ARTIGO ORIGINAL

EPIDEMIOLOGICAL TRENDS OF MENINGITIS IN BRAZIL FROM 2001 TO 2022

Tendências epidemiológicas da meningite no Brasil de 2001 a 2022

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ABSTRACT

Introduction: Meningitis is a worldwide pathology that has a high morbidity and mortality rate. Its pathophysiology consists of an inflammation that affects the meninges, especially in the subarachnoid space, cranial and spinal segments. Materials and methods: Descriptive study that used secondary data to examine the disease "meningitis" that occurred between 2001 and 2022. The data were obtained from the Database of the Department of Information and Informatics of the SUS (DATASUS), accessible at https:/ /datasus.saude.gov.br/informacoes-de-saude-tabnet/. Results: In the years 2001-2022, 452,392 cases were reported in Brazil. The prevalence in the North region reached a total of 18,836 cases, in the Northeast 82,106, Southeast = 236,345, South = 93,353 and Central-West = 21,752, highlighting the Southeast region with the highest prevalence of cases. Discussion: The Southeast region has a higher number of meningitis cases due to the local health infrastructure and population growth in this region. Viral meningitis is one of the most relevant causes as it affects individuals of all ages, being the cause of large epidemic outbreaks and bacterial is a condition of great importance, due to its high mortality and morbidity compared to viral meningitis, the main bacterial agent is Neisseria meningitidis. Conclusion: Meningitis is a serious public health problem due to its intensity of spread and its high morbidity and mortality rate, especially in children. Therefore, it is necessary to highlight the importance of prophylactic methods such as vaccination, which are extremely effective in controlling and eradicating diseases.

Keywords: Viral meningitis, bacterial meningitis, nursing, epidemiology.

RESUMO

Introdução: A meningite é uma condição de alcance global que tem uma alta taxa de morbimortalidade. Sua fisiopatologia envolve uma inflamação que afeta as meninges, particularmente no espaço subaracnóideo, segmento craniano e medular. Materiais e métodos: Estudo descritivo que utilizou dados secundários para examinar a doença "meningite" ocorrida entre 2001 e 2022. Os dados foram obtidos no Banco de Dados do Departamento de Informação e Informática do SUS (DATASUS), acessível em https:/ /datasus.saude.gov.br/informacoes-de-saude-tabnet/. Resultados: Nos anos de 2001-2022 foram notificados 452.392 casos no Brasil. A prevalência na região Norte obteve um total de 18.836 casos, no Nordeste 82.106, Sudeste= 236.345, Sul= 93.353 e Centro-Oeste=21.752, destacando-se a região Sudeste com maior prevalência de casos. Discussão: A região Sudeste apresenta um maior número de casos de meningite devido a infraestrutura da saúde local o crescimento populacional dessa região. A meningite viral é uma das causas mais relevantes pois afeta indivíduos de todas as idades, sendo a causadora de grandes surtos epidêmicos e bacteriana é uma afecção de grande importância, devido à sua alta mortalidade e morbidade em comparação com as meningites virais, tendo como principal agente bacteriano é a Neisseria meningitidis. Conclusão: A Doença meningocócica é um sério problema de saúde pública devido sua alta intensidade de propagação e seu alto índice de morbimortalidade.

Palavras-chaves: Meningite, meningite viral, meningite bacteriana, enfermagem, perfil epidemiológico.

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INTRODUCTION

Meningitis is a global disease that has a high morbidity and mortality rate. Its pathophysiology involves inflammation that affects the meninges, particularly the subarachnoid space, cranial and spinal segments. It can manifest itself in the bacterial form, a more serious variant that leads to death in a matter of hours, and the viral form, which is less serious and has a lower mortality rate, with faster recovery of the individual[1].

The main bacteria that cause the disease are Neisseria meningitidis, Mycobacterium tuberculosis, Streptococcus pneumoniae and Haemophilus influenzae, the latter being frequently associated with infections in children and Mycobacterium tuberculosis presenting a higher fatality rate in children under five years of age[2].

The viral pathogens most identified as causing acute meningitis are enteroviruses, mumps virus, arboviruses, measles, chickenpox, herpes simplex, rubella and adenoviruses[3].

Viral meningitis is often confused with the bacterial form and can easily be caused by different families of viruses, which is why it is important to carry out an early and differentiated diagnosis, as well as isolation or identification of the causative agent for more specific treatment (Santos et al., 2022).

Meningitis shares similar symptoms to the flu, which makes accurate diagnosis challenging. For this reason, it is crucial that the evaluating healthcare professional conducts neurological exams and performs a lumbar puncture exam to collect cerebrospinal fluid (CSF). The disease presents signs and symptoms such as headache, fever, malaise, vomiting, photophobia, petechiae, convulsions and stiff neck. The latter symptom being more common in children[4].

Due to its high level of contagion, it is classified as a notifiable disease and must be reported 24 hours after diagnosis [4]Epidemiological surveillance is responsible for controlling reported cases, this data is available in the Notifiable Diseases Information System (SINAN)[5]Sinan is a nationwide and universal tool that assists epidemiological surveillance and supports decision-making. It is powered by the notification and investigation of cases of diseases and injuries that appear on the National List of Compulsory Notifiable Diseases, of which it is 'part meningitis, in accordance with Ordinance of the Brazilian Ministry of Health: GM/MS nº 104, of January 25, 2011. All this data is made available by the SUS Information Technology Department (DATASUS), of the Ministry of Health[6].

Meningitis can affect people of different ages, being more common in children aged 1 to 4 years, due to the immaturity of their immune system. Treatment involves antibiotic therapy, and vaccination is the most effective form of prevention, being crucial to protecting this group[7].

It is a condition with a high morbidity and mortality rate and a significant impact on public health around the world. In Brazil, despite the preventive measures adopted, the disease is

still responsible for a high number of cases and deaths, especially in children[2].

In this context, it is crucial to conduct studies that can contribute to understanding the epidemiology of meningitis and improving disease prevention and control strategies. The role of nurses in the clinical management of cases of the disease is essential to guarantee the quality of care provided to patients and minimize the risks of complications and sequelae. Therefore, the objective of this study is to provide an overview of meningitis and present descriptive epidemiological data on the disease in Brazil between the years 2001 and 2022, in addition to outlining an epidemiological profile with information collected from the Notifiable Diseases Information System (SINAN).

METHODOLOGY

This research focused on a descriptive study that used secondary data to examine the disease "meningitis" that occurred between 2001 and 2022. The data was obtained from the Database of the Department of Information and Informatics of the SUS (DATASUS), accessible at https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

The following variables were considered as inclusion criteria: sex (male and female), age (children: under 1 year old to 14 years old, adolescents and young people: 15 to 19 years old, adults: 20 to 59 years old; and elderly people: from 60 years old), color or race (white, black, brown, yellow, indigenous, no information), year of symptom (2001 to 2022), region of notification in Brazil (North, Northeast, Southeast, South and Central-West) and applied doses of meningococcal vaccine.

The electronic data was obtained between the months of March and August 2023. These details were added to Microsoft Office 365 spreadsheets and made visible.

RESULTS

According to data obtained from SINAN, 452,392 cases of meningitis were reported in Brazil in the years 2001 to 2022. The prevalence of confirmed cases in the North reached a total of 18,836 cases, in the Northeast 82,106, Southeast=236,345, South=93,353 and Central-West=21,752, highlighting the Southeast with the highest prevalence of cases (Figure 1).

Table 1 shows that the male population was the most affected by the disease with 33,759 notifications. The other 23,420 cases represent the female portion.

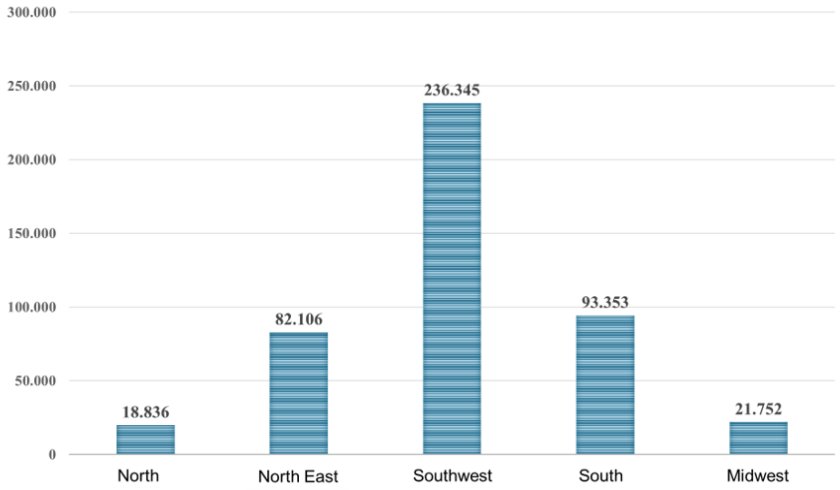

Figure 1: Meningitis Cases 2001-2022. **(Ministry of Health/SVS - Notifiable Diseases Information System – Sinan)**

The population most affected by the disease was the age group of children aged less than 1 to 14 years with 34,058 confirmed cases and the second most affected was the age group of 20-59 years with a total of 16,650 cases.

Data regarding color/race suggest that: 14,573 of the individuals were white and 9,849 were brown; it was found that 31,218 of the notifications of individuals affected by the disease during the study period had this field filled in as ignored/blank (no information).

Table 1: Meningitis variables in Brazil in 2001, 2015 and 2022 according to DATASUS.

	2001					2015					2022				
	North	North East	Southeast	South	Midwest	North	North East	Southeast	South	Midwest	North	North East	Southeast	South	Midwest
Sex															
Masculine	893	3.052	9.075	3.287	996	500	1.500	4.776	2.129	464	324	1.232	3.816	1.393	322
Feminine	639	2.075	6.410	2.223	627	320	1.007	3.274	1.430	309	239	756	2.852	1.082	177
Total	1.532	5.127	15.485	5.510	1.623	820	2.507	8.050	3.559	773	563	1.988	6.668	2.475	499
Age group															
<1-14 years	943	3.526	10.638	3.716	1.097	311	1.223	4.476	1.776	354	192	898	3.508	1.182	218
15-19	171	408	817	306	98	95	205	366	159	39	31	80	220	85	18
20-59	400	1.095	3.549	1300	404	384	949	2.522	1.315	338	303	858	2.143	882	208
60 ou +	18	98	481	188	24	30	130	686	309	42	37	152	797	326	55
Total	1.532	5.127	15.485	5.510	1.623	820	2.507	8.050	3.559	773	563	1.988	6.668	2.475	499
Race or color															
White	91	140	839	698	76	82	265	3.799	2.764	176	46	164	3.373	1.956	104
Black	8	20	53	21	8	15	92	379	134	34	8	80	318	88	8
Yellow	4	3	9	1	2	3	2	40	14	5	0	9	57	16	6
Brown	252	370	194	14	41	648	1.797	1.632	248	423	478	1.502	1.711	226	313
Indigenous	3	0	4	4	1	10	9	11	18	14	14	3	3	6	2
No information	1.174	4.594	14.386	4.772	1.495	62	342	2.189	381	121	17	230	1.206	183	66
Total	1.532	5.127	15.485	5.510	1.623	820	2.507	8.050	3.559	773	563	1.988	6.668	2.475	499

Source: Ministry of Health/SVS - Notifiable Diseases Information System – Sinan

According to table 2, meningitis due to viral etiology (MV) was the most common among infections corresponding to a total of 23,806 cases, meningitis of other etiologies (MOE) was in second place with 14,957 individuals reported, followed by the disease due to bacterial cause (MB) with 12,465 cases. The number of hospital discharges was 21,211, against 6,140 deaths confirmed from meningitis.

The following figure shows the number of cases of the disease confirmed in Brazil per year and by region, as well as the doses of vaccines applied. The North region is represented by black, followed by the Northeast (red), Southeast (blue), South (pink) and Central-West (green) (figure 2).

Figure 2a shows the number of cases of the disease occurring in Brazil by year and region. In 2001, there were 1,583 confirmed cases of the disease in the North. In the same year, the Northeast presented 5,213 cases; followed by the Southeast (15,973); South (5,658) and Midwest (1,663).

In 2004, there were 1,190 cases registered in the North region; 4,605 in the Northeast; 13,475 (Southeast); 4,874 (South) and 1,236 (Central-West). In 2007, 869 cases (North); 6,941 (Northeast); 14,180 (Southeast); 6,672 (South) and 1,266 (Central-West). In 2010, there were 684 cases (North); 4,025 (Northeast); 11,022 (Southeast); 3,779 (South) and 1,009 (Central-West).

The year 2013 presented 750 cases (North); 3,675 (Northeast); 10,355 (Southeast); 3,556 (South); 912 (Midwest). 2016, 767 cases (North); 2,113 (Northeast); 8,831 (Southeast); 3,129 (South) and 811 (Central-West). 2019, 750 (North); 2,433 (Northeast); 8,869 (Southeast); 3,810 (South); 672 (Midwest). In 2022, there were 563 cases in the North; 1,900 (Northeast); 6,445 (Southeast); 2,356 (South) and 442 (Midwest).

Table 2: Etiological characteristics and evolution of meningitis in the years 2001, 2015 and 2022.

	Frequency	
Variables	**N**	**%**
Etiology		
MCC	1.581	2,29%
MM	2.393	3,46%
MM+MCC	1.900	2,75%
MTBC	927	1,34%
MB	12.465	18,06%
MNE	7.107	10,29%
MV	23.806	34,49%
MOE	14.957	21,67%
MH	647	0,93%
PM	3.220	4,66%
Evolution		
Ignored/White	3.887	11,94%
High	21.211	65,17%
Death from meningitis	6.140	18,86%
Death from another cause	1.306	4,01%

Source: Ministry of Health/SVS - Notifiable Diseases Information System – Sinan.

Meningococcemia (MCC); Meningococcal Meningitis (MM); Meningococcal Meningitis with Meningococcemia (MM + MCC); Tuberculous meningitis (MTBC); Bacterial meningitis (MB); Non-specific meningitis (MNE); Viral meningitis (MV); Meningitis of other etiologies (MOE); Hemophilus meningitis (MH); Pneumococcal meningitis (PM).

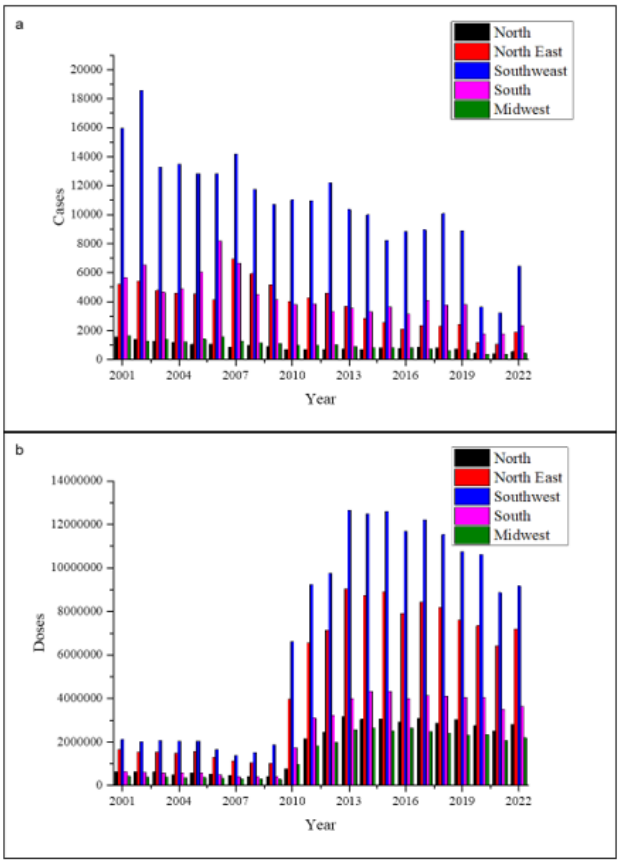

Figure 2. a) Cases x Doses of Meningitis in the years 2001, 2004, 2007, 2010, 2013, 2016, 2019 and 2022 by region; b) Vaccine doses administered by region and year.

Figure 2b depicts the year 2001 with 627,543 doses of vaccines applied in the North region; 1,659,915 in the Northeast region; 2,108,627, Southeast region; 622.330, South and 433.131, Midwest. In 2004, 507,792 (North); 1,485,052 (Northeast); 2,046,314 (Southeast); 589,135 (South) and 359,956 (Central-West). 2007, 454,413 (North); 1,132,248 (Northeast); 1,380,476 (Southeast); 402.316 (South); 287,512 (Midwest). 2010, 775,072 (North); 3,959,544 (Northeast); 6,621,318 (Southeast); 1,726,677 (South); 971.230 (Midwest). In 2013 there were 3,171,422 (North); 9,051,166 (Northeast); 12,658,290 (Southeast); 3,994,246 (South) and 2,554,595 in the Midwest. In 2016 there were 2,925,724 (North); 7,919,230 (Northeast); 11,686,254 (Southeast); 3,986,589 (South); 2,648,606 (Midwest). 2019, 3,042,546 (North); 7,614,592 (Northeast); 10,755,184 (Southeast); 4,037,181 (South); 2,317,280 (Midwest). And finally, in 2022 there were 2,811,586 (North); 7,204,828 (Northeast); 9,171,772 (Southeast); 3,639,949 (South) and 2,196,088 in the Midwest.

Figure 3 shows the incidence of meningitis in Brazil from 2000 to 2022, represented by the North (figure a), Northeast (figure b), Southeast (figure c), South (figure d) and Central-West (figure e) regions. In this image, it is possible to see that there was a tendency towards a reduction in the incidence of cases of the disease. This was only possible due to the advancement of vaccination in all Brazilian states.

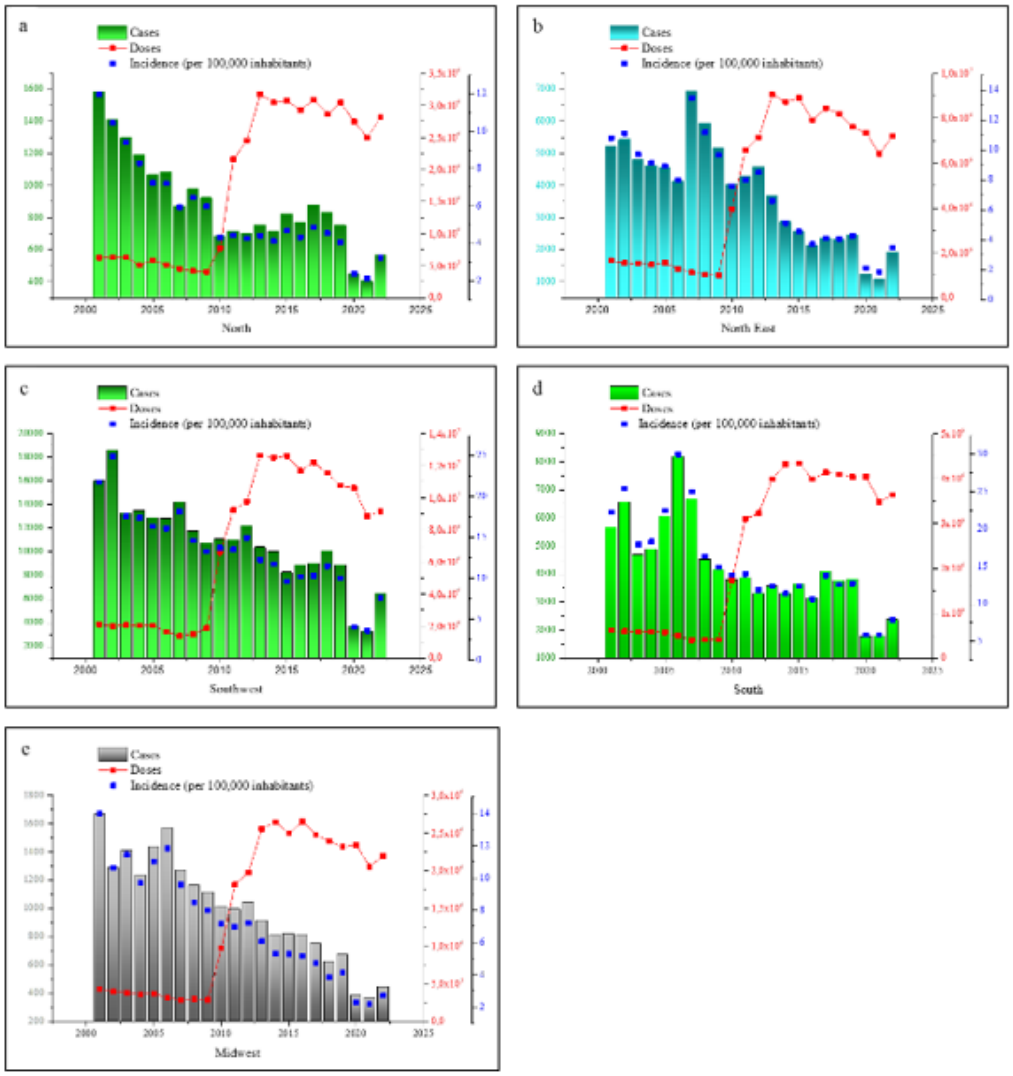

Figure 3: Incidence of Meningitis per 100,000 inhabitants per region. a) North; b) Northeast; c) Southeast; d) South; e) Midwest.

DISCUSSION

According to Focaccia & Negra[8] the Southeast region has a greater number of cases of meningitis. This number is devastating, causing high lethality. This region was the most affected due to the local health infrastructure and due to the precarious living conditions of the population in the past and due to population growth in this region, becoming the most populous in the country. This fact may be the reason why the Southeast region has the highest absolute number of cases, although access to diagnosis can be a complicating factor and underreporting of cases is a reality throughout the country[1]

Macedo Júnior et al.[9] found that the prevalence of cases occurs in males because this population is more exposed to risk factors, as they constantly perform physical activity,

which ends up causing the spread of the disease. Furthermore, they end up having difficulty seeking medical help, seeking primary care later, making it difficult to adhere to the treatment of certain diseases. Such behaviours contribute to the worsening of the condition, consequently causing the most aggravating factor, death[9].

It is known that this disease can affect individuals in any age group, but children are the most affected by it. In the literature it is stated[7] that meningitis is more common in children aged[1-4] years because their immune system is not completely mature. The immunity that children acquire in childhood through vaccination ends up losing its protective effect over the years, which is why the adult population ends up becoming a more vulnerable target for contamination of the disease[9]. Furthermore, there are other factors that contribute to the increase in the number of cases, one of which is the anti-vaccine movement that has gained great strength in recent years, especially during the COVID-19 pandemic. The adult population ends up being more susceptible to crowds due to the providing role they play in society and consequently ends up being more intolerant to the immunization process[4].

The viral meningitis is one of the most relevant causes as it affects individuals of all ages, being the cause of large epidemic outbreaks, its main form of spread occurs through the bloodstream, contact with contaminated feces, sexual intercourse and through the air. It evolves benignly, expressing reduced mortality when compared to bacterial etiology[3]. In addition to bacterial meningitis is a condition of great importance, due to its high mortality and morbidity compared to viral meningitis, its main bacterial agent is Neisseria meningitidis, also known as meningococcus, the main cause of meningitis in Brazil and around the world[10].

Neisseria meningitidis is a commensal bacterium that resides in the human upper respiratory tract, which is its only known reservoir. It becomes pathogenic when it crosses the epithelial barrier of the nasopharynx and reaches the bloodstream, causing septicemia and consequently can cross the blood-brain barrier causing meningitis[11] . In addition to this, there are other ways of becoming infected with bacterial meningitis: through Haemophilus influenzae type b (Hib) (the main cause of bacterial meningitis until 1990) and Streptococcus pneumoniae, also called pneumococcus. After the introduction of vaccination in Brazil in 1999 by the National Immunization Program (PNI), the occurrence of cases of meningitis caused by the bacteria H. influenzae decreased by up to 90%[4].

In the study carried out by Dazzi et al.[12], an increase of 50% in deaths caused by aseptic meningitis and 50% in cases of bacterial meningitis was observed during the years 2009 to 2012. Patients who died presented a measure of proteinorrhaquia of 297.17 mg/dl, compared to 95.74 mg/dl in patients who survived. Furthermore, there was a significant frequency of fatalities in 2002, 2004 and 2005, two to three times higher than in 2001 and 2004.

In the study conducted by Rodrigues[13], in the period from 2009 to 2012, morbidity varied between 0.009% and 0.016%, being the lowest in 2013 and peaking in 2007. This indicates advances in prevention, screening, diagnosis and treatment of the disease. Regarding mortality, a small variation was observed, between 0.0009% in 2012 and 2013 and 0.0011% in 2009.

From 2010 onwards there was a significant drop in cases of meningitis in Brazil. This was due to the increase in doses of vaccines applied (figure 2b), after the inclusion of the vaccine against meningococcal meningitis C, which was included by the National Immunization Plan (PNI) in the vaccination calendar in 2010. This reduction in cases was due to the health promotion and prevention policies that were developed by government bodies (Roller et al., 2023). According to the same authors, social isolation policies resulting from the Covid-19 pandemic at the end of 2020 enabled a significant drop in meningitis cases in Brazil.

Vaccination is the main form of meningitis prophylaxis, being the main resource to help control and eradicate the disease. In recent years, with the advancement of technology, it has become easier to transmit information to the population, but along with this technological advancement, fake news also came, which are used to transmit false information, generating large-scale consequences[14].

The main vaccines used in figure 2b were BCG (Bacillus of Calmette and Guérin), responsible for preventing the most serious forms of miliary and meningeal tuberculosis; meningococcus A/C vaccine (MnAC), which prevents infections caused by the bacteria Neisseria Meningitidis of serogroups A and C; meningococcal conjugate C (MncC), prevents infections caused by serogroup C of the disease. This vaccine is available at the health center for children aged 3 months to 1 year, as well as adolescents aged 11 to 14 years. Meningococcal ACWY 135, which prevents infections from serogroups A, C, W, Y and 135; meningococcal B, prevents contagion with serogroup B, and can be recommended in outbreak situations or for people at greater risk of exposure to the disease; pentavalent vaccine, protects against five infectious diseases: diphtheria, tetanus, whooping cough, hepatitis B and the bacterium Haemophilus influenzae type b (Hib), one of the main causes of meningitis in young children. And finally, the 10-valent pneumococcal vaccine offers protection against 10 serotypes of the bacterium Streptococcus pneumoniae[15].

It was observed in figure 2b that the number of doses of vaccines against meningitis applied has increased in recent years and the number of confirmed cases of the disease has decreased over the years (figure 2a). This was due to prophylactic measures and the introduction of the meningococcal C vaccine (conjugate) which was introduced throughout the national territory from October 28, 2010[15]. In addition, the meningitis vaccination is the main means of prophylaxis as they help reduce the disease. In this

way, it is expected that everyone who received the vaccine will be protected against the most serious forms of the infection[16].

Contamination of the disease occurs through direct person-to-person contact through the respiratory tract, through droplets and secretions from the nasopharynx, in addition to fecal-oral contact, in the case of enteroviruses. Therefore, due to its rapid mode of propagation, the disease has a high fatality rate, therefore, it is essential to carry out prophylaxis against bacterial biological agents through antimeningococcal vaccination, reducing the chances of infection occurring[17].

CONCLUSION

Meningitis is a serious public health problem due to its high intensity of dissemination and its high rate of morbidity and mortality, especially in children. Therefore, this study found that the male population was most affected by the disease, accounting for 33,759 of the notifications. The population most affected by meningitis was the age group of children aged less than 1 to 14 years and the second most affected was the age group of 20-59 years. Meningitis due to viral etiology (MV) was the most common among infections, corresponding to 23,806 cases. Thus, it is important to highlight the relevance of preventive methods, such as vaccination, which are highly effective in controlling and eradicating diseases, not only individually, but also collectively, as they contribute to reducing the spread of diseases, bringing benefits to the entire population. community. Furthermore, studies show that, historically, the Brazilian population trusts the effectiveness and safety of vaccines. However, in recent years, adherence has declined due to the growth of the anti-vaccine movement and the dissemination of incorrect or unscientific information, especially on social media. Therefore, it is essential to make quality scientific information available in an accessible and understandable way to combat the anti-scientific movement and make science accessible to the entire population. The role of the nurse in this journey is essential to improve symptoms, their role is to know the etiology of the disease and the necessary care, in addition to disseminating information in a concise manner about the prevention and complications of the disease, in addition to providing humanized and welcoming care, not only with the patient, but also with the entire family.

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Observação: os/(as) autores/(as) declaram não existir conflitos de interesses de qualquer natureza.