Prevalence of seropositivity for toxoplasmosis in pregnant women in the Brazilian Federal District from 2014 to 2018

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Abstract

Toxoplasma gondii is found worldwide and infects up to one third of the world population, an infection that can be fatal to the fetus during pregnancy and in immunocompromised individuals. The prevalence of infection is variable in different countries, depending on its social and economic determinants. Considering the worldwide relevance of toxoplasmosis and its devastating effects in children infected during pregnancy, this study aims to estimate the prevalence of seropositivity for toxoplasmosis in pregnant women from the Federal District of Brazil, from January 2014 to December 2018. This is a retrospective study that included a historical series of 170,678 pregnant women screened by the Pregnant Women Protection Program (PWPP). The coverage of the Program was around 70%, being considered very good, since people seek assistance in the private service or face other types of barriers to access. The global prevalence of toxoplasmosis in pregnant women was 90,566 (53.21%; 95% CI 52.97-53.44). In the time course of the sample, the prevalence of toxoplasmosis infection dropped from 81.84% in 2014 to 38.65% in 2018. The prevalence of toxoplasmosis was higher in pregnant women aged 20 to 30 years. Another important factor was that the number of pregnancies and abortions also influenced, proportionally, the prevalence. This data indicates that the number of identified cases was similar to those observed in other countries and other regions in Brazil. However, over time, it showed a significant drop that may be due to the implementation of the PWPP in the current molds, based on public policies to protect pregnant women and newborns.

Key words: Toxoplasmosis; Prevalence; Seropositivity; Pregnant women.

Introduction

The protozoan *Toxoplasma gondii* is found worldwide. Felines are the only definitive host, while other warm-blooded animals, including humans, are intermediate hosts for the parasite [1–3]. Toxoplasma infects up to a third of the world's population and the infection can be fatal to the fetus during pregnancy and in immunocompromised individuals.

The main routes of transmission to humans are ingestion of contaminated raw or undercooked meat, contaminated unpasteurized milk, food or water with oocysts from cat feces, or vertical transmission via transplacental tachyzoites [2, 5-7]. Beef and lamb are known to be the most common sources of food-related *T. gondii* infections [2]. Injuries with sharp perforations, blood transfusions and organ transplants are also possible risk factors for infection [4].

The disease is asymptomatic in most patients. However, in the congenital form, the sequelae in the fetus can be severe and irreversible. Some babies infected with the parasite in an intrauterine form can be born without complications but present changes during the first year of life, in childhood or even in adulthood. Among the clinical evidence, the following stand out: brain calcifications, chorioretinitis, blindness, delayed neuropsychomotor development, microcephaly, hydrocephalus, bulging fontanelle, meningoencephalitis, strabismus, hepatosplenomegaly, rash, petechiae, jaundice and pneumonia [8-12].

The WHO (World Health Organization) estimates that more than half of the world's population is infected, however, most individuals are asymptomatic and do not develop the disease [17]. The prevalence of infection can vary for each country, depending on its social and economic determinants [19, 24, 25]. In Brazil, the prevalence indicators for antibodies to toxoplasmosis vary widely, from 54% to 80%, with an equal distribution in both sexes, seroprevalence that increases with age and depends on different factors that influence its epidemiology. [18-20, 24, 25].

During prenatal diagnosis, serological screening can be performed, enabling the identification of patients susceptible to primary prevention. It also allows the detection of acute *T. gondii* infection and guides treatment to reduce the likelihood of fetal transmission, which is close to 40% in untreated women. The incidence of fetal infection is higher when the disease is acquired in the third trimester of pregnancy compared to the first trimester, but the severity of the involvement is greater when the maternal infection occurs in the first trimester [13-16].

The complications that occur during pregnancy present a serious public health problem in Brazil and worldwide. However, as mitigating factors, there are several support programs developed by the various spheres of health care, which aim to reduce the rate of morbidity and mortality. One of these is the Pregnant Women Protection Program (PWPP), also known as the Mommy Test or Prenatal Screening, which is carried out at the health unit where the pregnant woman is registered, with the main objectives of preventing, diagnosing and guiding on several types of illnesses during pregnancy, reducing the risk of mortality and sequelae for mothers and their babies. [21, 22].

Considering the worldwide relevance of toxoplasmosis and its devastating effects on infected children during pregnancy, this study aims to estimate the prevalence of seropositivity for toxoplasmosis in pregnant women from the Federal District of Brazil from January 2014 to December 2018.

Materials and methods

This is a retrospective study that included a historical series of 170,678 pregnant women screened by the Pregnant Women Protection Program (PWPP) in the Federal District of Brazil between years 2014 to 2018. The PWPP was created following the model of the Humanization Program Before and after Birth implemented by the Ministry of Health of Brazil.

Every woman has the right to assistance during pregnancy, prenatal care, delivery and after delivery. In this sense, the Ministry of Health prepared the pregnant woman's handbook, which aims at a humanized and non-exclusive reception, providing the basis for the pregnant woman protection program. The safety of the patient in this extended path is something crucial, since the booklet is the document of the pregnant woman, where it contains all the information about her pregnancy, guidelines and the care that must be taken along this long-winded path [23].

The Pregnant Women Protection Program (PWPP) in the Federal District of Brazil performs 12 basic exams during prenatal care, diagnosing, among others, Chagas disease / trypanosomiasis, hepatitis B, hepatitis C, HTLV, rubella, syphilis and toxoplasmosis. Screening tests are performed using dried blood drops stored on filter paper, a technique validated by Gómez and collaborators [23]. Blood samples of pregnant women were obtained via digital puncture with disposable lancets, collected on filter paper (S and S903) and dried at room temperature. In the laboratory, dried blood samples were eluted from the filter paper.

During primary infection the body produces IgM antibody against the infectious agent, but there is no production of IgM for long periods, as there is a process of changing the antibody class that changes from IgM to IgG, that is, after a three months we have a reduction in the concentration of antibody of the IgM class, until it is no longer secreted by the plasma cells or is released in a residual form for up to one year. Consequently, the antibody changes classes, with the production of the IgG antibody (which is observable during chronic infection / exposure) and this is characterized as an immunological memory tool, being produced for life (acquired immunity). The purpose of the test is to find out if there is a recent infection or if the pregnant woman has been in contact with the parasite in the past. According to the serological profile presented by the individual, the stage of the infection (acute or chronic) can be determined.

The diagnosis is based on direct and indirect methods. Commonly, the indirect method is performed in primary serological screening, being performed for both the IgG and IgM antibodies *T. gondii* using the Elisa method (immunoenzymatic assay). The exam is done at the beginning of the 1st trimester of pregnancy (IgM and IgG) [24-27].

In order to estimate the prevalence of toxoplasmosis in pregnant women, the presence of positive IgG and / or IgM was considered.

Ethical Considerations

This study is a continuation of the research “Prevalence of diseases screened in the Pregnant Women Protection Program of the State of Mato Grosso do Sul between 2004 and 2007” approved by the Research Ethics Committee of CEP / UFMS (Protocol No. 1046).

Data analysis

Initially, frequencies were calculated to identify duplications and typos. Duplicate and / or inconsistent records (0.3%) were discarded. The selected variables were: age of the pregnant woman, trimester of pregnancy at the time of the exam, number of reports of spontaneous abortions, type of delivery and number of previous pregnancies. The patients were divided into five age groups: 1 (≤ 14 years old), 2 (15-19 years old), 3 (20-29 years old), 4 (30-39 years old) and 5 (40 years old or more). The data were organized using Excel ™ spreadsheets and the descriptive measures were calculated using EpiInfo software version 6.4, EpiInfo 2000 version 3.2.2v, and ArcView GIS version 3.3. The coverage of pregnant women screened by PWPP in the total population was calculated using the expected rate for pregnant women according to Ordinance No. 650 of October 5, 2011 from the Ministry of Health of Brazil, where information was collected on the number of live births in each year plus 10%. Global prevalence (from 2014 to 2018) and per year was estimated; for that, we used data from pregnant women positive for toxoplasmosis divided by the total number of pregnant women screened multiplied by 100, both globally and per year, with a 95% confidence interval. The proportions of toxoplasmosis positivity in the variables mentioned above were also compared for positive and negative pregnant women using the gross Odds Ratio (OR) with a 95% Confidence Interval (CI).

Results

This study analyzed the prevalence of toxoplasmosis using data from the Pregnant Woman Protection Program in the Federal District from 2014 to 2018. In this period, 170,698 pregnant women were screened, and 480 (0.3%) were excluded from the data analysis due to duplicity and / or inconsistencies in the data (Figure 1). Thus, there was a coverage of 69.38% of the total pregnant women expected for the period, with 2016 being the year with the highest coverage (77.54%, 37042 patients) and the year 2017 with the lowest coverage (59.86 %, 29,348 patients) (Table 1).

Figure 1. Flowchart of the screening carried out by the Pregnant Women Protection Program (PWPP) of the Federal District of Brazil in the years 2014 to 2018.

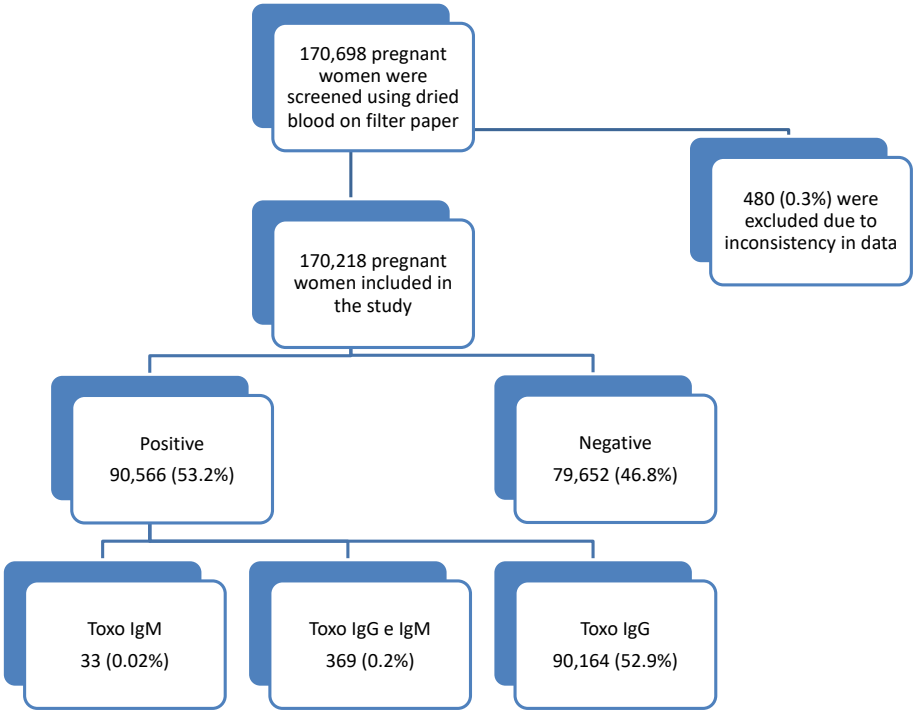
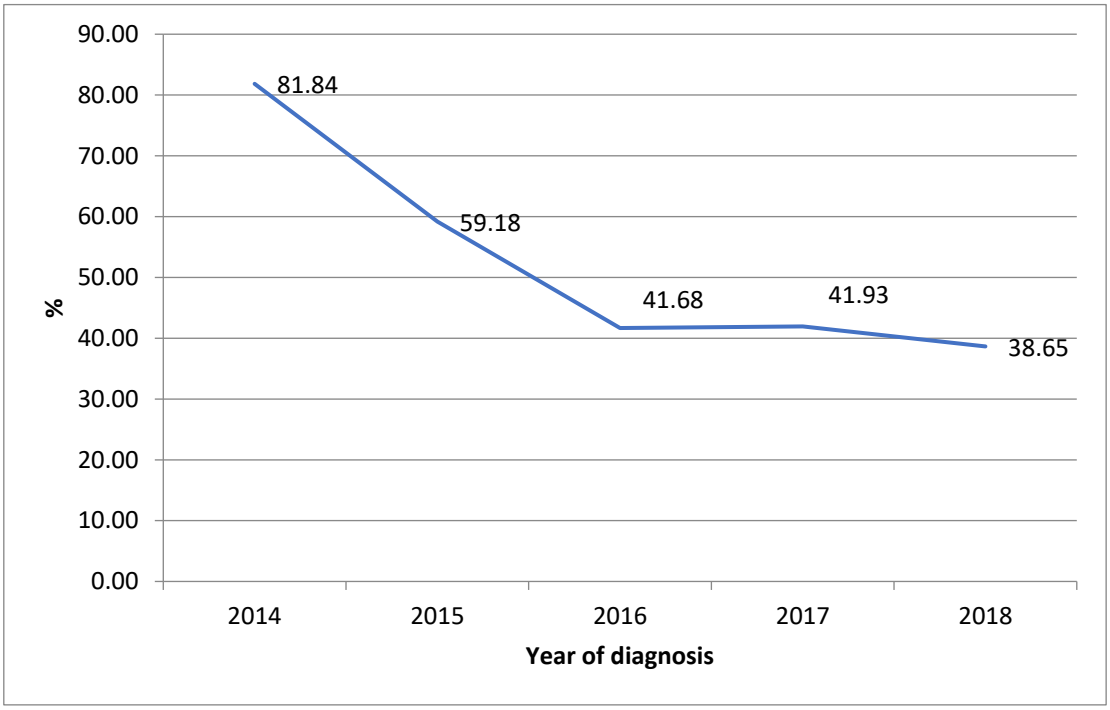


Table 1. PWPP coverage of the Federal District of Brazil in the years 2014 to 2018.

Year	Born Alive	Estimate of Pregnant Women for the Year	Pregnant women screened by PWPP	PWPP Coverage %
2014	44721	49193	35322	71,80
2015	46122	50734	36217	71,39
2016	43430	47773	37043	77,54
2017	44568	49025	29348	59,86
2018	44193	48612	32288	66,42
Total	223034	245337	170218	69,38

Of the 170,218 patients examined, 33 (0.02%) were only IgM positive for toxoplasmosis, 369 (0.2%) IgM and IgG positive, and 90,164 only IgG positive, resulting in an overall prevalence of 90,566 (53.21%; 95% CI 52.97-53.44) (Figure 1). When we analyzed the prevalence over time, there was a sharp drop over the years, starting in 2014 with 81.84% (95% CI 81.43-82.24), 2015 59.18% (95% CI 58, 67-59.68), 2016 41.68% (95% CI 41.18-42.19), 2017 41.93% (95% CI 41.37-42.50) and 2018 38.65% (95% CI 38 , 12-39,18) (Figure 2).

Figure 2. Prevalence of Toxoplasmosis in Pregnant Women Screened by the Protection Program in the Federal District of Brazil in the years 2014 to 2018.



About 81% of toxoplasmosis cases were concentrated in the 20 to 39 age group. However, when comparing positive and negative pregnant women in relation to the age group, it was observed that the greater the age, the greater the chance of the pregnant woman having a positive diagnosis for toxoplasmosis; the age group ≤ 14 years old with an OR 0.74 (95% CI 0.67-0.82) and the greater than or equal to 40 years old with an OR 1.52 (95% CI 1.44-1.61) (Table 2).

Regarding the number of previous pregnancies, it was observed that women who were in their first pregnancy had a lower chance of having a positive diagnosis for toxoplasmosis (OR 0.82; 95% CI 0.80-0.84). In contrast, those who had three or more pregnancies had an OR of 1.52 (95% CI 1.48-1.56) (Table 2).

Table 2. Characteristics of Pregnant Women Screened by the Protection Program in the Federal District of Brazil in the Years 2014 to 2018.

Characteristics		Positive		Negative		OR	CI95%
		N	%	N	%		
Age in Years	<= 14	727	0,8	860	1,1	0,74	0,67-0,82
	15 a 19	12784	14,3	15533	19,8	0,68	0,66-0,69
	20 a 29	43142	48,3	40737	52,0	0,87	0,85-0,88
	30 a 39	29337	32,9	19314	24,7	1,50	1,46-1,52
	>= 40	3263	3,7	1905	2,4	1,52	1,44-1,61
Gestation	1	36219	40,0	35702	44,8	0,82	0,80-0,84
	2	16543	18,3	13950	17,5	1,05	1,02-1,08
	>= 3	20450	22,6	12821	16,1	1,52	1,48-1,56
	Did not Inform	17354	19,2	17179	21,6	0,86	0,84-0,88

Abortions	None	46310	51,1	44540	55,9	0,82	0,81-0,84
	1	8505	9,4	6146	7,7	1,24	1,20-1,28
	2	1699	1,9	1085	1,4	1,34	1,28-1,50
	>= 3	523	0,6	344	0,4	1,34	1,20-1,53
	Did not Inform	33529	37,0	27537	34,6	1,11	1,09-1,13
Cesarean	None	50843	56,1	49173	61,7	0,79	0,78-0,81
	1	3594	4,0	2367	3,0	1,34	1,28-1,42
	>= 2	963	1,1	559	0,7	1,52	1,37-1,69
	Did not Inform	35166	38,8	27553	34,6	1,20	1,18-1,22

Pregnant women who reported never having an abortion were less likely to have a positive diagnosis for toxoplasmosis (OR 0.82; 95% CI 0.81-0.84). On the other hand, the greater the number of abortions reported by women, the greater the chance of having toxoplasmosis, reaching an OR of 1.34 (95% CI 1.20-1.53) in pregnant women who had 3 or more abortions (Table 2).

Discussion

This study detected a global prevalence of toxoplasmosis of 53.21% (95% CI 52.97-53.44) in pregnant women screened by the PWPP in the Federal District of Brazil between the years 2014 to 2018. This result is in accordance with global data and national, since the World Health Organization (WHO) estimates that more than half of the world population is infected, this prevalence being conditioned to the social and economic determinants that differentiate countries [19, 24, 25]. According to studies in Brazil, the prevalence indicators for antibodies to toxoplasmosis vary from 54% to 80% [18-25].

The prevalence of toxoplasmosis infection, studied here, decreased over the period studied: from 81.84% in 2014 to 38.65% in 2018. Considering that before 2014 there was no a such program implemented in the Federal District, it can be suggested that this decrease is influenced by the measures adopted by the PWPP, including: prevention, diagnosis and guidance on the various types of diseases still in pregnancy, thus reducing the risks of morbidity and mortality in pregnant women and their babies. [21, 22].

The coverage of the Pregnant Women Protection Program in the Federal District of Brazil was around 70% between 2014 and 2018. This coverage can be considered good since many people seek care in the private service. Furthermore, studies show barriers in assistance, such as failures, difficulties in access, late start, inadequate number of consultations and incomplete procedures, factors that directly interfere with the effectiveness of the program [28].

The prevalence of toxoplasmosis was higher in pregnant women aged 20 to 30 years. Most pregnant women in Brazil are in this age group, a factor that could explain the high prevalence in this age group. However, when the chance of having anti-*Toxoplasma gondii* antibodies is analyzed, the study shows that it is higher in pregnant women over 40 years of age (OR = 1.52 95% CI 1.44-1.61). It is known, however, that in any infectious disease, the longer one lives, the greater the chance of being exposed to the infectious agent.

Another important aspect that the study indicated was that the number of pregnancies and abortions also influenced, proportionally, the prevalence. Women in the first pregnancy had OR 0.82 (95% CI 0.80-0.84) while those who had three or more pregnancies showed OR 1.52 (148-1.56). Pregnant women who reported never having an abortion had a chance of OR 0.82 (95% CI 0.81-0.84), while pregnant women who had three or more abortions the chance was OR 1.34 (95% CI 1, 20-1.53). However, one must take into account the fact that this study is observational and uses secondary data; therefore, it has some limitations due to the absence of complementary data regarding these pregnant women, thus not allowing a more robust analysis to infer whether these variables are actually associated or not.

Conclusion

This study analyzed the prevalence of toxoplasmosis using data from the Pregnant Woman Protection Program in the Federal District from 2014 to 2018. The data revealed that the number of cases identified, in this period, was similar to what occurs in the world and other regions of Brazil. Over time, the number of cases has dropped significantly, which may have occurred due to the implementation of the protection program for pregnant women along the current lines. Therefore, this program, associated with other public policies for the protection of pregnant women and newborns, must be expanded so that this serious public health problem can be alleviated.

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