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Occurrence of anti-*Toxoplasma gondii* antibodies in pregnant women in a municipality in the Sertão region of Paraíba

Ocorrência de anticorpos anti-Toxoplasma gondii em gestantes em um município do Sertão da Paraíba

Presencia de anticuerpos anti-Toxoplasma gondii en gestantes de un municipio del sertão de Paraíba

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Abstract:
Toxoplasmosis is an important public health concern during pregnancy due to the risk of congenital transmission and its potential consequences for the fetus. This study aimed to determine the occurrence of anti-*Toxoplasma gondii* antibodies among pregnant women receiving primary health care in a municipality located in the sertão region of Paraíba, Brazil, to identify dietary habits and potential factors associated with exposure to the parasite, and to conduct a health education intervention. This descriptive, exploratory, quantitative, cross-sectional study included 50 pregnant women receiving prenatal care at six Family Health Strategy units, selected through non-probability convenience sampling. Data were obtained using a semi-structured questionnaire and IgG and IgM serological test results and were analyzed using IBM SPSS Statistics 27. Serological analysis showed reactive IgG in 8% of the pregnant women, while 92% had a serological profile consistent with susceptibility to *T. gondii* infection. No reactive IgM results were identified. Practices and conditions potentially associated with exposure involving food, water, and environmental factors were observed, as well as a low frequency of counseling on toxoplasmosis during prenatal care. Significant associations were found between area of residence and water treatment and between having heard of the disease and receiving counseling during prenatal care. The findings provide relevant epidemiological information and reinforce the importance of serological monitoring combined with preventive counseling during prenatal care.

Keywords: Primary Health Care. Pregnancy. Prenatal. Public Health. Toxoplasmosis.

Resumo:
A toxoplasmose constitui um importante problema de Saúde Pública durante a gestação, devido ao risco de transmissão congênita e às possíveis repercussões para o feto. Este estudo teve como objetivo determinar a ocorrência de anticorpos anti-*Toxoplasma gondii* em gestantes atendidas na Atenção Primária à Saúde em um município do sertão da Paraíba, identificar hábitos alimentares e possíveis fatores de exposição ao parasito e realizar uma ação de Educação em Saúde. Trata-se de um estudo descritivo, exploratório, quantitativo e transversal, realizado com 50 gestantes acompanhadas em seis Unidades de Saúde da Família (USF), selecionadas por amostragem não probabilística por conveniência. Os dados foram obtidos por meio de questionário semiestruturado e resultados sorológicos para IgG e IgM, sendo analisados no IBM SPSS Statistics 27. A análise sorológica demonstrou IgG reagente em 8% (4/50) das gestantes, enquanto 92% (46/50) apresentaram perfil sorológico compatível com suscetibilidade à infecção por *T. gondii*. Não foram identificados resultados reagentes para IgM. Foram observadas práticas e condições de possível exposição relacionadas à alimentação, à água e ao ambiente, além de baixa frequência de orientações sobre toxoplasmose durante o pré-natal. Houve associação significativa entre zona de residência e tratamento da água, e entre ter

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ouvido falar sobre a doença e receber orientações no pré-natal. Os achados fornecem informações epidemiológicas relevantes e reforçam a importância do acompanhamento sorológico associado às orientações preventivas durante o pré-natal.

Palavras-chave: Atenção Primária à Saúde. Gravidez. Pré-natal. Saúde Pública. Toxoplasmose.

Resumen:
La toxoplasmosis constituye un importante problema de salud pública durante la gestación debido al riesgo de transmisión congénita y a sus posibles repercusiones para el feto. Este estudio tuvo como objetivo determinar la presencia de anticuerpos anti-*Toxoplasma gondii* en gestantes atendidas en la Atención Primaria de Salud de un municipio del sertão de Paraíba, identificar hábitos alimentarios y posibles factores de exposición al parásito y realizar una acción de Educación en Salud. Se trata de un estudio descriptivo, exploratorio, cuantitativo y transversal, realizado con 50 gestantes atendidas en seis Unidades de Salud de la Familia (USF), seleccionadas mediante muestreo no probabilístico por conveniencia. Los datos se obtuvieron mediante un cuestionario semiestructurado y resultados serológicos de IgG e IgM, y se analizaron en IBM SPSS Statistics 27. El análisis serológico mostró IgG reactiva en el 8% (4/50) de las gestantes, mientras que el 92% (46/50) presentó un perfil serológico compatible con susceptibilidad a la infección por *T. gondii*. No se identificaron resultados reactivos para IgM. Se observaron prácticas y condiciones de posible exposición relacionadas con la alimentación, el agua y el ambiente, además de una baja frecuencia de orientaciones sobre toxoplasmosis durante la atención prenatal. Hubo asociación significativa entre zona de residencia y tratamiento del agua, y entre haber oído hablar de la enfermedad y recibir orientaciones durante la atención prenatal. Los hallazgos aportan información epidemiológica relevante y refuerzan la importancia del seguimiento serológico asociado con orientaciones preventivas durante la atención prenatal.

Palabras clave: Atención Primaria de Salud. Embarazo. Atención prenatal. Salud pública. Toxoplasmosis.

1. Introduction

Toxoplasmosis is a zoonosis with a worldwide distribution, caused by *Toxoplasma gondii*, a parasite that infects several species of homeothermic animals, including humans (CDC, 2025; Kochanowsky; Koshy, 2018). A considerable proportion of the world's population is believed to have already come into contact with the parasite, highlighting its epidemiological relevance (Rahmanian et al., 2020). The parasite's life cycle involves intermediate and definitive hosts, with domestic and wild felids considered essential hosts for its persistence in the environment (Dubey, 2013).

Human infection occurs mainly through the ingestion of contaminated water or food, such as raw or undercooked meat (Dubey, 2021; Ferreira et al., 2019). Although most infected individuals do not develop symptoms, the parasite can spread to different tissues, causing

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various clinical manifestations, especially in immunocompromised people (Lima; Lodoen, 2019). Transplacental transmission is also noteworthy, as it can result in congenital toxoplasmosis and cause problems for the fetus and newborn (Chavez et al., 2020).

During pregnancy, infection takes on particular importance, since transmission can have serious consequences, such as miscarriage, fetal death, and neurological, visual, and hearing abnormalities in the newborn (Jadjischi et al., 2024). The risk of transmission to the fetus varies throughout pregnancy and is generally considered higher in later stages, although early infection is associated with the most severe forms of the disease (Blaszkowska; Góralska, 2014). Thus, prenatal follow-up, combined with serological testing and preventive measures, is essential for early identification and control of infection (Brasil, 2022).

T. gondii infection represents an important public health problem, especially in tropical and developing countries, where environmental, socioeconomic, and cultural factors influence disease occurrence (Pappas; Roussos; Falagas, 2009). In Brazil, high seroprevalence is observed in the population, indicating widespread circulation of the parasite (Walcher; Comparsi; Pedroso, 2016). In northeastern Brazil, seroprevalence studies reveal substantial proportions of pregnant women susceptible to infection, highlighting an increased risk of gestational and congenital toxoplasmosis (Silva; Diniz; Barbosa, 2025).

Toxoplasmosis surveillance in Brazil prioritizes notification of cases in pregnant women and congenital cases, with Primary Health Care (PHC) playing a fundamental role in screening, diagnosis, notification, and educational activities (Brasil, 2018).

In this context, generating information at the local level can help expand epidemiological knowledge and guide care practices aimed at pregnant women. This study aimed to determine the occurrence of anti-*Toxoplasma gondii* antibodies in pregnant women receiving Primary Health Care in a municipality in the sertão region of Paraíba, identify dietary habits and potential factors associated with exposure to the parasite, and carry out a Popular Health Education activity on toxoplasmosis.

2 Theoretical framework

2.1 *Toxoplasma gondii* and general aspects of toxoplasmosis

Toxoplasmosis is a zoonotic infectious disease with a worldwide distribution, caused by the protozoan *Toxoplasma gondii*. It is an obligate intracellular parasite belonging to the phylum Apicomplexa and the family Sarcocystidae, capable of causing systemic changes in different

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hosts, including birds and mammals (Dubey; Petersen, 2005). A significant proportion of the world's population is estimated to have been exposed to the parasite, revealing its wide distribution and epidemiological importance (Rahmanian et al., 2020).

T. gondii has three infectious developmental stages: tachyzoites, bradyzoites, and sporozoites. Tachyzoites represent the rapidly multiplying, systemic form in the host, corresponding to the acute phase of infection. Bradyzoites are found in tissue cysts, structures that allow the parasite to persist for prolonged periods and characterize the chronic phase of infection. Sporozoites are present in oocysts, which are shed into the environment and become infectious after sporulation in the environment (Mineo; Vitor, 2016).

The life cycle of *T. gondii* is heteroxenous, involving intermediate hosts such as humans, birds, and other mammals, and definitive hosts, mainly felids such as domestic cats (*Felis catus*). In intermediate hosts, the parasite undergoes its asexual phase, whereas the sexual phase occurs only in definitive hosts (Dubey, 2010; Tenter; Heckeroth; Weiss, 2000).

The parasite exhibits genetic diversity and is divided into strains that vary in their degree of virulence. Traditionally, three main lineages are recognized, classified as types I, II, and III (Howe; Sibley, 1995). Type I is associated with greater virulence, whereas types II and III are associated with milder clinical presentations. However, more recent studies have shown that the genetic variability of *T. gondii* is significantly greater than previously estimated (Chikweto et al., 2022; Vieira; Duarte; 2023).

T. gondii can be transmitted mainly through the ingestion of raw or undercooked meat containing tissue cysts, unpasteurized milk, and water, fruits, and vegetables contaminated with oocysts. These foods may become contaminated by oocysts shed in felid feces, which contaminate soil and water sources. The oocysts can adhere to food and be ingested when it is not properly cleaned. Infection can therefore also occur through contact with contaminated soil during activities such as gardening or handling cat litter boxes, especially when personal hygiene practices are inadequate (Dubey, 2021; Ferreira et al., 2019; Breganó; Mori; Navarro, 2010).

Less frequently, transmission may occur through blood transfusion and organ transplantation (Siegel et al., 1971; Boin et al., 2023; Paduan, 2017). Transplacental transmission is also noteworthy and occurs when *T. gondii* crosses the placental barrier during pregnancy, potentially resulting in congenital toxoplasmosis. This condition is characterized by fetal infection and possible clinical manifestations in the newborn (Bichara; Andrade; Lago, 2014; Jadjischi et al., 2024).

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Felids can become infected mainly by ingesting sporulated oocysts or tissue cysts present in the environment, prey, or contaminated meat. As the parasite's sexual phase occurs in these animals, infectious oocysts are shed in their feces. This process promotes the genetic variability of *T. gondii*, contributing to the maintenance of the disease transmission cycle (Dubey, 2005; Portilho; Carvalho, 2019). In this context, rodents may stand out as important intermediate hosts because of their predator–prey relationship with felids (Melchor; Ewald, 2019).

After infection, *T. gondii* invades host cells and spreads throughout the body, potentially affecting various tissues and organs, such as the brain, muscles, and liver, where the parasite can remain for long periods (Tong et al., 2021). Clinical manifestations vary according to the host's immune status and the tissues affected, ranging from asymptomatic infection to signs of varying intensity, such as flu-like symptoms, fever, lymphadenopathy, ocular abnormalities with significant visual impairment, and neurological changes (Montoya; Liesenfeld, 2004; Arruda et al., 2021; Souza et al., 2023).

Toxoplasmosis is therefore highly relevant to public health, especially in pregnant women because of congenital toxoplasmosis, and in immunocompromised individuals, such as HIV-positive patients or those receiving immunosuppressants, in whom infection may be asymptomatic or severe (Dubey, 2010; Bastos; Silva; Fagundes, 2025; Dian; Ganiem; Ekawardhani, 2022).

2.1 Toxoplasmosis during pregnancy and its implications

Although *Toxoplasma gondii* infection is commonly asymptomatic or causes nonspecific clinical manifestations in most people, it is highly relevant when it occurs during pregnancy. At this stage, maternal infection is important because the parasite can be transmitted from mother to fetus through the placenta, resulting in congenital toxoplasmosis. This condition can cause significant harm to the fetus, making prenatal follow-up essential for detection and appropriate treatment of the disease (Montoya; Remington, 2008; Jadjischi et al., 2024).

In general, the risk of fetal transmission of *T. gondii* is higher in the second half of pregnancy because of changes in the placenta, whereas early infection tends to be associated with greater clinical severity (Blaszkowska; Góralska, 2014; Dubey et al., 2021). Recent studies confirm this pattern, indicating variation in the distribution of diagnoses across trimesters, with a smaller proportion of cases identified in the first trimester and a greater frequency in the second and third trimesters (Carvalho et al., 2025; Chaves et al., 2024).

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Because maternal infection can result in transmission of the parasite to the fetus, congenital toxoplasmosis can cause miscarriage and fetal death, as well as clinical manifestations that may appear after birth or later, such as neurological disorders (hydrocephalus, microcephaly, and intellectual disability), visual deficits (chorioretinitis and blindness), and hearing deficits (deafness), which may also manifest during adulthood (Gangneux; Dardé, 2012; Oliveira et al., 2024).

In Brazil, the Ministry of Health recommends diagnosis through IgM (immunoglobulin M) and IgG (immunoglobulin G) serology with assessment of IgG avidity during the first trimester of pregnancy, using other methods, such as PCR (polymerase chain reaction), according to each case's needs and laboratory availability. These tests allow the identification of susceptible pregnant women or those with acute infection, with the aim of identifying the disease (Montoya; Remington, 2008; Brasil, 2018).

Negative IgM and positive IgG results indicate past infection; when both are negative, the pregnant woman is considered susceptible. When IgM is positive, acute infection is suspected, and in cases with positive IgM and IgG, an IgG avidity test is performed: low avidity indicates recent infection, whereas high avidity suggests an older infection (Bártholo et al., 2015). Studies indicate that most cases of gestational toxoplasmosis are identified through laboratory testing, with diagnoses based solely on clinical symptoms being less frequent, reinforcing the relevance of serological screening in asymptomatic pregnant women (Elias et al., 2025).

Appropriate prenatal follow-up, combined with serological testing and proper interpretation of results, is therefore essential for early disease identification. Guidance on the main preventive measures, such as personal, environmental, and food hygiene, is also important in reducing the risk of infection during pregnancy (Brasil, 2022; Paim; Durigon, 2024).

2.1 Toxoplasmosis as a public health problem

Toxoplasma gondii infection is considered an important public health problem worldwide, especially in tropical and developing countries. Infection varies between regions and may be influenced by environmental, cultural, and socioeconomic factors (Pappas; Roussos; Falagas, 2009; Gangneux; Dardé, 2012). In Brazil, studies indicate high seroprevalence of antibodies against *T. gondii* in the adult population. This characteristic demonstrates the parasite's widespread circulation in the country and frequent exposure among different population groups (Walcher; Comparsi; Pedroso, 2016).

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The parasite's genetic diversity has important public health implications, since different strains are commonly associated with different levels of virulence and clinical severity. In Brazil, toxoplasmosis tends to present in more severe forms than in North American and European countries, probably because of the greater diversity of genotypes in South America. Strains with lower genetic variability predominate in those other regions, whereas atypical strains, frequently associated with greater virulence, are more prevalent in Brazil. This condition contributes to more severe clinical presentations (Bessa et al., 2023).

In the sertão region of Paraíba and other northeastern municipalities, studies have shown substantial percentages of pregnant women susceptible to primary infection. In Cuité, Paraíba, approximately 66% of pregnant women were seronegative (IgG−/IgM−), demonstrating high vulnerability to toxoplasmosis during pregnancy (Silva; Barbosa, 2025). In Campina Grande, Paraíba, 79.1% of pregnant women had negative serology, whereas 20.9% were IgG-positive (Ferreira et al., 2020).

In Jaçanã, Rio Grande do Norte, 59% of pregnant women were IgG-positive and IgM-negative, indicating previous immunity, whereas 40.4% were susceptible, highlighting the importance of screening through serological testing and strengthening preventive measures during prenatal care (Freitas et al., 2017). Congenital toxoplasmosis is also one of the most concerning forms of the condition in Brazil, with several cases reported between 2019 and 2023, particularly in children under one year of age (Matos et al., 2024).

Seroprevalence studies indicate that livestock such as cattle, goats, and pigs may be infected, posing a consumption-related risk to the most vulnerable groups (Almeida et al., 2015; Gomes et al., 2020; Batista et al., 2022). Consumption of game meat also represents an important risk, because wild animals act as reservoirs of pathogens such as *T. gondii* and are not subjected to sanitary inspection, potentially increasing the frequency of gestational and congenital toxoplasmosis cases (Borbulhosa et al., 2026).

Socioenvironmental factors also influence toxoplasmosis transmission, especially in contexts of inadequate sanitation or problems with water quality and distribution, which are associated with disease incidence (Silva, 2025). The outbreak in Santa Maria, Rio Grande do Sul, in 2018 stands out as one of the largest ever reported, with hundreds of cases, including pregnant women and congenital toxoplasmosis cases. Epidemiological investigation indicated an association with environmental contamination by *T. gondii*, especially in the water distribution network of city neighborhoods (Fernandes et al., 2023).

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Regarding disease monitoring in Brazil, toxoplasmosis was included in the list of notifiable diseases in 2010, subsequently removed in 2014, and reintroduced in 2016 (Brasil, 2010; 2014; 2016). Unlike other diseases, toxoplasmosis is not subject to compulsory notification in the entire population. Notification therefore focuses on pregnant women, newborns with suspected congenital infection, and confirmed outbreaks (Brasil, 2018). In 2020, neonatal screening was also expanded to include identification of congenital toxoplasmosis through the heel-prick test (Brasil, 2020).

Primary Health Care (PHC), through the Family Health Strategy (FHS), acts as the gateway for identifying cases, with serological testing during prenatal care as the main monitoring strategy, together with correct entry of data into the Notifiable Diseases Information System (SINAN) (Brasil, 2018; Paraíba, 2024). Educational activities in PHC aimed especially at pregnant women are therefore important, as they help identify risk behaviors, encourage preventive measures, and strengthen shared responsibility between health services and the population (Gomes et al., 2023; Borges; Barreto, 2024).

2. Materials and methods

This descriptive and exploratory study, with a quantitative approach and cross-sectional design, was conducted in the municipality of Santa Luzia, located in the sertão region of the state of Paraíba, at central geographical coordinates 06°52′19″ S and 36°55′08″ W. The municipality has a population of 14,959 inhabitants, according to the Brazilian Institute of Geography and Statistics (IBGE, 2022), and the research was conducted in six Family Health Units (FHUs).

The sample consisted of 50 pregnant women of different age groups and gestational trimesters receiving prenatal care at the participating FHUs, selected through non-probability convenience sampling. Inclusion criteria comprised pregnant women at any gestational stage who were present during data collection, agreed to participate by signing the Informed Consent Form (TCLE) and, when applicable, the Minor Assent Form (TAM), and were able to answer the instrument. Women who were not receiving prenatal care at the units, declined to participate, or were unable to answer the questionnaire were excluded.

Data collection took place between August and September 2026 through individual interviews conducted in a private setting at the FHUs. A semi-structured questionnaire was administered by a single researcher, covering sociodemographic, socioeconomic, and gestational data; dietary habits; hygiene habits and behavior; and information related to

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knowledge about toxoplasmosis. After the questionnaire, an individual Health Education activity was conducted with the participants. Results of serological tests for anti-*Toxoplasma gondii* IgG and IgM antibodies were obtained from the tests presented by participants at the time of the interview.

The study was submitted to and approved by the Research Ethics Committee through Plataforma Brasil, under opinion no. 8.432.210. Data were organized and analyzed using IBM SPSS Statistics software, version 27. Descriptive analysis of variables was performed using absolute frequencies and percentages. Pearson's chi-square test (χ^2) was used to assess associations between categorical variables, adopting a significance level of 5% ($p < 0.05$). Results were interpreted in light of the relevant scientific literature.

3. Results and discussion

The study included 50 pregnant women receiving care at six Family Health Units (FHUs) in Santa Luzia, Paraíba. Women aged 21–34 years predominated, accounting for 68% (34/50); 86% (43/50) lived in urban areas, 60% (30/50) self-identified as Brown, and 54% (27/50) were single. Regarding membership in traditional communities, 18% (9/50) reported belonging to a quilombola community (Table 1).

Table 1 – Sociodemographic characteristics of the pregnant women participating in the study (n = 50).

Variable	Category	n	%
Age group	Under 20 years	8	16.0
	21–34 years	34	68.0
	35 years or older	8	16.0
Marital status	Single	27	54.0
	Married	11	22.0
	Civil partnership	11	22.0
	Widowed	1	2.0
Race/color	Brown	30	60.0
	White	14	28.0
	Black	6	12.0
Traditional community	No	41	82.0
	Quilombola community	9	18.0
Area of residence	Urban	43	86.0
	Rural	7	14.0

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Source: Research data, 2026.

Regarding socioeconomic and care characteristics, pregnant women with incomplete upper secondary education predominated (19/50), accounting for 38%, and 56% (28/50) identified as homemakers. Family income was predominantly up to one minimum wage, 74% (37/50), and 66% (33/50) of participants were beneficiaries of the Bolsa Família Program. In addition, 74% (37/50) received health care exclusively through the Unified Health System (SUS), demonstrating the relevance of the public health network for the population studied (Table 2).

Table 2 – Socioeconomic conditions of the pregnant women participating in the study (n = 50).

Variable	**Category**	**n**	**%**
Education level	Incomplete primary/lower secondary education	2	4.0
	Complete primary/lower secondary education	7	14.0
	Incomplete upper secondary education	19	38.0
	Complete upper secondary education	15	30.0
	Higher education	7	14.0
Occupation	Homemaker	28	56.0
	Formal employee	12	24.0
	Student	6	12.0
	Farmer	2	4.0
	Self-employed	2	4.0
Monthly family income	Up to one minimum wage	37	74.0
	1–2 minimum wages	8	16.0
	2–3 minimum wages	4	8.0
	More than 3 minimum wages	1	2.0
Social program beneficiary	Yes (Bolsa Família)	33	66.0
	No	17	34.0
Health care follow-up	SUS only	37	74.0
	SUS and private services	13	26.0

Source: Research data, 2026.

The concentration of participants in lower income groups, together with the high proportion of beneficiaries of an income transfer program, characterizes a socioeconomic context that should be considered in prenatal care. The literature indicates that socioeconomic

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factors such as low income and lack of formal employment may form part of contexts of vulnerability and affect access to and continuity of prenatal care (Nolasco et al., 2025).

Regarding gestational characteristics, 68% (34/50) of participants were not in their first pregnancy, and 56% (28/50) were in the second trimester. As for toxoplasmosis investigation during prenatal care, 52% (26/50) reported having been tested for the disease, while 42% (21/50) did not know and 6% (3/50) reported not having been tested. Dental follow-up was reported by 78% (39/50) of participants (Table 3).

Table 3 – Gestational characteristics of participants (n = 50).

Variable	**Category**	**n**	**%**
First pregnancy	Yes	16	32.0
	No	34	68.0
Stage of pregnancy	First trimester	5	10.0
	Second trimester	28	56.0
	Third trimester	17	34.0
Underwent toxoplasmosis testing	Yes	26	52.0
	No	3	6.0
	Did not know	21	42.0
Dental follow-up	Yes	39	78.0
	No	11	22.0

Source: Research data, 2026.

The proportion of pregnant women who did not know whether they had undergone toxoplasmosis testing may indicate difficulties in recognizing or understanding the tests requested during prenatal care. This finding reinforces the importance of explaining the purpose of tests to pregnant women, considering that serological screening should preferably begin in the first trimester of pregnancy (Brasil, 2022).

Regarding dietary habits, there was high consumption of beef (56%) and vegetables and leafy greens (96%), and a low frequency of undercooked meat consumption (10%). However, 16% reported consuming raw milk and 18% reported consuming game meat (Chart 1).

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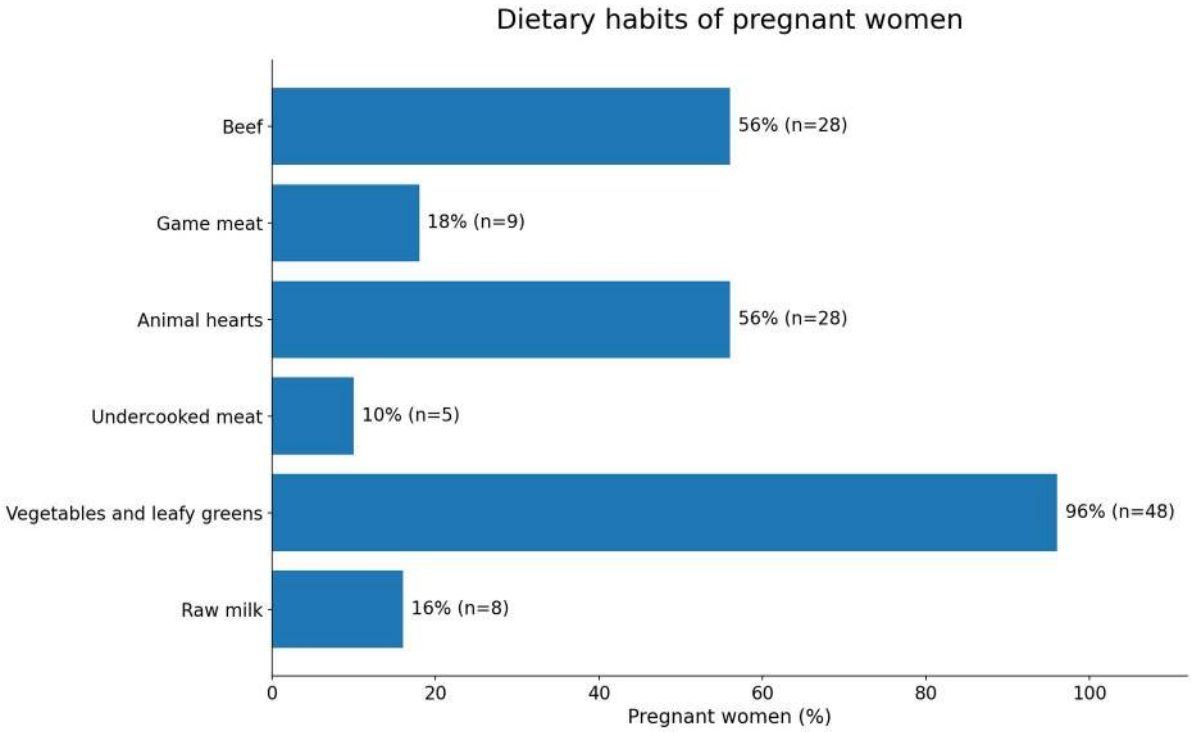
Chart 1 – Dietary habits of pregnant women (n = 50).



Source: Research data, 2026.

Consumption of undercooked meat by some pregnant women is relevant to gestational toxoplasmosis, since ingestion of raw or undercooked meat is a route of *Toxoplasma gondii* transmission because of the possible presence of tissue cysts in infected animals (Freitas; Almeida, 2026). Reported consumption of game meat also deserves attention in the local epidemiological context, since studies of wild animals in the Caatinga have demonstrated circulation of the parasite in regional fauna (Moura et al., 2026).

Reported raw milk consumption is also a relevant finding, considering the possible involvement of this food in infection transmission. Studies have investigated the parasite's occurrence in milk from different animal species, with more consistent evidence for goat milk and recent findings also in cow's milk (Arruda et al., 2024; Leite, 2026).

Regarding hygiene habits and environmental aspects, all pregnant women reported washing their hands after handling raw meat. For cleaning fruits and vegetables, bleach use predominated (40%), followed by washing with water alone (32%). The main source of drinking water was bottled water (mineral or with added salts) (60%), followed by water purchased from street vendors (18%), cistern water (14%), and well water (8%). Most reported consuming treated water (62%), although 30% did not know about treatment conditions.

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Contact with sand or soil was infrequent (2%); 26% of participants reported owning cats, and 8% cleaned their feces, as shown in the table (Table 4).

Table 4 – Hygiene habits and environmental factors associated with toxoplasmosis (n = 50).

Variable	Category	n	%
Washes hands after handling raw meat	Yes	50	100.0
Cleaning fruits and vegetables	Bleach	20	40.0
	Water only	16	32.0
	Vinegar	11	22.0
	Sodium hypochlorite (2.5%)	3	6.0
Drinking water source	Bottled water	30	60.0
	Water from street vendors	9	18.0
	Cistern	7	14.0
	Well	4	8.0
Treated water	Yes	31	62.0
	No	4	8.0
	Does not know	15	30.0
Handles sand or soil	Yes	1	2.0
	No	49	98.0
Owns cats	Yes	13	26.0
	No	37	74.0
Cleans cat feces	Yes	4	8.0
	No	46	92.0

Source: Research data, 2026.

The variety of methods used by pregnant women shows different practices for cleaning fruits and vegetables in the study population. This deserves attention because *T. gondii* oocysts are resistant to conventional chemical disinfectants, including chlorine compounds (Ureña et al., 2022). The Ministry of Health recommends that cleaning these foods also include mechanical rubbing under running water before consumption or preparation (Brasil, 2021a).

Handling sand or soil and cleaning cat feces were rarely reported by pregnant women, indicating a low occurrence of these practices. Although some participants owned cats, the literature shows that the animal's presence alone is not necessarily related to infection.

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However, contact with cat feces and contaminated soil represents a possible form of exposure, making it important to consider these practices in preventive guidance during pregnancy (Akins; Furtado; Smith, 2024).

Among reported ways of obtaining water, purchase from local street vendors stands out, raising questions about its origin and transport and storage conditions, given the importance of controlling the quality of drinking water (Brasil, 2021b). The fact that some pregnant women did not know whether their drinking water received any treatment is also important, as it demonstrates uncertainty about water conditions, since untreated water may act as a vehicle for *T. gondii* oocyst transmission (Nayeri et al., 2026).

Considering differences related to place of residence, the association between pregnant women's area of residence and treatment of drinking water was analyzed (Table 5).

Table 5 – Association between area of residence and treatment of drinking water.

Area of residence	Treated water (%)	Untreated water (%)	Does not know (%)
Urban	65.1	2.3	32.6
Rural	42.9	42.9	14.3
χ^2	13.513		
p	0.001		

Source: Research data, 2026.

A significant association was observed between area of residence and drinking water treatment ($p = 0.001$). Among pregnant women in rural areas, 42.9% reported consuming untreated water, compared with 2.3% in urban areas. This finding demonstrates that untreated water consumption was more frequent among participants living in rural areas.

The greater occurrence of untreated water consumption among pregnant women in rural areas may be related to differences in access to safe drinking water between urban and rural settings. This is a situation generally observed in Brazil, where difficulties in regular access to safe water are more common in rural areas and affect the North and Northeast regions more markedly (Silvério et al., 2024).

Regarding knowledge about toxoplasmosis, although 58% of pregnant women reported having heard of the disease, only 32% stated that they had received guidance about it during prenatal follow-up (Table 6).

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Table 6 – Knowledge about toxoplasmosis among pregnant women (n = 50).

Variable	Category	n	%
Has heard of toxoplasmosis	Yes	29	58.0
	No	21	42.0
Received guidance during prenatal care	Yes	16	32.0
	No	31	62.0
	Does not know	3	6.0

Source: Research data, 2026.

In view of these findings, the association between knowledge about toxoplasmosis and receipt of guidance during prenatal care was analyzed (Table 7).

Table 7 – Association between knowledge about toxoplasmosis and guidance received during prenatal care.

Has heard of toxoplasmosis	Received guidance (%)	Did not receive guidance (%)	Does not know (%)
Yes	55.2	37.9	6.9
No	0.0	95.2	4.8
χ^2	18.130		
p	< 0.001		

Source: Research data, 2026.

A statistically significant association was observed between knowledge about toxoplasmosis and receipt of guidance during prenatal care ($\chi^2 = 18.130$; $p < 0.001$). All pregnant women who reported having received guidance stated that they had already heard of the disease.

This result shows that receiving guidance during prenatal care was related to pregnant women having heard about toxoplasmosis. However, considering that only 32% of participants reported receiving this type of guidance, this approach did not reach most of the women evaluated.

Bringing together evidence from national and international research, Coelho et al. (2024) observed that limitations remain in the information pregnant women have about this disease. These findings, together with the present study's results, reinforce the importance of

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strengthening Health Education during prenatal care and systematically introducing guidance about the disease during pregnancy.

No statistically significant associations were identified between education level and knowledge about toxoplasmosis (p = 0.153), education level and receipt of disease-related guidance (p = 0.124), or area of residence and cat ownership (p = 0.867). In some comparisons, expected frequencies below five individuals per cell were observed, a condition that reduces the robustness of association tests and should be considered when interpreting results.

Regarding the serological profile for *Toxoplasma gondii*, analysis showed a low occurrence of IgG antibodies, with 8% (n = 4) of pregnant women testing reactive and 92% (n = 46) nonreactive. For IgM antibodies, all participants had nonreactive results (100%; n = 50) (Table 8).

Table 8 – Occurrence of anti-*Toxoplasma gondii* antibodies in pregnant women participating in the study (n = 50).

Serological test	**Result**	**n**	**%**
IgG	Reactive	4	8.0
	Nonreactive	46	92.0
IgM	Reactive	0	0.0
	Nonreactive	50	100.0

Source: Research data, 2026.

The low frequency of reactive IgG indicates that few pregnant women showed evidence of exposure to *T. gondii*, similar to the finding of Silva et al. (2022), who identified IgG antibodies in 8.2% of pregnant women receiving care in Santa Terezinha, Pernambuco. Higher results, however, have been recorded in municipalities in the sertão region of Paraíba. In Catolé do Rocha, Paraíba, Mesquita, Andrade Júnior, Barbosa (2026) found seropositivity of 28.5% among evaluated pregnant women, while Araujo et al. (2023), in Malta, Paraíba, identified reactive IgG in 40.3% of participants.

Percentages found in different studies show that the presence of anti-*Toxoplasma gondii* antibodies may vary between groups of pregnant women, even in nearby locations. This variation has also been identified in research conducted in different regions of the world (Salari et al., 2025).

Conversely, the high frequency of nonreactive IgG (92%), combined with the absence of IgM reactivity, indicates that most pregnant women had a serological profile compatible with

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susceptibility to primary infection. This finding is particularly important because women without serological evidence of previous exposure remain at risk of acquiring infection with possible transmission to the fetus, making preventive measures especially relevant (Barbosa et al., 2026).

The high proportion of susceptible pregnant women, considered together with the practices and conditions of possible parasite exposure identified in the research, reinforces the importance of guidance for pregnant women. However, since the relationship between these conditions and serological results was not analyzed, it is not possible to state that they influenced the observed profile.

Regarding IgM, the absence of reactive results indicates that no serological profiles suggestive of recent *T. gondii* infection were identified at the time of the research (Brasil, 2022).

Considering the low frequency of guidance about toxoplasmosis, a Health Education activity was conducted to expand access to information about the disease. The activity took place individually after questionnaire administration and addressed parasite transmission, possible means of exposure, and preventive measures during pregnancy. To support the guidance, each participant received educational material in leaflet format, prepared for the Health Education activity and containing the main information covered (Figures 1 and 2).

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Figure 1 – Educational leaflet about toxoplasmosis during pregnancy – outer side.



Source: Prepared by the authors.

Translation of the text in Figure 1:

Toxoplasmosis during pregnancy.

Drink safe, treated water.

When handling soil, sand, or plants, wear gloves and wash your hands thoroughly afterward.

What about cats? Having cats does not mean you will get toxoplasmosis. The main precaution is to avoid direct contact with feces and keep the litter box clean, preferably leaving this task to someone else during pregnancy.

It is also important to:

• Wash your hands after caring for animals;

• Avoid feeding cats raw meat;

Attend prenatal care, undergo the requested tests, and talk to the health care team whenever you have questions.

Your diet, water, hygiene habits, and animal care are part of your protection during pregnancy.

Institutional marks: Residency; SMS – Municipal Health Secretariat; Santa Luzia Municipal Government.

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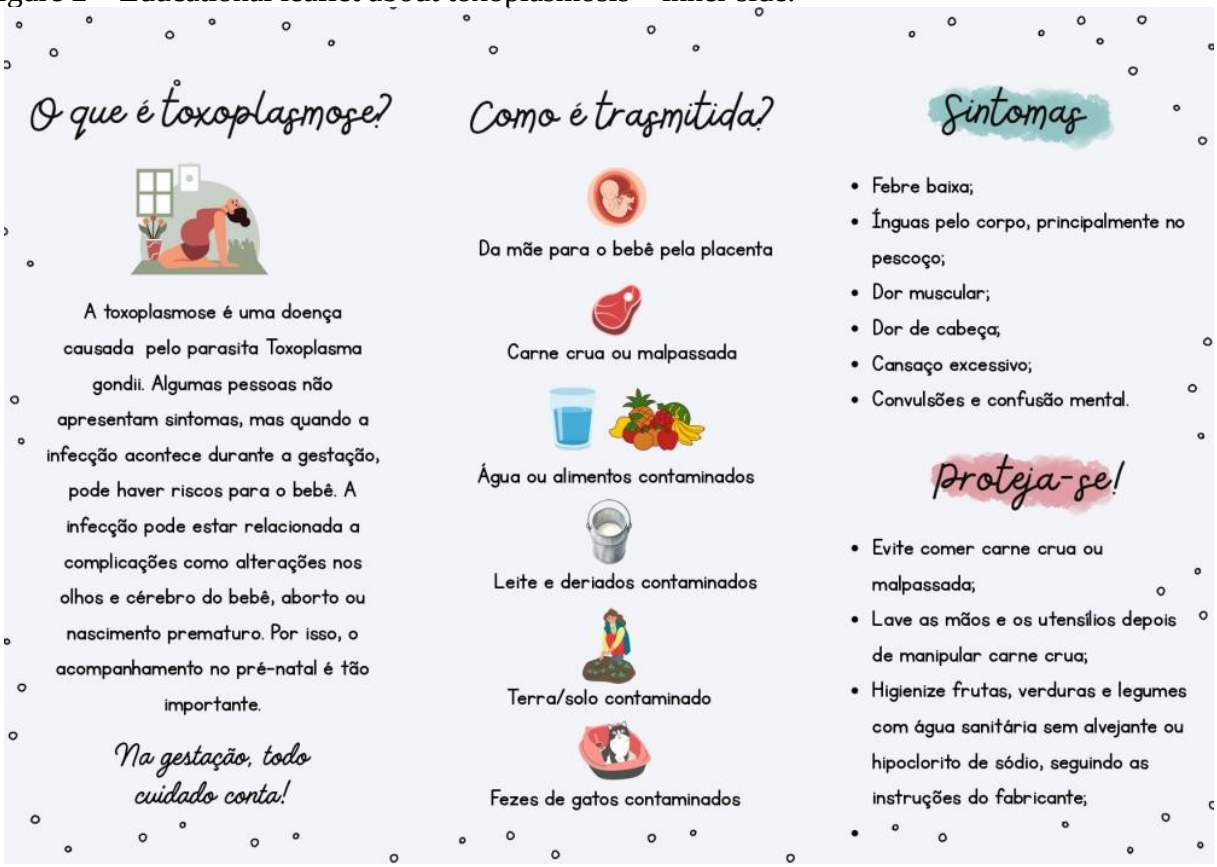
Figure 2 – Educational leaflet about toxoplasmosis – inner side.



Source: Prepared by the authors.

Translation of the text in Figure 2:

What is toxoplasmosis? Toxoplasmosis is a disease caused by the parasite *Toxoplasma gondii*. Some people have no symptoms, but when infection occurs during pregnancy, there may be risks to the baby. Infection may be associated with complications such as changes in the baby's eyes and brain, miscarriage, or premature birth. This is why prenatal follow-up is so important.

During pregnancy, every precaution counts!

How is it transmitted?

• From mother to baby through the placenta;

• Raw or undercooked meat;

• Contaminated water or food;

• Contaminated milk and dairy products;

• Contaminated earth/soil;

• Contaminated cat feces.

Symptoms:

• Low-grade fever;

• Swollen lymph nodes throughout the body, especially in the neck;

• Muscle pain;

• Headache;

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• Excessive tiredness;
• Seizures and mental confusion.

Protect yourself!

• Avoid eating raw or undercooked meat;
• Wash your hands and utensils after handling raw meat;
• Clean fruits, vegetables, and leafy greens with bleach without whitening additives or sodium hypochlorite, following the manufacturer's instructions;

The Health Education activity sought to expand pregnant women's access to an understanding of toxoplasmosis-related care. Since most participants received care exclusively through the Unified Health System (SUS), Primary Health Care (PHC) is an important setting for these activities, allowing guidance to be addressed throughout prenatal care with the participation of different professionals from the Family Health Strategy (FHS) team (Vellen et al., 2026).

Study limitations include the small sample size, cross-sectional design, research conducted in a single municipality, and low frequency of positive serological results. These factors limit generalization of the findings and do not allow a direct cause-and-effect relationship to be established. Nevertheless, the results provide relevant contributions to the local epidemiological context and highlight the importance of strengthening educational activities during prenatal care.

Final considerations

Prevention of gestational toxoplasmosis is an important strategy for protecting maternal and fetal health, especially among pregnant women susceptible to infection. Prenatal follow-up plays a fundamental role in identifying the serological profile and providing guidance on the care needed to reduce the risk of maternal infection and its possible fetal consequences.

Beyond clinical aspects, the influence of social determinants of health must be considered, since sanitation conditions, dietary habits, and access to information and health services may affect exposure to *Toxoplasma gondii*. Health Education is therefore an essential tool for expanding pregnant women's knowledge and encouraging care practices compatible with their living conditions.

The study thus reinforces the importance of comprehensive Primary Health Care that combines serological follow-up, identification of risk factors, and development of educational

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strategies. This integration helps strengthen care provided to pregnant women and demonstrates the need for ongoing activities aimed at reducing exposure to infection.

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