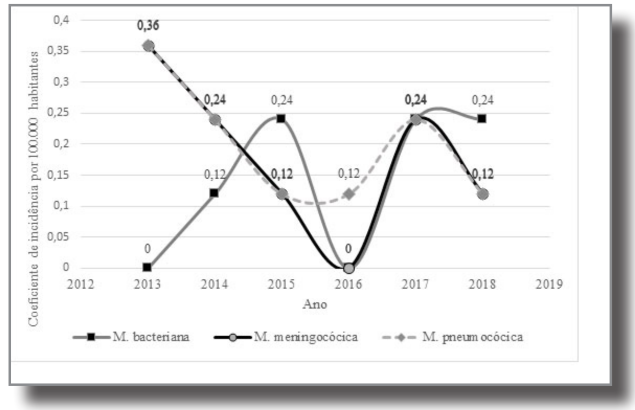
	YEAR						
City	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
Amapá	0	0	0	1	1	0	2
Cutias	0	0	0	0	0	0	0
Calçoene	0	1	0	0	0	0	1
Ferreira Gomes	0	0	0	0	0	0	0
Itaubal	0	0	0	0	0	1	1
Laranjal do Jari	0	3	3	0	1	1	8
Macapá	28	17	22	6	13	11	97
Mazagão	0	0	0	0	0	0	0
Oiapoque	3	1	0	0	0	0	4
Pedra Branca	0	0	2	0	0	0	2
Porto Grande	0	3	1	0	0	1	5
Pracuúba	0	0	0	0	0	1	1
Santana	3	6	3	6	1	1	20
Serra do Navio	0	0	0	0	0	0	0
Tartarugalzinho	0	0	1	0	1	0	2
Vitória do Jari	0	0	0	0	0	0	0
Total	**34**	**31**	**32**	**13**	**17**	**16**	**143**

Source: Notifiable Diseases Information System.

Table 3- Confirmed cases of Bacterial Meningitis by year and city of residence in the State of Amapá from 2013 to 2018.

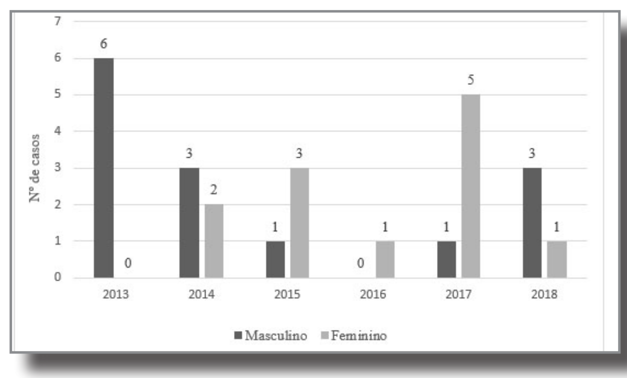
	YEAR						Total	
City	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**nº**	**%**
Amapá	0	0	0	0	1	0	1	4
Cutias	0	0	0	0	0	0	0	0
Calçoene	0	0	0	0	0	0	0	0
Ferreira Gomes	0	0	0	0	0	0	0	0
Itaubal	0	0	0	0	0	1	1	4
Laranjal do Jari	0	0	1	0	1	0	2	7
Macapá	5	5	3	1	4	3	21	81
Mazagão	0	0	0	0	0	0	0	0
Oiapoque	0	0	0	0	0	0	0	0
Pedra Branca	0	0	0	0	0	0	0	0
Porto Grande	0	0	0	0	0	0	0	0
Pracuúba	0	0	0	0	0	0	0	0
Santana	1	0	0	0	0	0	1	4
Serra do Navio	0	0	0	0	0	0	0	0
Tartarugalzinho	0	0	0	0	0	0	0	0
Vitória do Jari	0	0	0	0	0	0	0	0
Total	**6**	**5**	**4**	**1**	**6**	**4**	**26**	**100**

Source: Notifiable Diseases Information System.



Source: Notifiable Diseases Information System.

Figure 1- Distribution of the incidence coefficient of meningitis by etiology in the State of Amapá from 2013 to 2018.



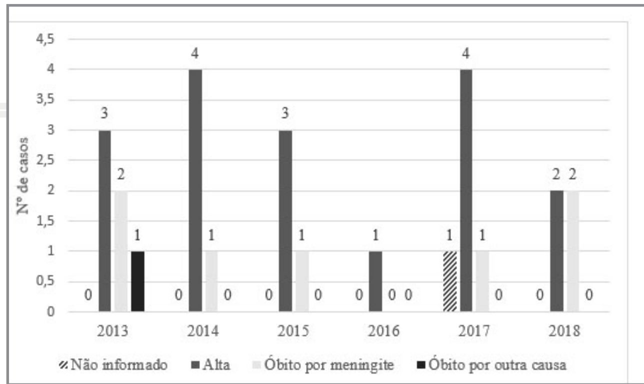
Source: Notifiable Diseases Information System.

Figure 2- Confirmed cases of Bacterial Meningitis by year and gender in the State of Amapá from 2013 to 2018.

Table 2- Confirmed cases of Bacterial Meningitis by year and etiology in the State of Amapá from 2013 to 2018.

	Year							
Etiology	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**nº**	**%**
Bacterial Meningitis	0	1	2	0	2	2	7	27
Meningococcal Meningitis	3	2	1	0	2	1	9	35
Pneumococcal Meningitis	3	2	1	1	2	1	10	38
Total	6	5	4	1	6	4	26	100

Source: Notifiable Diseases Information System.



Fonte: Sistema de Informação de Agravos de Notificação.

Figure 3- Evolution of cases of Bacterial Meningitis in the State of Amapá from 2013 to 2018.

Table 4- Confirmed cases of Bacterial Meningitis by year and months of the year in the State of Amapá from 2013 to 2018.

Months of the Year	Year							
	2013	2014	2015	2016	2017	2018	nº	%
January	0	0	0	0	0	0	0	0
February	0	1	0	0	0	0	1	4
March	2	0	0	0	1	1	4	15
April	0	0	0	0	0	0	0	0
May	1	0	0	0	0	1	2	8
June	0	0	1	1	2	0	4	15
July	0	2	2	0	2	0	6	23
August	0	1	0	0	0	0	1	4
September	2	0	0	0	1	1	4	15
October	0	1	0	0	0	1	2	8
November	1	0	1	0	0	0	2	8
December	0	0	0	0	0	0	0	0
Total	**6**	**5**	**4**	**1**	**6**	**4**	**26**	**100**

Source: Notifiable Diseases Information System.

Table 5- Confirmed cases of Bacterial Meningitis by year and age group in the State of Amapá from 2013 to 2018.

Age Group	Year							
	2013	2014	2015	2016	2017	2018	nº	%
< 1 year	2	1	4	0	3	0	10	38
1 – 4 years	0	2	0	0	1	0	3	11
5 – 9 years	1	0	0	1	1	0	3	12
10 – 14 years	1	0	0	0	0	2	3	12
15 – 19 years	1	0	0	0	0	0	1	4
20 – 39 years	0	0	0	0	0	1	1	4
40 – 59 years	1	1	0	0	1	1	4	15
60 – 79 years	0	0	0	0	0	0	0	0
> 80 years	0	1	0	0	0	0	1	4
Total	**6**	**5**	**4**	**1**	**6**	**4**	**26**	**100**

Fonte: Sistema de Informação de Agravos de Notificação.

DISCUSSION

According to Pobb *et al.*[11] during an epidemiological study, the greater the number of variables analyzed, the broader the investigation will be. Thus, the investigation of the epidemiological behavior of a disease will provide fundamental information for its reduction and prevention.

Of the 143 cases suspected as being meningitis reported during the study period, 74 were confirmed and classified as Bacterial Meningitis, Meningococcal Meningitis, Pneumococcal Meningitis, Unspecified Meningitis, and Meningitis of another etiology. The classifications studied in the research (Bacterial Meningitis, Meningococcal Meningitis, and Pneumococcal Meningitis) totaled 26 cases. Unspecified Meningitis had the highest number of occurrences (32 cases), this can be explained by the fact that, during the disease diagnosis process, it is not possible to discover the etiology, either by factors related to the evolution of the disease or time of sample analysis. Thus, meningitis was confirmed, but its etiology was not known[11].

As for occurrences due to Bacterial Meningitis, in 27% of the cases it was not possible to identify the etiologic agent, therefore, they were classified only as Bacterial Meningitis. This situation can be explained by the fact that Meningitis is a pathology that has a rapid evolution and can lead to death in a few hours. In many cases, the time elapsed between the onset of symptoms and the beginning of medical research may be delayed due to the geographical conditions of the region or the lack of knowledge of the population about the disease; thus, there may not be enough time for further investigations that could classify the bacterial etiology of the disease[2].

Pneumococcus (*Streptococcus pneumoniae*) has a hospital mortality rate ranging from 20 to 30%, and a 40% rate of intracranial complications (such as cerebral edema, hydrocephalus, and intracranial hemorrhage) and, for this reason, is considered the most common severe cause of Bacterial Meningitis12. In meningitis caused by this pathogen, the people who are most at risk of illness are the elderly and individuals with chronic conditions or immunosuppressive diseases, due to their greater vulnerability[7]. In this study, it was found that the agent *Streptococcus pneumoniae* was responsible for the highest number of occurrences (38%) in the studied period and place, which reinforces the importance of surveillance and vaccination coverage against this agent.

According to Duarte, Lourenço and Camargo[2], meningitis caused by the bacterium Neisseria meningitidis (meningococcus) is an acute bacterial infection, which is infectious and contagious, and highly pathogenic. In Brazil, the disease has a lethality rate that can reach 20%. According to Murray, Rosenthal and Pfaller[13], the mortality rate in properly treated patients is less than 10%, and it can be close to 100% in patients who do not receive treatment. The agent Neisseria meningitidis was responsible for 35% of the cases of meningitis, with numbers close to those of the bacterium Streptococcus pneumoniae, which had a higher occurrence.

Other studies conducted in Brazil[14,15,16] obtained similar results regarding the etiology of Bacterial Meningitis, where the one caused by Streptococcus pneumonia had a higher incidence than that caused by Neisseria meningitidis.

The absence of cases by the agent Hemophilus influenzae explained the efficacy in vaccination coverage against type B Hemophilus influenzae (Hib). According to the Ministry of Health[6], meningitis caused by this agent represented, until 1999, the second main cause of Bacterial Meningitis after Meningococcal Meningitis. Starting from the year 2000, after the introduction of the conjugate vaccine against Hib, there was a drop of 90% in its incidence.

The Ministry of Health, in the 7th edition of the Epidemiological Surveillance Guide[6], points out that meningitis distributed worldwide and that the factors related to its epidemiological expression are linked to the infectious agent, the existence of population clusters, and the socioeconomic characteristics of population groups and of the environment. A possible explanation for the municipality of Macapá being responsible for the largest number of confirmed cases (81%) may be related to the fact that it has a greater part of the population of the entire state (approximately 493,634 inhabitants) and also because it has favorable factors for the spread of agents, such as only having 26.8% of adequate sewage[10].

According to the Ministry of Health[1], cases of meningitis are expected throughout the year, as it is an endemic disease. In Amapá, only the months of January, April, and December did not present any cases of the disease and, of the remaining nine months, July showed the highest occurrence. These figures are in line with a study by Pobb *et al.*[11], which points to the variation of meningitis cases according to the months of the year.

The predominance of cases in males coincides with other studies carried out in Brazil[11,14,17,18,19,20]. However, there are also studies that reveal a higher occurrence in females[2,15]. Even though most of the studies point to a greater predominance of cases in males, there was no evidence that this is an aspect that impacts the evolution or management of the disease, showing that there is some variation between cases of meningitis and the gender of people.

The main age group affected during the study period was children under one year of age (38%). According to Pobb *et al.*[11], one of the factors responsible for these numbers is the social factor, as children often remain in greater contact, and in isolated environments, which facilitates the transmission of the disease. In addition, this age group is characterized by a certain immaturity of the Central Nervous System (CNS). Other studies conducted in Brazil[11,16,21] point to a higher incidence of Bacterial Meningitis in children, a factor that draws attention to the need for greater preventive actions aimed at this age group. According to Franco, Sanjad and Pinto[22], in addition to the fact that children are more affected by the disease, are the ones that most evolve to death. In a study by Berezin *et al.*[23], mortality in children under two years old reached levels close to 40%, and in relation to neurological sequelae, these reached 40% of surviving children and 60% of those evaluated.

Regarding the evolution of the disease, in most cases (65%) the patients were discharged and 27% died from meningitis, which coincides with other studies carried out in Brazil in which most of the cases evolved to be cured[11,14,15]. According to the Ministry of Health1, if medical assistance is provided during the period of symptoms, most cases tend to evolve to be cured.

CONCLUSION

There was a predominance of cases of Bacterial Meningitis in male patients, mainly involving those less than 1 year of age. The state capital, Macapá, had the highest number of cases, and the month of July had the highest occurrence. The etiologic agent highlighted as the main cause of Bacterial Meningitis was *Streptococcus pneumonia*, followed by the bacterium *Neisseria meningitidis*; meanwhile, cases by the agent *Hemophilus influenzae* were not reported.

Despite the fact that most of the cases evolved to a discharge, which shows some efficacy regarding the treatment of affected patients, the percentage of patients who died of meningitis (27%) highlights the need for health actions aimed at the more affected age groups (children under the age of one year) than for the others, due to the rapid evolution that the disease presents, as well as aiming at reducing cases and preventing possible outbreaks.

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