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RESEARCH ARTICLE

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TEMPORAL-SPATIAL DISTRIBUTION OF REPORTED CONGENITAL TOXOPLASMOSIS IN PARA STATE

***¹Silas José Guimarães Pantoja Cardoso, ¹Lorena Reis Pereira, ²Alfredo Cardoso Costa, ³Marcelo Coelho Simões, ⁴Eurinetto Gomes do Nascimento, ⁴André Luiz Aluizio Brasil Galvão, ⁵Ruhan da Conceição Sacramento, ⁶Natália Kiss Nogueira da Silva and ⁷Cléa Nazaré Carneiro Bichara**

¹Medical Student, State University of Para, UEPA, Para, Brazil; ²Doctoral Student, State University of Para, UEPA, Para, Brazil; ³MSc. in Environmental Sciences, State University of Para, UEPA, Para, Brazil; ⁴Graduated in Medicine, Federal University of Para, UFPA, Para, Brazil; ⁵Nurse, State University of Para, UEPA, Para, Brazil; ⁶Teacher of State University of Para, UEPA, Para, Brazil; ⁷Doctor, PhD in Biology of Infectious and Parasitic Agents. Federal University of Pará UFPA, Teacher of State University of Para, Para, Brazil

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*Corresponding author:

Silas José Guimarães Pantoja Cardoso,

ABSTRACT

Congenital toxoplasmosis is an important public health problem in Brazil, and it started to have compulsory notification in 2016. In the northern region of the country, in the state of Pará, in the Amazon, prevalence rates are high, and this research aimed to assess longitudinally, between 2012-2021 the reported cases according to geographic location by municipality, year, race, gestational period and maternal education, based on official data from the State Department of Health. 117 cases were reported in 40 of the 144 municipalities in Pará, predominating in 8 of these: Redenção (16.2%), Belém (15.4%), Paragominas (10.3%), Tucuruí (6.8%) and others. with an average of 1,667 cases. Most occurred after 2016 (78 cases), especially in 2019 (20.51%), in the second (50%) and third trimester (33.3%) of pregnancy, respectively, in pardos (76.92%), with mothers with low education (14 out of 30 notified). There are achievements in the surveillance and control of toxoplasmosis, however it is necessary that the management of the municipalities compromise to structure the health network for the diagnosis of gestational and neonatal toxoplasmosis, since it was observed that less than a third of the municipalities are making the notifications.

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INTRODUCTION

Toxoplasmosis is a protozoan disease considered a public health problem found in all countries, with important differences in seropositivity, which varies according to environmental conditions and cultural habits (<10% to >90%) (Barros *et al.*, 2021), being higher in the African and South American continents, reaching rates above 60% (Messerer, 2014). The maintenance, expansion and transmission of the etiologic agent, the protozoan *Toxoplasma gondii*, are directly related to hygiene and food issues, contact with felines considered definitive hosts, socioeconomic condition and with regions of tropical climates (Kota; Shabbir, 2021). Infection occurs by ingestion of cysts or oocysts, ingested orally through raw or undercooked meats and water and food contaminated by feline feces, respectively. There are other less frequent transmission routes, such as the transplacental route, being even rarer the transmission through

organ transplantation, blood transfusion and contaminated aerosols (Brazil, 2018). In Brazil, prevalence rates of toxoplasmosis are high, ranging from 37 to 91%, depending on the geographical area of the country (Chaves *et al.*, 2019). Epidemiological bulletins from the Ministry of Health Surveillance Secretariat have shown that approximately 50 to 80% of Brazilian women of childbearing age have antibodies against *Toxoplasma gondii*, which supports this prevalence as present in Brazilian reality (Brazil, 2019). In the Brazilian Amazon, toxoplasmosis is a frequent affection, presenting a seroprevalence above 70%, with the city of Belém-PA as an example, in which the general rates reach 78%, according to a study conducted with more than 2,700 individuals residing in the metropolitan area (Carmo, 2011). According to Bichara *et al.* (2012), there is a high incidence of congenital toxoplasmosis in the city of Belém-PA, with 10 positive cases expected per 10,000 newborns tested. In contrast, in other countries where screening programs have been implemented, an

incidence between 0.73 to 4.7 per 10,000 newborns tested was observed, among them Poland, Sweden, Italy, and Denmark. Most cases of toxoplasmosis are asymptomatic in its various clinical forms, even in congenital toxoplasmosis, and the cases that present with malformations are a minority. The mother-to-child transmission of toxoplasmosis is one of the main problems that we try to reduce as much as possible, especially by prioritizing early prenatal care and the necessary measures. It is important to define in the first trimester of pregnancy the serological status of these women: they are seronegative (IgM and IgG non reagent) and may develop a primoinfection, they present IgM and IgG reagent and would already have an acute infection in pregnancy, or the tests show IgM non reagent and IgG reagent, revealing previous contact with *T. gondii*, and in most cases there would be no risk to the ongoing pregnancy, except under the remote possibility of reactivation or reinfection (Maldonado; Read, 2017; Campoamor, 2021). In pregnant women affected by an acute primary infection the fetal morbidity will be proportional to gestational age, that is, the severity and transmission are inversely proportional to the trimesters, cases will be more severe when transmission occurs in the first trimester and the chance of transmission will be higher from the second and third trimesters. In any trimester fetal toxoplasmosis can occur (Teimouri *et al.*, 2020).

About 85% of newborns infected with congenital toxoplasmosis do not show clinical symptoms of the disease, causing late sequelae (Brazil, 2018). Regarding the clinical manifestations caused by congenital toxoplasmosis in symptomatic patients, we can highlight the lesions in the central nervous system, causing focal necrosis and inflammation, possibly resulting in hydrocephalus and calcifications, and retinochoroiditis, which can be bilateral or unilateral. There are also documented cases of mental retardation, deafness, microcephaly, convulsions, and psychomotor deficiencies, but these are rare cases. Spontaneous abortion, prematurity, and stillbirths can also occur during pregnancy (Durlach *et al.*, 2021). With the increase in the diagnosis of toxoplasmosis in pregnancy and the presence of outbreaks in Brazil, there was a greater mobilization of several institutions seeking to expand support for the study of the disease as a public health problem, the only information on the real magnitude of toxoplasmosis in the country came from prenatal serological data. Considered a neglected disease and with no mandatory notification, the official data were underreported. From the ordinance No. 204 of February 17, 2016, it became mandatory the notification of congenital toxoplasmosis and in pregnancy. However, still, the data do not reflect reality. In this context, within an area of high prevalence of the grievance, it was deemed important to evaluate these data after the period of mandatory notification to see the current scenario in the state of Pará.

Table 1. Spatial distribution, by municipalities, of cases of congenital toxoplasmosis reported in the State of Pará, northern Brazil, in the Amazon, between 2012-2021

Municipalities	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Grand total by municipality	Grand total by municipality %
Redenção	0	5	6	0	2	0	2	1	1	2	19	16,2%
Belém	1	0	0	0	3	3	3	3	5	0	18	15,4%
Paragominas	0	5	7	0	0	0	0	0	0	0	12	10,3%
Tucuruí	0	0	0	0	2	0	1	2	0	3	8	6,8%
Augusto Corrêa	0	2	1	0	1	0	0	0	0	0	4	3,4%
Marituba	0	0	0	0	0	0	0	2	0	1	3	2,6%
Bragança	0	0	0	0	0	0	0	1	0	2	3	2,6%
Parauapebas	0	0	0	0	0	0	1	1	0	1	3	2,6%
Others*	4	6	1	1	2	3	4	14	4	8	47	40,2%
Grand total by year	5	18	15	1	10	6	11	24	10	17	117	100%

Source: research protocol.

*Dom Eliseu, Capanema, Tailândia, Viseu, São Geraldo do Araguaia, Peixe-Boi, Santa Maria das Barreiras, Santana do Araguaia, Santarém, São Domingos do Araguaia, Tracuateua, Água Azul do Norte, Altamira, Ananindeua, Baião, Barcarena, Canaã dos Carajás, Conceição do Araguaia, Concórdia do Pará, Igarapé-Miri, Inhangapi, Irituia, Jacundá, Juruti, Marabá, Melgaço, Nova Ipixuna, Moju, Novo Repartimento, Oeiras do Pará, Oriximiná, Santa Cruz do Ariri.

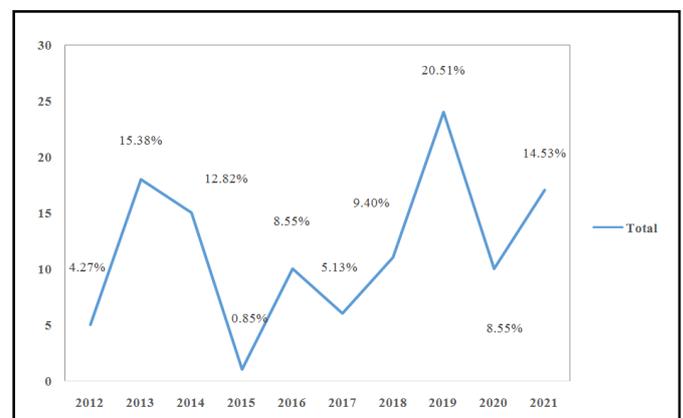
MATERIALS AND METHODS

This is a retrospective, observational, longitudinal study, conducted according to the ethical precepts in accordance with the National Research Ethics Committee (CONEP) of Brazil. The research

universe involved the cases notified of congenital toxoplasmosis in the period between 2012 and 2021 in the State of Pará, northern Amazon of Brazil. This area has an equatorial climate, with altitude below 200 meters, and is characterized as having a high prevalence of toxoplasmosis. The data used were made available by the State Department of Health Surveillance of the Health Secretariat of the State of Pará, Brazil. As variables were observed: the number of cases of congenital toxoplasmosis notified in the state, by municipalities, maternal data such as education, trimester of pregnancy in the period of notification and newborn races. Notified cases with incomplete information were excluded.

RESULTS

The annual evolution of the notifications of cases of congenital toxoplasmosis does not present a uniform pattern: 2013 (15.38%), 2014 (12.82%) 2015 (0.85%) 2016 (8.55%), 2017 (5.13%) 2018 (9.40%) 2019 (20.51%) 2020 (8.55%) and 2021 (14.53%), with emphasis on 2019, with 20.51% of the cases of the total of 117. (Figure 1).

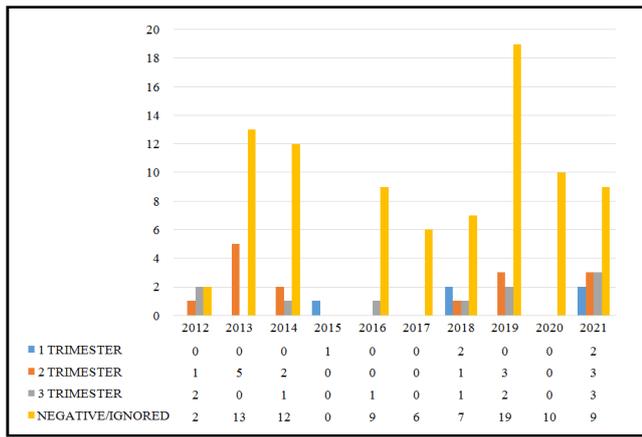


Source: research protocol.

Figure 1. Cases of congenital toxoplasmosis reported in the State of Pará, northern Brazil, in the Amazon, between 2012-2021

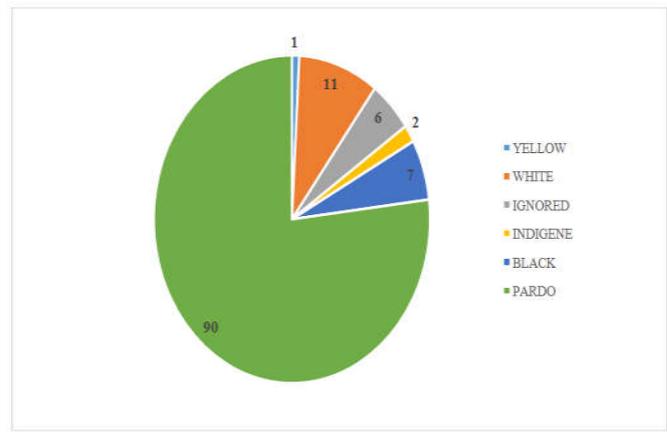
Of the 144 municipalities in the state, only 40 have official registered data. 117 cases were reported and are distributed among the eight main municipalities of occurrence: Redenção (19 cases, 16.2%), Belém (18 cases, 15.4%), Paragominas (12 cases, 10.3%), Tucuruí (8 cases, 6.8%), and others with an average of 1,667 cases (Table 1). As for diagnosis by trimesters of pregnancy, it was observed that 50%*

of cases were reported in the 2nd trimester, followed by the 3rd trimester with 33.3%*. (Figure 2) *considering the cases there was information recorded in the database. Regarding race, there was a predominance of pardo (90 cases, 76.92%), followed by white (11 cases, 9.40%), black (7 cases, 5.98%), ignored (6 cases, 5.13%), indigene (2 cases, 1.71%), and yellow (1 case, 0.85%), (Figure 3).



Source: research protocol.

Figure 2. Distribution of cases of congenital toxoplasmosis in Pará State, northern Brazil, in the Amazon, according to the gestational period of notification, between 2012-2021



Source: research protocol.

Figure 3. Distribution of cases of congenital toxoplasmosis reported in Pará State, northern Brazil, in the Amazon, according to race, between 2012-2021

Table 3. Distribution of cases of congenital toxoplasmosis reported in Pará State, northern Brazil, in the Amazon, according to maternal education, between 2012-2021.

Year	Complete Primary School	Incomplete Elementary School	Complete High School	Incomplete High School	Incomplete Higher Education	Ignored	Illiterate
2012		1	2	1		1	
2013	2	2	1			13	
2014		8				6	1
2015						1	
2016						10	
2017			1			5	
2018	2		1		1	7	
2019			2	3		19	
2020						10	
2021		2	1			14	

Source: research protocol

DISCUSSION

The attention to diagnosis and treatment of toxoplasmosis in the world is very uneven, especially where there is a higher prevalence rate, which are the tropical areas, including Brazil. Health policies are not institutionalized and there is no legal obligation to do so, unlike some countries such as Austria, France and others (Bénard *et al*, 2008). Thus, in a continental country like Brazil, with important regional differences, the management of attention to toxoplasmosis becomes more difficult, further contributing to the possibility of congenital toxoplasmosis, a result of lack of investment in the quality of prenatal care. In the context, aiming to mitigate these difficulties and facing outbreaks in the country, in addition to the maintenance of high prevalence, public institutions, scientific institutions and non-governmental institutions joining efforts, have achieved some milestones with an impact on the control of toxoplasmosis, such as the mandatory notification of cases in pregnancy and congenital form (Capobiango, 2016), diagnosis and treatment protocol (Brazil, 2018) and more recently the inclusion of congenital toxoplasmosis diagnosis in neonatal screening (Brazil, 2020). However, when the conquests of the legal landmarks arrive, not everything happens simultaneously, much less immediately. It is necessary that the states and especially the municipalities become aware and become conscious of the needs of such implementations, since, in Brazil, this level of care is municipalized. Hence the importance of verifying and following the named achievements, aware that despite the mandatory notification of gestational and congenital toxoplasmosis since 2016, the reality is still of great underreporting. In Pará between 2012 and 2021, 117 cases of congenital toxoplasmosis were reported, showing a high probability of underreporting, since the number of accompanied cases is much higher in maternal and childcare services. In the research conducted, it was observed that between 2012-2015, before the obligation, 39 cases were notified, and in the following period, in an

increasing way the remaining cases, prevailing in 2019 (24 cases), falling in 2020 probably under the impact of the COVID-19 pandemic and already showing recovery in 2021 (17 cases). Another problem in the state regarding the confrontation of the grievance is the lack of a proper form for the notification of congenital toxoplasmosis. As illustrated in the study by Capobiango (2016), having a specific form for the collection of notification data is fundamental for the follow-up of patients, control of cases, and establishment of prevention goals. Added to this, the low level of education of pregnant women regarding the prevention of the disease is a variable that is closely linked to the increasing number of cases, which may be related to the level of education of the population, because, despite the large number of non-filling of this information in the database, 46.6% (14 of the 30 filled), are mothers with incomplete elementary education to illiteracy, a result also found in the research of Moura (2018), in which 52% (22 pregnant women) had just over 4 years of study. According to Costa *et al.* (2011), women lack knowledge about basic means of prevention and expose themselves to the risks of toxoplasmosis transmission, such as the consumption of untreated water, consumption of raw or undercooked meat, and handling the cat litter box without adequate protection and this is due to the inefficient approach about the disease in prenatal care, showing that without the intervention of health education in this scenario, the chain of transmission will not be broken. The brown race was the race with the highest number of notifications, compatible with the profile of the region, unlike a similar evaluation by Marzola *et al.* (2021) in Santa Catarina, who did not observe such differences or predominance of races. Regarding the quarter of diagnosis, there was a deficiency of due to incomplete data in the notification, but the information shows that the second quarter was the period of greatest discovery of toxoplasmosis in Pará, contrary to what was observed in a study conducted in Cascavel-PR by Takanashi (2019), where the highest number of cases was diagnosed in the third quarter, considered the quarter of greatest risk for marmoset-fetal transmission (Brazil,

2018). In this first analysis conducted in Pará regarding the notification of congenital toxoplasmosis since 2016, it was observed that most cases are concentrated in 8 municipalities, but mainly between Redenção, Belém, and Paragominas, and that 104 municipalities did not notify any case, which does not match the cases seen in the reference services, where children from several other municipalities are under monitoring. Such observations are possibly related to better structuring of the health care networks in these municipalities, more and better training of professionals, among other factors. Thus, there is urgency for the complete implementation of congenital toxoplasmosis notification to control the growing number of cases and to avoid the severe consequences that affect newborns. Proper notification form, training of professionals for notification and health education for the population at risk, such as early intervention during prenatal care and awareness of treatment, as proposed by Gonçalves (2019), are fundamental to combat this grievance.

CONCLUSION

The spatial-temporal analysis of congenital toxoplasmosis in the State of Pará, Brazil, comprising a period before and after the ordinance of the Ministry of Health with the obligation of its notification showed the importance of this initiative to have the opportunity to estimate the magnitude of this public health problem with high prevalence in the country. It has already been possible to observe the increase in notifications, as well as the concentration of cases in 8 municipalities, in an erroneous way, leaving more than 100 municipalities without case records. However, even in the 117 notification forms it was notorious the lack of data for the analysis to be effective and represent the real state of the disease in the state to establish public health measures against the problem. In this sense, even in the face of the fragility of the information, it is expected that, from the knowledge of the research results, a greater mobilization of action plans can occur for the continuity of improvements in the prevention of congenital toxoplasmosis and, therefore, it is expected that new measures will be adopted, such as greater dissemination of its importance for fetal and neonatal health, as well as greater dissemination in health education.

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