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EPIDEMIOLOGY OF GESTATIONAL TOXOPLASMOSIS IN PARANÁ: STUDY OF CASES RECORDED BETWEEN 2019 AND 2023

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ABSTRACT

OBJECTIVE: To analyze the epidemiological profile of toxoplasmosis acquired during pregnancy and notified by the state of Paraná from 2019 to 2023. METHOD: Ecological study covering the entire territory of Paraná. It focuses on the analysis of prevalence, distribution and factors related to occurrence in a specific population, in this case, pregnant women. Data collection took place from January 2019 to December 2023, whose data were collected through the Diseases and Notification Information System, with the variables age group, education, gestational age, classification, evolution, and criteria of pregnant women. The collected data were transported to an electronic spreadsheet in the Microsoft Office Excel software, and the data analysis was performed through simple descriptive statistical analysis, with absolute and relative frequency presentation. RESULTS: Between 2019 and 2023, the state of Paraná recorded 4,062 cases of gestational toxoplasmosis, predominantly in women between 20 and 39 years of age. The highest number of confirmed cases occurred in 2023 (700 cases), while the lowest was recorded in 2020 (626 cases). Most diagnoses were made through laboratory tests, totaling 768 confirmations in 2023.

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The disease was more frequent in the 1st trimester of pregnancy, with 385 confirmed cases in 2023. White women, with complete high school education, were the most affected. CONCLUSION: The effectiveness of the information provided by health services and professionals is essential to change behaviors, adopt healthy habits, and disseminate knowledge to those without the necessary accessories for these services. This not only applies to congenital toxoplasmosis, but also to any disease where information plays a transformative role.

Keywords: Fetal toxoplasmosis. Toxoplasmosis Congenital. Toxoplasma Gondii. Congenital Infection.

INTRODUCTION

Gestational toxoplasmosis is a condition caused by the parasite *Toxoplasma gondii*, transmitted mainly through the ingestion of contaminated food or contact with feces of infected cats. During pregnancy, women can become vulnerable to infection due to changes in the immune system, which makes them more likely to contract this disease. Although many may not have overt symptoms, toxoplasmosis during pregnancy poses a significant risk to fetal development (Righi, *et al*, 2021).

Recent studies reveal that the incidence of congenital toxoplasmosis varies between 1 and 10 cases per 10,000 live births, depending on the region. On the other hand, in countries with a high prevalence of maternal infection, such as some nations in Latin America and Central Europe, the rates of congenital infection are higher. In Brazil, and in certain countries in Africa and Europe, seroprevalence rates in pregnant women are higher, reaching 50-70% in endemic areas. On the other hand, in non-endemic regions, such as the United States, the prevalence is lower, ranging from 10% to 30% (Bigna, *et al*, 2019).

The rate of vertical transmission, that is, from mother to fetus, varies according to the stage of pregnancy. In the first trimester, transmission occurs in about 10% to 15% of cases, but the consequences for the fetus tend to be more severe, including risk of miscarriage, severe malformations, or fetal death. In the second trimester, the transmission rate increases to about 25% to 30%, with an increased likelihood of neurological sequelae such as hydrocephalus, intracranial calcifications, and chorioretinitis. In the third trimester, the transmission rate can reach 60% to 90%, although clinical manifestations in the newborn are often less severe, with complications that can arise in the long term, such as visual and neurological problems (Rodrigues, *et al*, 2022).

Symptoms in pregnant women can range from mild to severe, including: fever, headache, muscle pain and lymphadenopathy, often confused with other infections. Therefore, it is essential to carry out IgM and IgG serology tests during prenatal care for accurate diagnosis. Early detection is crucial for the initiation of appropriate treatment, minimizing the risks to the mother and fetus (Guimarães, *et al*, 2024).

The risks associated with gestational toxoplasmosis go beyond fetal complications, such as neurological damage and eye problems. Maternal health can also be impacted, requiring specialized monitoring to ensure that complications are treated quickly. Thus, women diagnosed during pregnancy require continuous medical care to monitor both their health and fetal development (Sampaio, *et al*, 2020).

Prevention is an essential aspect and involves simple measures, such as washing fruits and vegetables thoroughly, cooking meat thoroughly, and avoiding contact with cat

feces, especially when handling litter boxes. Medical guidance and education on hygiene and food safety practices are key to reducing the risk of infection (Toledo, Kowalski, 2021).

If necessary, a multidisciplinary approach in the management of gestational toxoplasmosis is essential, involving obstetricians, infectologists and neonatologists. The treatment aims to reduce the parasite load in pregnant women and prevent transmission to the fetus, with continuous monitoring of fetal development (Barros, *et al*, 2023).

In this context, the study of the epidemiology of gestational toxoplasmosis has been an effective tool to guide women's health care, identifying vulnerable populations and analyzing risk factors. With this, it is possible to develop prevention and control strategies, aiming to reduce cases of *Toxoplasma gondii infection* in pregnant women (Da Rosa, *et al*, 2024).

Thus, the objective of this study was to analyze the epidemiological profile of toxoplasmosis acquired during pregnancy and notified in the state of Paraná from 2019 to 2023.

METHODOLOGY

STUDY DESIGN

This is an ecological and retrospective study, including a historical series of pregnant women, covering the entire territory of Paraná. This article was prepared in accordance with the recommendations of the EQUATOR Network guidelines and the checklist Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (Malta, *et al*, 2010).

PERIOD

Data collection was carried out between January 2019 and December 2023, and was carried out in July 2024, whose data were collected through the Department of Informatics of the Unified Health System (DATASUS) and in the subsection of the Information System for Diseases and Notifications (SINAN).

POPULATION AND STUDY SITE

The study covered pregnant women from Paraná diagnosed with toxoplasmosis between 2019 and 2023, attended at Basic Health Units (UBS) in different regions of the state. Paraná, the scenario of the study, is the fifth most populous state in Brazil with about 11.8 million inhabitants in 2024, has a scenario of growing urbanization, with emphasis on the cities of Curitiba and Londrina. According to the IBGE, 24 municipalities in Paraná have already surpassed the mark of 100 thousand inhabitants (IBGE, 2024).

STUDY VARIABLES

The sociodemographic variables considered for this study were: age group (10-14 years, 15-19 years, 20-39 years, and 40-59 years), education (complete elementary school, incomplete elementary school, complete high school, incomplete high school, complete higher education, incomplete higher education), race (white, black, yellow, or brown), gestational trimester (1st trimester, 2nd, and 3rd trimester), classification (confirmed, discarded, and inconclusive), evolution (cure, death from the notified disease, death from another cause, death under investigation) and criteria of pregnant women (laboratory, clinical-epidemiological, clinical).

DATA COLLECTION, PROCESSING AND ANALYSIS

Information was collected through the DATASUS data processing system, accessing the "Epidemiological and Morbidity" tab, specifically the Notifiable Diseases System (SINAN) from 2007 onwards, focusing on data related to Gestational Toxoplasmosis. The collected data were transferred to an electronic spreadsheet in the Microsoft Office Excel software, with the application of a double check, ensuring the accuracy and consistency of the information. Next, the data were submitted to a simple descriptive statistical analysis, presenting the absolute and relative frequencies of the cases, which allowed the identification of patterns and trends in the distribution of notifications.

ETHICAL ASPECTS

As these data are in the public domain, there was no need for approval by the Research Ethics Committee, according to Resolution No. 510/2017 of the National Health Council (Conselho Nacional de Saúde, 2016).

RESULTS

From January 2019 to December 2023, 4062 cases of gestational toxoplasmosis were registered in Paraná. Regarding the age group, the highest number was 3059 women, aged 20 to 39 years, and the lowest number among women was 66, aged 10 to 14 years. (Table 1).

Table 1 - Notifications of gestational toxoplasmosis according to Year and Age Group. (Paraná, 2019 –2023).

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)

10 to 14 years old	15 (1,87)	9 (1,20)	11 (1,33)	17 (2,04)	14 (1,65)
15 to 19 years old	181(22,51)	147 (19,57)	179 (21,72)	162 (19,45)	164 (19,29)
20 to 39 years old	586 (72,89)	573 (76,3)	618 (75)	629 (75,51)	653 (76,82)
40 to 59 years old	22 (2,74)	22 (2,93)	16 (1,94)	25 (3)	19 (2,24)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

Regarding education, women who had completed high school were the ones who had the most notifications of gestational toxoplasmosis, with a total of 1010 cases, in the state of Paraná. In addition, the lowest number of cases of gestational toxoplasmosis reported were women with no schooling. (Table 2).

Table 2 – Notifications of gestational toxoplasmosis according to year of schooling. (Paraná, 2019 –2023)

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)
Ign/Branco	174 (21,64)	138 (18,38)	151 (18,33)	188 (22,57)	217 (25,53)
Illiterate	0 (0,00)	0 (0,00)	1 (0,12)	2 (0,24)	0 (0,00)
1st to 4th incomplete grade of EF	20 (2,49)	19 (2,53)	16 (1,94)	18 (2,16)	11 (1,29)
Complete 4th grade of EF	18 (2,24)	16 (2,13)	18 (2,18)	16 (1,92)	16 (1,88)
5th to 8th grade incomplete EF	113 (14,05)	100 (13,32)	107 (12,99)	98 (11,76)	118 (13,88)
Complete elementary school	97 (12,06)	101 (13,45)	117 (14,20)	77 (9,24)	69 (8,12)
Incomplete high school	139 (17,29)	164 (21,84)	155 (18,81)	142 (17,05)	126 (14,82)
Complete high school	198 (24,63)	157 (20,91)	211 (25,61)	228 (27,37)	216 (25,41)
Incomplete higher education	12 (1,49)	21 (2,80)	21 (2,55)	25 (3,00)	21 (2,47)
Complete higher education	33 (4,10)	35 (4,66)	27 (3,28)	39 (4,68)	56 (6,59)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

Regarding race, the most affected population was white, with 2830 cases notified, and the smallest was the Indigenous race, with only 26 cases of gestational toxoplasmosis notified. By year of notification, the population most affected by gestational toxoplasmosis perseveres being the white race. (Table 3).

Table 3 – Notifications of gestational toxoplasmosis according to Year and Color/Race. (Paraná, 2019 –2023)

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)
Ign/Branco	47 (5,85)	26 (3,46)	29 (3,52)	31 (3,72)	37 (4,35)
White	575 (71,52)	533 (70,97)	570 (69,17)	575 (69,03)	577 (67,88)
Black	20 (2,49)	33 (4,39)	27 (3,28)	30 (3,60)	33 (3,88)

Yellow	6 (0,75)	6 (0,80)	7 (0,85)	6 (0,72)	8 (0,94)
Brown	147 (18,28)	149 (19,84)	186 (22,57)	187 (22,45)	191 (22,47)
Indigenous	9 (1,12)	4 (0,53)	5 (0,61)	4 (0,48)	4 (0,47)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

Regarding the diagnosis of patients who had suspected gestational toxoplasmosis, the year in which there were more confirmed cases was in 2023, with 700 confirmed cases and the year with the fewest confirmed cases was in 2020, with 626 confirmed cases of gestational toxoplasmosis. The year with the most discarded cases was 2021 with 99 cases, and the year with the fewest discarded cases was 2022 with 86 cases of gestational toxoplasmosis. The year with the most inconclusive cases of gestational toxoplasmosis was in 2022, with 72 cases, and the year with the fewest inconclusive cases reported was in 2020 with 28 inconclusive cases of gestational toxoplasmosis. (Table 4).

Table 4 – Notifications of gestational toxoplasmosis according to Year and Classification (Paraná, 2019 –2023)

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)
Ign/Branco	5 (0,62)	2 (0,27)	0 (0,00)	3 (0,36)	46 (5,41)
Confirmed	669 (83,21)	626 (83,36)	671 (81,43)	672 (80,67)	700 (82,35)
Castoff	87 (10,82)	95 (12,65)	99 (12,01)	86 (10,32)	79 (9,29)
Inconclusive	43 (5,35)	28 (3,73)	54 (6,55)	72 (8,64)	25 (2,94)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

As for patients who were cured and those who died due to other causes, the highest number of cases related to cure was in 2023, with 276 cured cases, and the lowest number was in 2020, with 149 cured cases. There were only two deaths from other causes, and they occurred in 2019 and 2022. (Table 5).

Table 5 – Notifications of gestational toxoplasmosis according to Cure/Death from Other Causes (Paraná, 2019 –2023)

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)
Ign/Branco	237(29,48)	149(19,84)	197 (23,91)	259 (31,09)	276 (32,47)
Care	566 (70,40)	602 (80,16)	627(573)	573 (68,79)	574 (67,52)
Death from other causes	1(0,12)	0 (0,00)	0 (0,12)	1 (0,12)	0 (0,00)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

Regarding the forms of diagnosis of gestational toxoplasmosis, the highest number of cases confirmed by laboratory tests was in 2023, with 768 cases confirmed by laboratory tests, while the lowest number was in 2020, with 709 confirmed cases. The highest number

of confirmed cases by epidemiological clinical diagnosis occurred in 2019, with eleven cases, and the lowest number was in 2021, with 5 cases confirmed by this form of diagnosis. (Table 6).

Table 6 – Notifications of gestational toxoplasmosis according to Diagnosis and Year (Paraná, 2019 –2023)

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)
Ign/Branco	51 (6,34)	33(4,39)	53 (6,43)	77 (9,24)	73 (8,59)
Laboratory	742 (92,29)	709 (94,41)	766 (92,96)	747 (89,68)	768 (90,35)
Clinical-epidemiological	11 (1,37)	9 (1,20)	5 (0,61)	9 (1,08)	9 (1,06)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

With regard to gestational age affected by gestational toxoplasmosis, the highest number of confirmed cases in the 1st gestational trimester was in 2023, with 385 cases, while the lowest number in this period was in 2020, with 335 cases. The highest number of confirmed cases in the 2nd trimester of pregnancy occurred in 2021, with 291 cases, while the lowest number was in 2023, with 251 cases. Finally, the highest number of confirmed cases in the 3rd quarter in 2022, with 224 cases, and the lowest number in this gestational age was in 2020, with 140 cases. It is noted that cases are commonly discovered in the 1st trimester of pregnancy compared to the 2nd and 3rd trimesters (Table 7).

Table 7 – Notifications of gestational toxoplasmosis according to Gestational Age and Year (Paraná, 2019 – 2023)

	2019	2020	2021	2022	2023
	n(%)	n(%)	n(%)	n(%)	n(%)
1st Trimester	353 (43,91)	335 (44,61)	375 (45,51)	338 (40,58)	385 (45,29)
2nd Trimester	272 (33,83)	274 (36,48)	291 (35,32)	261 (31,33)	251 (29,53)
3rd Trimester	167 (20,77)	140 (18,64)	146 (17,72)	224 (26,89)	203 (23,88)
Ignored	12 (1,49)	2 (0,27)	12 (1,46)	10 (1,20)	11 (1,29)

Source: Data extracted from SINAN from the Ministry of Health's DATASUS platform.

DISCUSSION

Toxoplasmosis is one of the most serious infections that can occur during pregnancy, mainly due to the risks associated with it, such as miscarriage and harm to the fetus. In Paraná, data from 2019 to 2023, it is observed that pregnant women in the age group of 20 to 39 years were the most notified in relation to the disease in question. In addition, pregnant women with complete high school education had the highest number of notifications. Regarding skin color, self-declared white pregnant women were the most affected. Most of the affected pregnant women managed to recover, while few cases died.

The first trimester of pregnancy was identified as the gestational period most vulnerable to the diagnosis of the disease.

Several risk factors have contributed to the incidence of gestational toxoplasmosis worldwide. The ingestion of raw or undercooked meat, contact with feces of infected cats, and consumption of contaminated water are the main means of transmission of *Toxoplasma gondii.* Local studies indicate that inadequate eating and hygiene habits are prevalent in certain regions, increasing the vulnerability of pregnant women. In addition, the lack of knowledge about the disease and its forms of prevention remains a challenge, despite the educational campaigns promoted by the state government (Dos Santos, *et al*, 2021).

The prevention and control strategies implemented in Paraná include health education, regular prenatal exams, and awareness campaigns about the risks of toxoplasmosis. Health services have focused on informing pregnant women about the importance of avoiding raw meat, maintaining proper hygiene practices, and avoiding contact with possible sources of infection. The implementation of active surveillance programs to monitor the incidence of toxoplasmosis has been essential to identify outbreaks and implement rapid containment measures (Rodrigues, *et al*, 2024).

The impacts of gestational toxoplasmosis on maternal and child health are significant. The infection can lead to miscarriages, stillbirths, and serious birth defects such as hydrocephalus, mental retardation, and visual problems. In Paraná, data between 2019 and 2023 show a correlation between the lack of early diagnosis and the severity of cases. Pregnant women who do not receive adequate prenatal care are at higher risk of severe complications, highlighting the importance of an accessible and efficient health system (Silva, *et al*, 2023).

The predominance of cases of gestational toxoplasmosis among women aged 20 to 39 years, with 3059 records, can be explained by the higher incidence of pregnancy in this age group. Recent studies confirm that maternal age is a relevant risk factor for toxoplasmosis, since younger women are often of active reproductive age. The predominance of women with complete secondary education, which totaled 1010 cases, may reflect a higher notification rate among this group, since women with a higher level of formal education may have less knowledge about prevention practices due to an incorrect perception of low risk (Prata, *et al*, 2023).

The higher incidence of gestational toxoplasmosis among white women compared to other races may be related to socioeconomic factors and unequal access to health care. White women may have different eating, pet handling, and hygiene practices, which can

influence the infection rate. The low incidence among indigenous women may reflect differences in access to health care and prevention practices (Correa, Machado, 2024).

The reduction in confirmed cases in 2020 may have been influenced by the COVID-19 pandemic, which affected access to health services and diagnostic tests. The increase in confirmed cases of gestational toxoplasmosis in 2023 may be associated with a decrease in the care taken during the pandemic (Serafim, *et al*, 2023).

Diagnostic data indicate an increase in laboratory-confirmed cases in 2023, suggesting greater efficacy and availability of these tests over the years. The higher number of cases confirmed by clinical epidemiological diagnosis in 2019 may reflect a greater dependence on this diagnostic method in previous years, when access to laboratory tests may have been more limited (Costa, *et al*, 2023).

The predominance of cases in the 1st trimester of pregnancy is consistent with studies indicating that toxoplasmosis acquired during the first trimester has a more significant impact on fetal health and is more easily detected due to more frequent monitoring of pregnant women during this period. The annual variation in the number of cases per quarter may be linked to changes in monitoring and diagnostic practices, as well as fluctuations in the incidence of the disease over the years (Diaz, *et al*, 2022).

Despite advances in the prevention and control of gestational toxoplasmosis in Paraná, there are still significant challenges. Inequality in access to health services, especially in rural areas, and the need for ongoing education campaigns are issues that need to be addressed. In addition, cultural resistance to changes in eating and hygiene habits represents an obstacle to reducing the incidence of the disease (Lima, *et al*, 2023)

For the future, it is essential to strengthen public health policies, focusing on the universalization of prenatal care and the continuous education of pregnant women. Investing in research to develop better methods of diagnosing and treating toxoplasmosis will also be essential to improve maternal and child health outcomes (Silva, et al, 2021).

Gestational toxoplasmosis in the state of Paraná between 2019 and 2023 presents a number of challenges, but also opportunities to improve public health. Through a combination of education, prevention, and improved health care, it is possible to reduce the incidence and impacts of this infection (Barros, *et al*, 2022).

The limitations of this study should be considered when interpreting the results. Secondary data on pregnant women with toxoplasmosis were used, and national databases may have irregular coverage; underreporting may occur, in different proportions, among locations in the state, leading to underestimation of this variable (Martim, *et al*, 2023).

CONCLUSION

Despite the methodological limitations of the study, research of this type is essential not only to understand the magnitude of the problem, but also to identify elements that enable an early diagnosis. These investigations contribute to the construction of a more in-depth knowledge about an extremely complex topic. Gestational toxoplasmosis, which affects the health of the mother-child binomial, continues to be a serious public health problem, with several risks to the baby's development and survival. Preventive measures are the main strategy to avoid the devastating effects of this infection on children.

The provision of an active, proactive and informative health service is crucial to transform the experience of pregnant women, promoting a healthy pregnancy. The execution of effective prenatal care, combined with appropriate guidance during this period, ensures the quality of the care provided, contributing to a safe delivery, without negative repercussions for both the mother and the newborn, and preventing the emergence of various complications.

The dissemination of health information is essential to prevent several diseases, such as toxoplasmosis and congenital toxoplasmosis. Awareness can interrupt the cycle of toxoplasmosis transmission, thus reducing the incidence of cases. This contributes directly to health education, promoting knowledge on how to avoid infection and identifying risk factors, such as the consumption of raw or undercooked meats, inadequate hygiene practices, use of unfiltered water, exposure of food to insects, in addition to contact with cat litter and contaminated soil.

It is concluded that the quality of information transmitted by health services and professionals in the area, especially in primary care, becomes crucial for changing behaviors, adopting healthy habits and disseminating this information to those who have little or no access to health services. This is vital not only for the prevention of congenital toxoplasmosis, but also for any disease whose dissemination of knowledge can be a transformative factor.

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