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ORIGINAL ARTICLE

Epidemiological profile of meningococcal disease in capitals of the Midwest region of Brazil

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ABSTRACT

Introduction: Meningococcal disease is a bacterial infectious disease caused by *Neisseria meningitidis*. The condition has three presentations: Meningococcal Meningitis (MM), Meningococcemia (MCC), and both MM+MCC. The prognosis without proper diagnosis and treatment may be severe or even fatal. **Objectives:** To evaluate the epidemiological profile of this disease in the Midwest Brazilian cities. **Material and Methods:** This is a descriptive cross-sectional epidemiological study of the reported cases obtained in Datasus in Brasilia, Campo Grande, Cuiaba, and Goiania from 2016 to 2020. The variables studied included prevalence, clinical presentation, gender, age group, and outcome. **Results:** During the period analyzed, 164 cases were recorded in the four capitals, with an average of 32.8 per year. The most frequent clinical form was meningococcal meningitis, with an increase in the number of reports between 2016 and 2017, followed by a slight decrease until 2019. In 2020, there was an abrupt decrease in the number of reported cases, possibly due to the covid-19 pandemic. **Conclusion:** A typical distribution of the disease may be observed in each of the towns; health hygiene, educational measures, and appropriate medical care are instruments for reducing the morbidity and mortality of the meningogoccal disease.

KEYWORDS: Meningococcal disease, Meningococcal profile, Epidemiological profile, Meningococcal Meningitis, Meningococcemia.

RESUMO

Introdução: A doença meningocócica é enfermidade infecciosa bacteriana causada pela Neisseria meningitidis, com três apresentações clínicas: meningite meningocócica (MM), meningococcemia (MCC) e MM+MCC. O prognóstico sem o devido diagnóstico e tratamento pode ser grave ou até fatal. Objetivos: Avaliar o perfil epidemiológico dessa doença nas cidades do Centro-Oeste brasileiro. **Casuística e métodos:** Trata-se de estudo epidemiológico descritivo transversal sobre os casos notificados em Brasília, Campo Grande, Cuiabá e Goiânia, entre 2016 e 2020, obtidos no Datasus. As variáveis estudadas foram: prevalência, apresentação clínica, sexo, faixa etária e desfecho. **Resultados:** No período analisados foram registrados 164 casos registrados nas quatro capitais, com média anual de 32,8. A forma clínica mais comum foi a meningite meningocócica, com aumento no número de notificações entre os anos 2016 e 2017, seguido de uma leve queda até 2019. No ano de 2020 houve queda abrupta nos casos notificados, possivelmente como uma repercussão da pandemia de covi-19. **Conclusão:** Percebe-se uma distribuição característica da doença em cada uma das cidades; medidas sanitárias, educativas e cuidados médicos adequados são instrumentos para a diminuir a morbimortalidade da DM.

PALAVRAS-CHAVE: Doença meningocócica, perfil epidemiológico, meningite meningocócica, meningococcemia.

INTRODUCTION

Meningococcal meningitis (MM) is an infectious disease characterized by inflammation of the membranes lining the central nervous system (CNS), the meninges, which presents typical neurological symptoms and systemic changes. Neisseria meningitidis (meningococcus) is the name of the bacteria that causes meningitis and meningococcemia (MCC), both called meningococcal diseases (MD). Meningitis is the inflammation of the meninges in the brain, whereas meningococcemia is the propagation of the bacteria through the various organs of the body.[1]

Still gram-negative diplococci, N. meningitidis can normally inhabit the nasopharyngeal mucosa of healthy people, being transmitted through the droplets of saliva of colonized individuals. After this colonization, the bacterium adheres to the local epithelium and passes through the mucosa, surviving the local defense mechanisms because of the important role of its virulence factors, including the polysaccharide capsule, the fimbriae, and the pili.[2] Through the bloodstream, N. meningitidis reaches the CNS, finding favorable conditions for its replication within the subarachnoid, given the absence of infection control mechanisms in this space.[3]

The genus Neisseria has ten species, two of which are pathogens in humans: N. gonorrhoeae, non-encapsulated, and N. meningitidis, encapsulated and with polysaccharide antigenic factors that allow its division into subgroups, outer membrane proteins and lipopolysaccharides. The Neisseriaceae family consists of 13 different serogroups, of which only six are the causes of pathology in human. Its main serogroups are A, B, C, W, Y and X, the latter being the only one without a vaccine.[4]

Meningococcal disease evolves quickly and may result in death between 1 and 2 days. The incubation period is from 2 to 10 days, typically no more than 4 days. Initial clinical manifestations include elevated fever, vomiting, prostration, headache, the appearance of purple-colored spots (petechiae) on the skin, and may be followed by pain and difficulty in the movements of the neck (stiff neck). With the progression of the infectious condition, tremors, convulsions, delusions and coma may arise.[5] In children under 1 year of age, when compared to adults, the manifestations may be characteristic, with fever, irritation, uncontrollable crying and bulging fontanel without nucal stiffness.[6] From the laboratory point of view, changes in cerebrospinal fluid (CSF) color and glucose levels can be identified.[7]

Meningococcemia is the most critical form of n. meningitidis infection, and, except for neck stiffness, its initial manifestations are similar to meningitis. The greatest risk is the possibility of rapid progression toward the signs of shock, abrupt drop in blood pressure and death.[4]

Diagnostic criteria consider the specific profile of each disease presentation and the conditions to which the individual is exposed. Not all meningitis are transmissible, but of those that are, the

contagion is usually done by droplets and secretions from the nose and throat. Therefore, cases of this disease usually increase in the cold months. Coughing, sneezing, kissing, and sharing personal items can transmit meningitis. Socioeconomic and environmental aspects have influence on the infection process by this Gram-negative cocci. For example, day care centers and prisons, as they are closed environments, contribute to increase the incidence of this disease. Immunosuppressed patients (primary immunodeficiencies and HIV-positive patients) have a higher risk of meningococcal infection, while the most affected age group is from 6 months to 1 year of age, with a higher gender involvement varying according to the region.[9]

As diagnostic criteria, laboratory tests, risk factors, socioeconomic conditions, age group, and gender can be found.[8] Among the diagnostic laboratory criteria we can mention the detection of antigens/antibodies, bacterial culture and bacterioscopy of cerebrospinal fluid or blood, counterimmunoelectrophoresis (CIE) and polymerase chain reaction (rt-PCR).[8] In line with these findings, clinical criteria are manifested as headache, petechiae, fever, shock, multiple organ failure, intravascular coagulation, vomiting, altered mental status, photophobia, and neck stiffness.[5]

Meningococcal disease has a high mortality rate, especially in children. In Brazil, this rate is approximately 20%, since without early diagnosis, meningogoccal disease can evolve rapidly.[1] Most Brazilian cases occur by serotypes A, B, C, W and Y. In 2010, the vaccine against serotype C, which is the most prevalent in the country, was introduced in the National Immunization Program of the Ministry of Health (PNI-MS); as a result, the number of meningococcal disease cases serotype C had decreased dramatically.[4]

It is important to say that from 2012 to 2016 the vaccination coverage reached more than 93%, however, in subsequent years, the coverage gradually dropped, and the rates were lower than 87% in 2018.[10] In this context, the need for a greater approach to meningogoccal disease is evidenced, and it is necessary to pay attention to other aspects of relevance to public health, such as the epidemiological profile, presented in this study.

MATERIAL AND METHODS

This is a cross-sectional, descriptive epidemiological study, with a case time series based on the collection of secondary data on meningococcal disease, reported in the capitals of the Midwest region of Brazil, between 2016 and 2020.

Data collection was performed in the Information System for Notification of Aggravations (Sinan), through the website of the Department of Informatics of the Brazilian Unified Health System

(Datasus/MS) of the Brazilian Department of Health. The data extraction from Tabnet was done on May 20, 2021, and these data were updated on April 7 of the same year. Population information for 2020 was collected from the Brazilian Institute of Geography and Statistics (2020), available at Datasus.

The variables studied were etiology by meningococcemia, meningococcal meningitis, and meningococcemia + meningococcal meningitis; age group; gender; specifically, progression by discharge or death from meningitis; and notification city (Brasilia, Campo Grande, Cuiaba, and Goiania).

Microsoft Office Excel 2019® software was used for tabulation and data analysis, as well as calculation of prevalence, mortality, and lethality indicators for delineation purposes among the different capitals of studied region.

RESULTS

From 2016 to 2020, 164 cases of meningococcal disease were reported in the four Midwest capitals. In terms of absolute numbers, Brasília had the highest number of cases in the period, 103, followed by Goiania, 41, Campo Grande, 15, and Cuiaba, 5. The federal capital also had the highest number of cases, with Goiania remaining in second place until 2019, in 2020 it was overtaken by Campo Grande.

There has been an average of 32.8 notified cases per year in the region over the last five years, while in the capital cities, there has been an increase in cases between 2016 and 2017. Thereafter, however, a drop in the number of cases is noticeable, which became more pronounced in 2020, when only eight cases were recorded.

As for the prevalence of meningogoccal disease, in 2016, Campo Grande ranked first, with about 6.94 cases per million people. In 2017, the position was occupied by Goiania, which with more than 10.17 cases per million people in the period had the highest prevalence among all Brazilian capitals. In 2018, Brasilia led the ranking, with 10.08 cases for each million people, a position that was repeated in 2019, when the federal capital recorded a prevalence of 8.62 cases for each million people. The year 2020—led by Campo Grande, with 3.3 cases per million people—stands out for the lowest prevalence in the period.

The analysis indicated a higher prevalence of meningogoccal meningitis over the other clinical presentations, accounting for 55.45% of the reported cases. This is followed by meningogoccal

meningitis +meningococcemia (25%) and meningococcemia (19.5%). Only in 2020 the meningogoccal meningitis+meningococcemia form had the same number of cases as meningogoccal meningitis. During the period, meningogoccal meningitis+meningococcemia was the second most prevalent presentation of meningococcal disease, except for 2019, in when there was a higher number of meningococcemia.

Among some important aspects, we can mention the fact that Brasilia accounts for most of the meningococcemia cases, having similar numbers of meningococcemia and meningogoccal meningitis+meningococcemia. In addition, it is worth pointing out that Campo Grande had a single case of meningococcemia during the period, while Cuiaba had only three, one of each form of meningogoccal disease.

Table 1. Prevalence of meningococcal disease in Brazilian Midwest capitals, from 2016 to 2020.

Cities	2016	2017	2018	2019	2020
Brasilia	6,22	8,52	10,08	8,62	1,3
Cuiaba	0	6,64	0	1,63	0
Campo Grande	6,93	2,28	1,12	3,34	3,31
Goiania	6,18	10,17	6,01	4,61	0,65
Midwest region	5,68	7,81	6,7	6,12	1,3

Source: Brazilian Department of Health/SVS - Sinan Net.

During the period, Cuiaba registered no cases between 0 and 9 years old. In the age groups between 10 and 14 years, 15 and 19 and 60 and 64 years, the capital of Mato Grosso registered one case (20%) each; and between 20 and 39 years, two (40%). The city, therefore, had a total of five cases between 2016 and 2020.

Campo Grande registered one case (6.6%) between 1 and 4 years; two (13.3%) between 5 and 9 years old; and two (13.3%) between 10 and 14 years. In the 20 to 39 age group, there were seven cases (46.6%); and between 40 and 59 years, three (20%). Thus, the capital of Mato Grosso do Sul had 15 cases in the period.

Brasilia notified 13 cases in children under 1 year old, and the same number between 1 and 4 years, each age group making up 12.62% of the total. Between the ages of 5 and 9, eight cases (7.8%) were recorded; between 10 and 14, seven (6.79%); between 15 to 19 years, 20 (19.4%); between 20 and 39 years, 28 (27.2%); and from 40 to 59 years, 10 cases (9.7%). In each age group between 60

and 64 years and 65 to 69 years, two cases (1.94%)were identified. Thus, the federal capital counted 103 cases from 2016 to 2020.

Finally, Goiania had four cases in each of the following age groups: children under 1 year old and 1 to 4 years, 9.75% each. Between 5 and 9 years of age, and between 15 and 19 years, the numbers are the same, making up each age group 14.6% of the total. Between 10 and 14 years of age there were two cases (4.9%); from 20 to 39 years, 28 (6.9%); from 40 to 59, four cases (9.75%); and in the groups between 60 and 64 and 65 and 69 years, one case each (2.4%). Therefore, the capital of Goias recorded 41 cases in the period.

When analyzed by age group, the numbers show striking characteristics. At first, Brasilia and Goiania registered infections in all age groups - in children under 1 year old, only these two cities presented cases. In the 1 to 4 years and 5 to 9 years age groups, the pattern of case distribution remained the same, with the federal capital having the highest incidence. Also, besides Brasilia, in these age groups, Goiania and Campo Grande have reported cases of meningococcal disease.

In the 10-14 age range, all four cities reported cases, with the highest numbers reported, in descending order, in Brasilia, Goiania, Campo Grande, and Cuiaba. Between 15 and 19 years old, the capital of the Mato Grosso do Sul state was the only one where there were no cases. In the 20-39 age group, there was in all cities a clear increase in all cases. In the 40 to 59 age range, there was a decrease in the infection rates, and Cuiaba had no cases in this age group. Between 60 and 64 years old, Brasilia, Goiania, and Cuiaba presented cases, and in the last age group analyzed, 65 to 69 years old, only the capitals of the Federal District and Goiás.

In Brasilia, there were 59 male and 44 female cases, respectively, 57% and 43% of the total registered in the city. In the federal capital there is a discrepancy between confirmed cases in both genders, compared to other capitals of the Midwest, with the total being almost double of the others summation. Furthermore, there is no linearity of a predominant gender in the four cities: in Brasilia, Cuiaba, and Campo Grande there are more confirmed cases among men, while in Goiania there is a slight predominance of women.

In the period, the cases ofmeningogoccal meningitis, meningococcemia or meningogoccal meningitis+meningococcemia in the region reported in Datasus had a higher average hospital discharge than mortality. Taking into account the population that presented any of the diseases, it is possible to observe that in the federal capital 50% of the patients died, and 50% were cured and discharged from the hospital. In Campo Grande, the proportion of the population that did not survive meningitis, meningococcemia, or a combination of the two diseases is lower: 20% mortality and,

therefore, 80% cure. In Cuiaba, as in Brasilia, half of the patients were discharged after being cured, and the other half died. Finally, in Goiania, 75.60% of the patients who presented one of the forms of the disease survived and were cured, therefore, a death rate of 24.40%.

Table 2. Evolution of meningococcal meningitis, meningococcemia or meningogoccal meningitis+meningococcemia cases in different Midwestern capitals, 2016 to 2020.

Cities	Mortality	Discharge
Brasilia	6.22	8.52
Cuiaba	0	6.64
Campo Grande	6.93	2.28
Goiania	6.18	10.17
Midwest region	5.68	7.81

Source: Brazilian Department of Health/SVS.

With an average of 72.30% hospital discharges and 27.70% deaths, the mortality rate from meningogoccal meningitis, meningococcemia, or meningogoccal meningitis+meningococcemia in the Midwest is 28 deaths per 100 people. Brasiliaand Cuiaba registered the highest average number of deaths, while Campo Grande and Goiania presented the lowest rates. In the Federal District and in the Mato Grosso capital this rate was 50%. The Mato Grosso do Sul capital had the lowest mortality rate among the four municipalities analyzed, with only 20% of deaths, while in Goiás it was approximately 24%.

Hospital discharge rates were higher than death rates, thus indicating that patients who contract meningococcal meningitis, meningococcemia, or meningococcal meningitis+meningococcemia are more likely to have an improved clinical condition. The total average percentage for the four cities was 72.33%. These rates were obtained by analyzing the Datasus data and calculating the percentage obtained by the number of confirmed cases and the number of patients who were discharged. Brasilia and Cuiaba had hospital discharge rates equal to 50%, so 5 out of 10 patients hospitalized for one form of the disease were discharged; Campo Grande, 80% (8 out of 10 patients); and in Goiania 76% of the hospitalized patients were discharged.

In an overall analysis, most of the population that was diagnosed with meningogoccal meningitis, meningococcemia or meningogoccal meningitis+meningococcemia was discharged, with the disease having a low mortality rate in these capitaals.

DISCUSSION

Brasilia was the Midwestern city that led the incidence of cases for three consecutive years. This is ratified by the evaluation of the context in which the population of Brasilia is inserted. According to Moraes and Barata (2005),[11] autumn and winter favor the proliferation of meningitis. In some regions of Africa, for example, an increase in the number of cases is observed during dry seasons.[12] Similarly, the Federal District has a semi-humid climate, with an average of 4 to 5 months with low relative humidity, which therefore facilitates infections caused by the etiologic agent of meningococcal disease. The prevalent serogroups of the regions also influence the incidence of the disease. In Brazil, types C and B prevail, the latter being the less immunoreactive serogroup,[9] which promotes an epidemics chronicity, while C is related to outbreaks and acute epidemics.[13] However, there is a relative scarcity of data regarding meningococcal typing in the Midwest, preventing an analysis of this aspect.

Compared to 2016, 2017 showed an increase in the prevalence of meningogoccal disease. In the following years there was a noticeable downward trend. It is also worth noting an abrupt decrease in notifications in 2020, which may be a repercussion of the SARS-CoV-2 pandemic, causing covid-19, which emerged in the country earlier that year. Among the possible hypotheses to explain this phenomenon is the sub-notification of cases caused by some actions that have been taken to prevent the virus spreading. In this sense, it is likely that many patients have not sought the health services for the accurate diagnosis, as well as the sanitary measures taken by the population and health institutions to avoid the pandemic virus contamination, such as hand washing and antisepsis, the compulsory use of masks, and the amplified social distancing, which may have hindered the transmission of the disease etiological agent.[14]

Regarding the epidemiological behavior of meningococcal disease in the Midwestern capitals, age patterns characterized by the peak occurrence between 20 and 29 years of age were observed in all the analyzed cities. Following are those affected between the ages of 15 and 20, especially in Goiania and Brasilia. This increase can be explained by the introduction of vaccines covering adolescents up to the age of 14. Thus, the decrease happens in the immunized groups (1 to 14 years old). Consequently, the increase in cases occurs more in the 20 to 39 age group, a non-immunized group.[16]

Regarding gender, there were a total of 164 cases of meningococcal meningitis from the years 2016 to 2020, of which 91 (55.5%) were male and 73 (44.5%) were female. Regarding the prevalence by gender, in Brasilia, Cuiaba, and Campo Grande the highest number of cases occurred among men, while in Goiania there was a higher prevalence of women. These findings reveal that there is no linearity in the gender parameter in the region, although epidemiological data analyzed throughout Brazil show that females are more affected.[16]

The analysis of the meningococcal meningitis, meningococcemia or meningogoccal meningitis+meningococcemia evolution contributes to control and avoid new cases. In the 2016-2020 period, most patients in the Midwest who developed one of these forms of the disease progressed to cure, however, a significant percentage, 27.67%, eventually died. Campo Grande was the capital city that had the lowest rate of deaths, followed by Goiania, Brasilia and Cuiaba, which were evenly tied. The values presented by each of these cities are associated to the control of the disease cycle. For this same reason, the notifications must be followed up, because in that way we have a parameter concerning the number and individual evolution of each case.[16]

FINAL CONSIDERATIONS

The analysis of cases of meningococcal meningitis, meningococcemia and the two forms of the disease meningogoccal (meningitis+meningococcemia) showed no outbreaks of meningitis in the four capitals of the Midwest in the period from 2016 to 2020, thus following a linearity.

Gender issues were not relevant to the study, as there were no major differences between men and women. As for the age of patients, except in Goiania, the others showed higher prevalence rates in people aged from 20 to 39 years old; in the city of Goiania the highest occurrence was among schoolchildren from 5 to 9 years old and teenagers and young people from 15 to 19 years old. In terms of mortality, when analyzing the average of the four cities, it is noted that more than two-thirds of the patients were recovered and the remainder died from one of the forms of meningitis, indicating a relatively low rate. Furthermore, considering the data and the results, it can be observed that Brasilia is proportionally the capital city with the most severe cases of the disease, which requires more comprehensive studies to justify this preponderance.

That being said, the limitation of this research is acknowledged regarding the many neglected cases that are not reported and, therefore, are not included in the statistics. In this regard, it is necessary to point out the impact of the covid-19 pandemic on the reporting of meningogoccal meningitis, meningococcemia and meningogoccal meningitis+meningococcemia in 2020, generating an underreporting. In addition, it is important to mention that, by accounting only for cases reported in capital cities, this paper is not sufficiently representative of the characteristics of the entire Midwest or its respective states.

In the same way, it is imperative to emphasize the relevance of vaccination campaigns and their positive epidemiological impact. This action results in the decline of meningitis cases over the years, as observed in this study.

Furthermore, regarding the repercussions of covid-19 on the epidemiological profile of communicable diseases, it is important to note that the dissemination of information in favor of actions such as hand hygiene and the use of masks may have contributed to the decrease in the number of cases of infectious diseases, including the reduction of meningococcal transmission. Therefore, fostering these practices, even after the current pandemic has ended, is highly recommended.

Another aspect that must be elucidated concerns the urgency of knowledge sharing about the symptomatology of the meningococcemia. Thus, the population, provided with information, may be able to recognize the events associated with this disease and to seek medical help, if necessary.

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