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Review

# Early Warning Signs, Effects, Risk Factors, and Diagnostic Indicators of Toxoplasmosis in Pregnant Women: A Systematic Review

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## Abstract

*Toxoplasma gondii* causes toxoplasmosis, a zoonosis of global importance, seriously affecting fetuses congenitally infected by their mother. Although early detection is important to prevent adverse fetal outcomes, maternal infections are frequently asymptomatic or present with mild, nonspecific signs. The present systematic review sought to synthesize evidence on early signs, risk factors, and diagnosis of toxoplasmosis in pregnant women. The study was conducted following the PRISMA 2020 guidelines. A literature search was conducted across PubMed, Scopus, ResearchGate, and Google Scholar for studies published between 2000 and 2025. The articles were exported to Zotero, citation management software. Duplicate articles were merged; those not published in English and lacking reference materials were excluded. After secondary screenings, 31 out of 407 articles met the inclusion criteria. Major maternal signs were lymphadenopathy (19.4%) and flu-like symptoms (19.4%), while major foetal effects were congenital anomalies (25.8%) and miscarriage (22.6%). Associated risk factors were contact with cat faeces and contaminated soil, consumption of undercooked or raw meat, raw vegetables, and contaminated water. Diagnosis was mainly by ELISA (65.5%). Therefore, routine screening awareness campaigns and timely diagnosis are recommended to safeguard maternal and fetal health in high-risk regions with limited diagnostic resources.

**Keywords:** *Toxoplasmosis*; early warning signs and symptoms; risk factors; diagnosis; pregnant women; systematic review

## 1. Introduction

Toxoplasmosis is a widely occurring zoonotic disease caused by the protozoan parasite *Toxoplasma gondii*, which can infect all warm-blooded animals, including humans. The disease is endemic in developing countries in Africa and Latin America and mainly spreads through ingestion of oocysts shed by infected cats or consumption of undercooked meat containing tissue cysts [1,2]. Although infections are often asymptomatic, they can cause serious health problems in immunocompromised people and pregnant women [3].

In pregnant women, toxoplasmosis is of special concern because of the risk of transmitting the infection to the unborn fetus [4]. If a primary infection occurs during pregnancy, it can lead to miscarriage, stillbirth, or birth defects such as hydrocephalus, intracranial calcifications, and chorioretinitis [5,6]. Most maternal infections are either asymptomatic or present with mild, nonspecific signs such as swollen lymph nodes, fatigue, and fever, making early diagnosis difficult [7,8]. Recognizing these subtle signs early is therefore crucial to enable prompt action and help prevent adverse effects on the fetus [9].

Despite its public health importance, early detection of toxoplasmosis in pregnant women is often difficult due to a lack of clear clinical signs [9]. Diagnosis primarily relies on serological screening and molecular methods, such as PCR, to confirm acute infection [2,10]. Recognizing the early warning signs and risk factors associated with *T. gondii* infection in pregnant women is crucial for improving diagnosis, treatment outcomes, and preventing severe complications [11].

The present systematic review aimed to identify and synthesize available evidence on early warning signs and symptoms, risk factors, and diagnostic methods for toxoplasmosis in pregnant women. By highlighting key indicators of infection, this review seeks to inform surveillance, clinical diagnosis, and public health interventions for this widely neglected parasitic disease.

## 2. Materials and Methods

This review was conducted in two phases: a preliminary scoping study, followed by a full systematic review. The scoping phase mapped the existing literature on early warning signs and symptoms of toxoplasmosis in pregnant women and identified gaps that warranted a more detailed synthesis. The findings from this phase informed the development of the review questions, inclusion criteria, and search strategy for the systematic review.

### 2.1. Search Strategy

A comprehensive literature search was conducted across Google Scholar, Scopus, ResearchGate, and PubMed. The search focused on publications on clinical manifestations and symptoms, epidemiology, and diagnostic techniques for toxoplasmosis in pregnant women, from January 2000 to December 2025. Key phrase combinations included “*Toxoplasma gondii*,” “toxoplasmosis,” “early warning signs,” “pregnant women,” “clinical signs,” “symptoms,” “risk factors,” and “diagnosis,” using Boolean operators (AND/OR). To find more papers, the reference lists of journal articles and qualified studies were manually screened after eliminating duplicate records and those without references.

### 2.2. Eligibility Criteria

Studies were included if they:

- a) Reported early clinicals or subclinical signs and symptoms, risk factors, or diagnostic indicators of *T. gondii* infection in pregnant women;
- b) Presented original research (cross-sectional, cohort, case–control, experimental, outbreak/case reports, or surveillance studies);
- c) Were published in English from January 2000 to December 2025;
- d) Provided sufficient methodological and outcome details for data extraction.

Studies were excluded if they:

- a) Did not focus on toxoplasmosis in pregnant women;
- b) Were reviews, editorials, conference abstracts, or commentaries;
- c) Had missing key information (e.g., title, abstract, or authors);
- d) Were inaccessible despite reasonable retrieval efforts.

### 2.3. Study Selection

The titles and abstracts were screened, followed by full-text assessment to select the relevant studies. The study selection process was conducted in accordance with the PRISMA guidelines, and the final number of included studies is presented in a PRISMA flow diagram.

### 2.4. Data Extraction

Data were extracted using a structured extraction form in Microsoft Word 2019 and later transferred to Excel for organization. Extracted information included:

1. Study characteristics (author, year, location, design)
2. Early symptoms, clinical or subclinical signs reported
3. Behavioral and host-related risk factors
4. Diagnostic tools used (e.g., ELISA, MAT, PCR)

The extracted data were cross-checked for accuracy and completeness.

### 2.5. Data Synthesis and Analysis

Due to variation in study designs, diagnostic methods, and outcome measures, meta-analysis was not feasible. Instead, a narrative synthesis approach was adopted, organizing data based on early warning signs, risk factors, and diagnostic indicators. Microsoft Excel was used to tabulate and visualize quantitative results such as prevalence figures and frequency distributions. The findings were summarized using descriptive statistics, where graphs and tables were used to illustrate clinical presentations, risk factor patterns, and diagnostic indicators.

### 2.6. Ethical Considerations and Data Availability

Only publicly available studies were used; ethical approval for this review was not required. All materials, data, and extraction forms will be made available upon request.

## 3. Results

A total of 407 studies were initially identified through database searches. After removing duplicates and screening titles and abstracts, 31 studies met the inclusion criteria (Figure 1). Studies were excluded if they did not focus on toxoplasmosis in pregnant women, lacked accessible full texts, or lacked essential bibliographic details. The remaining articles provided additional relevant evidence on early signs, risk factors, or diagnostic indicators of *Toxoplasma gondii* infection. Findings were synthesized narratively and summarized in Table 1, with the studies arranged alphabetically by study location. The 31 studies were from 18 countries, including 28 from Africa, 1 from France in Europe, 1 from Palestine in the Middle East, and 1 from El Salvador in Latin America. Most countries had only one or two studies, except for Nigeria, which had 5 studies, and Cameroon and Ethiopia, which each had 4 studies (Table 1). The 28 studies from Africa were distributed across the five African Union regions, with 10 from Eastern Africa, 9 from Western Africa, 5 from Central Africa, and 2 each from Northern and Southern Africa.

**Table 1.** Characteristics of 31 cross-sectional studies included in the systematic review on toxoplasmosis in pregnant women.

<i>Authors and year of publication</i>	<i>Study location</i>	<i>Geographical region</i>	<i>Potential symptoms and effects</i>	<i>Risks factors</i>

<i>Sebaa et al., 2024,</i>	Algeria	Northern Africa	Miscarriages, stillbirths, complications in newborns	consumption of undercooked meat, contact with cats, and previous spontaneous abortions.
<i>Dambrun et al.,2022,</i>	Benin	Western Africa	neurological and ophthalmic disorders, or abortion	immune and genetic host factors, and characteristics of the T. gondii strain
<i>Nguemaim et al., 2020,</i>	Cameroon	Central Africa	malaise, low-grade fever, and lymphadenopathy	pet ownership and handling of their litters
<i>Gebremedhin et al., 2013,</i>	Cameroon	Central Africa	mental retardation in congenitally infected children	raw vegetable consumption and poor drinking water quality.
<i>Mabeku et al.,2018</i>	Cameroon	Central Africa	mild febrile illness, lymphadenopathy, and fatigue in some patients	lower educational levels, soil-related occupations, and consumption of raw or unwashed vegetables
<i>Cedric et al., 2022</i>	Cameroon	Central Africa	malaise, low-grade fever, and lymphadenopathy	pet ownership and handling of their litters
<i>Doudou et al., 2014,</i>	Congo	Central Africa	severe malformations and spontaneous abortion.	Contact with soil, presence of a domestic cat, raw meat consumption, and poor hygiene.
<i>Mulugeta et al., 2020,</i>	Ethiopia	Eastern Africa	Causes mild symptoms	contact with cat feces, consumption of undercooked meat, raw vegetables, and blood transfusion
<i>Wadage et al., 2023</i>	Ethiopia	Eastern Africa	abortion, stillbirth, and neonatal mortality	cat ownership, contact with soil, and lack of knowledge about food-borne diseases

<i>Juja et al., 2018,</i>	Ethiopia	Eastern Africa	miscarriage and cerebral calcification	Drinking unsafe water
<i>Agma et al., 2015,</i>	Ethiopia	Eastern Africa	flu-like illness, abortion, stillbirth, and severe neurological disorders	age, educational status, and cat ownership
<i>Roy et al., 2025,</i>	France	Europe	fetal loss, neonatal death, and neurological complications	Age, parity, population density, region
<i>Addo et al., 2023,</i>	Ghana	Western Africa	seizures, jaundice, loss of vision, and developmental delay	education level, contact with cats, soil exposure, and consumption of raw fruits and vegetables
<i>Assoah et al., 2024</i>	Ghana	Western Africa	Miscarriage	level of education, residence, backyard animal farms, hygiene practices, water sources, and quality
<i>Atif et al., 2025,</i>	Morocco	Northern Africa	Miscarriage and congenital malformation	Contact with cats and a lack of awareness
<i>Zakari et al., 2020.</i>	Nigeria	Western Africa	blindness and neurological impairment in children	HIV-positive, older age, and urban settlement
<i>Bello et al. 2017</i>	Nigeria	Western Africa	Cold and flu, cervical lymphadenopathy, and mononucleosis-like syndrome	Contact with cats and their litter
<i>Dawet et al., 2022,</i>	Nigeria	Western Africa	asymptomatic	Ingestion of undercooked meat, unpasteurized milk, and contact with cat litter
<i>Akpan et al., 2023,</i>	Nigeria	Western Africa	Abortion, stillbirth, hydrocephaly, mental retardation, and	educational level, outdoor gardening, blood transfusion, consumption of

			chorioretinitis in infants	uncooked meat, and cat ownership
<i>Adeniyi et al., 2023,</i>	Nigeria	Western Africa	lymphadenopathy and flu-like illness	marital status, tasting raw meat, and the presence of rodents or cockroaches
<i>Nijem, &amp; Al-Amleh et al., 2009</i>	Palestine	Middle East	abortions and fetal anomalies	contact with contaminated soil, water, and vegetables, rather than just undercooked meat
<i>Murebwayire et al., 2017</i>	Rwanda	Eastern Africa	spontaneous abortions and congenital deformities	drinking untreated water and consuming undercooked meat
<i>Ndiaye et al., 2019,</i>	Senegal	Western Africa	Severe complication during pregnancy	Consuming raw or undercooked contaminated meat and ingesting oocysts from contaminated water or food
<i>Yusuf et al., 2021,</i>	Somalia	Eastern Africa	abortion and congenital defects	at contact and consumption of raw or undercooked meat
<i>Mustafa et al., 2019</i>	Sudan	Eastern Africa	severe fetal consequences in congenital transmission	Contact with cats, ingestion of raw meat
<i>Lushina et al. (2023)</i>	Tanzania	Eastern Africa	Asymptomatic but causes Miscarriage. Others: Swollen glands, Diarrhoea, Leg swelling, Nausea, Blindness, Eclampsia, Anaemia, Gestational diabetes	Increasing maternal age, consumption of undercooked meat, and lack of handwashing after meat preparation
<i>Paul et al., (2018),</i>	Tanzania	Eastern Africa	No clear sign, but it causes congenital problems	eating undercooked meat, raw vegetables, soil contact, and drinking contaminated water

<i>Rukamba et al., (2024),</i>	Uganda	Eastern Africa	Chronic: intrauterine growth retardation, post-term pregnancies, slow development of postnatal motor skills. Acute: miscarriages and congenital infections,	contact with cats, drinking untreated water, and HIV status
<i>Lynn et al., 2024,</i>	El Salvador. Western Region	Latin America	acute infection- labor and delivery complication,	presence of a cat pet
<i>Daka et al., (2024),</i>	Zambia	Southern Africa	Missed carriage and stillbirth	No significant risk factors
<i>Frimpong et al., 2017,</i>	Zambia	Southern Africa	ocular disease, lymphadenopathy, and encephalitis	Contact with cats

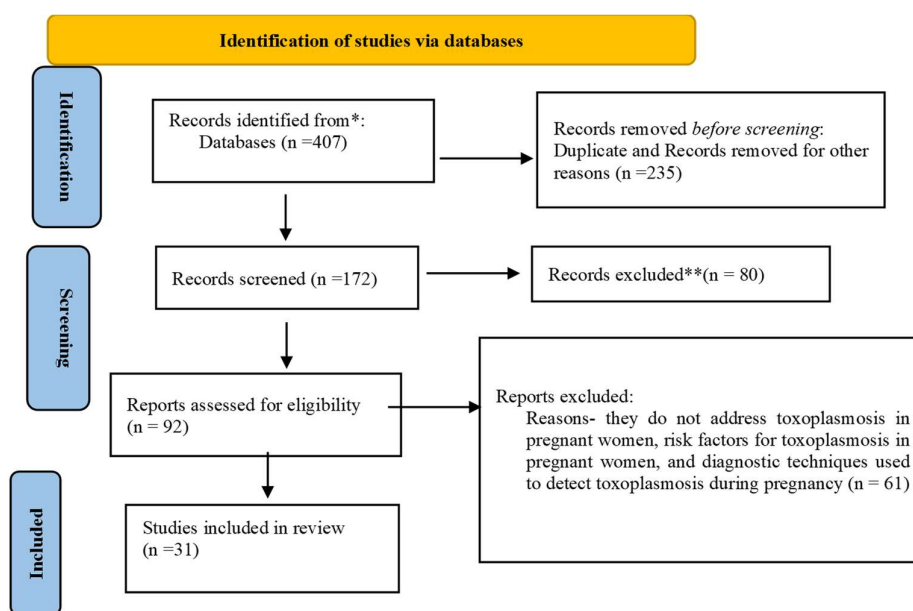
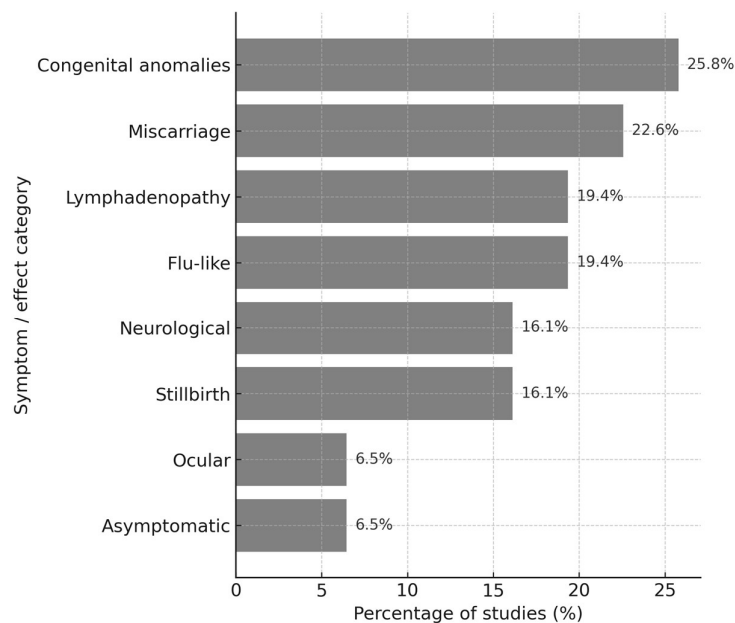


Figure 1. PRISMA 2020 Flow Diagrams modified from: [12].

### 3.1. Early Warning Signs / Clinical Manifestations and Outcomes

Congenital anomalies were the most frequently reported outcome of the infection, appearing in 25.8% of the studies (Figure 2), reflecting the well-documented risk of fetal structural damage following maternal toxoplasmosis. Miscarriage followed at 22.6%, highlighting its substantial contribution to adverse pregnancy outcomes. Lymphadenopathy and flu-like manifestations each occurred in 19.4% of studies, consistent with the nonspecific systemic presentation of acute infection. Neurological involvement and stillbirth were reported less often (both 16.1%), yet remain clinically

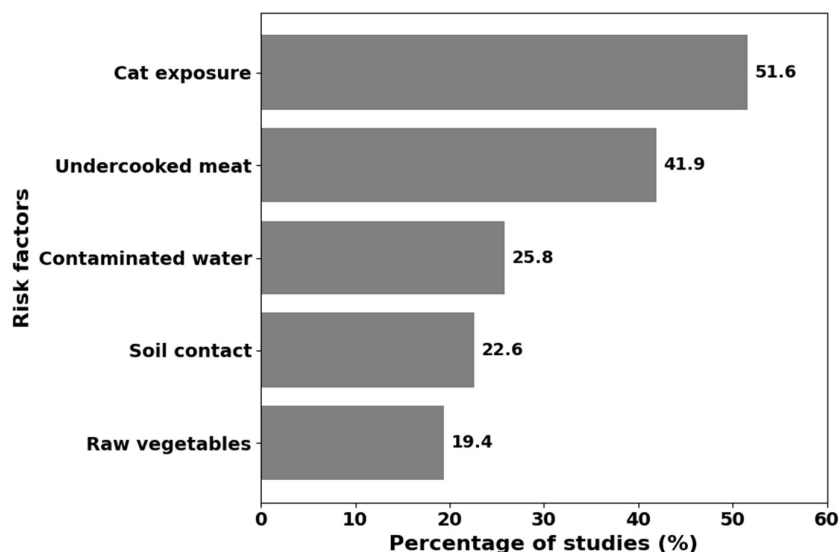
significant due to their severity. Ocular manifestations and asymptomatic infections were the least frequent (6.5% each), underscoring the heterogeneous clinical spectrum observed across studies.



**Figure 2.** The percentage of the 31 studies included in the review that reported specific clinical symptoms or outcomes among pregnant women with toxoplasmosis.

### 3.2. Key Risk Factors for Toxoplasmosis in Pregnancy

Exposure to cats was the most frequently reported risk factor, appearing in the greatest proportion of the included studies (51.6%) (Figure 3), followed by consumption of undercooked meat (41.9%), which remained a major contributor to *Toxoplasma gondii* transmission. Consumption of contaminated water (25.8%) was identified less often, yet still represented a relevant environmental source of infection. Contact with contaminated soil (22.6%) and consumption of raw vegetables (19.4%) were the least frequently documented exposures.

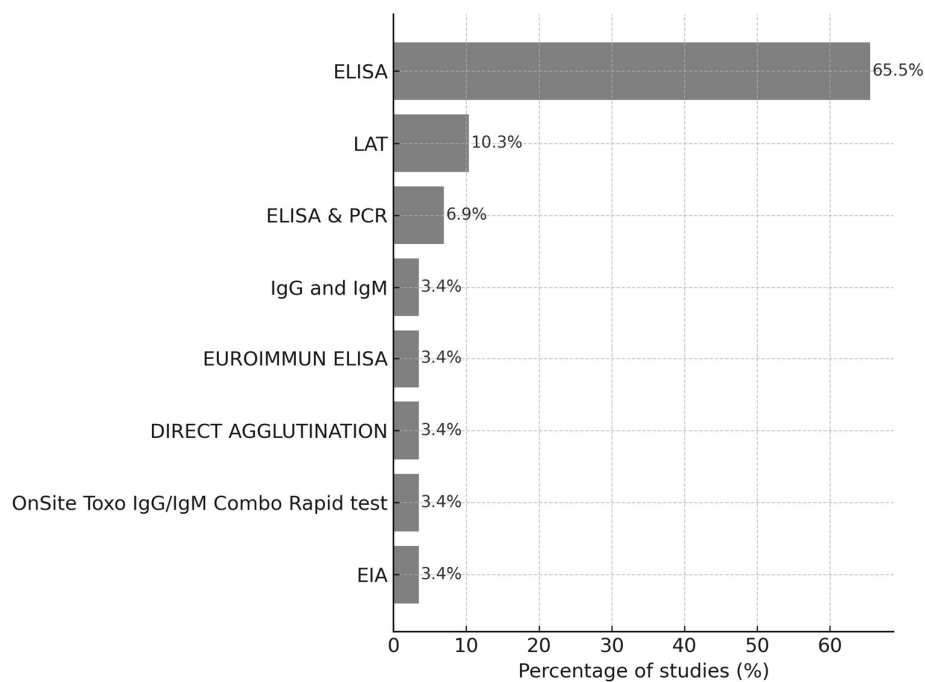


**Figure 3.** Percentage of major risk factors reported across 31 studies included in the review.

### 3.3. Diagnostic Indicators and Methods

The enzyme-linked immunosorbent assay (ELISA) was the diagnostic test used in the highest proportion of studies (65.5%) (Figure 4). Other tests were used in only one study (3.4%), except for the Latent Agglutination Test (LAT) and ELISA combined with polymerase chain reaction (PCR), which were used in 3 (10.3%) and 2 (6.9%) of the studies (Figure 4).

The seroprevalence of *T. gondii* infections varied widely across studies within countries and regions, even when the same test was used. For instance, of the 10 studies conducted in eastern Africa, 5 used ELISA and 3 used LAT. The median and range of seroprevalence based on ELISA were 23.9% (12.2% – 67.8%). Similarly, in western Africa, 8 of the 9 studies used ELISA to determine seroprevalence, and the observed median and range were 42.09% (29.60% - 55.90%). Four of the 5 studies in central Africa also used ELISA, and the median and range were 52.3% (34.6% - 80.30%).



**Figure 4.** Percentage of the 31 studies included in the review where specific diagnostic methods were used to estimate the prevalence of toxoplasmosis in pregnant women.

## 4. Discussion

In this systematic review, the most commonly reported signs and symptoms of toxoplasmosis during pregnancy are swollen lymph nodes and flu-like symptoms. These are mild symptoms that are often missed as they are disregarded and confused with the flu or other infections, as previously observed by Nguemaïm et al [14]. Signs of toxoplasmosis during pregnancy can be asymptomatic, as reported by Daweet et al (26). Lack of specific clinical signs and its asymptomatic nature complicates early detection using clinical signs without laboratory confirmation [16,26]. This is therefore of particular concern because it carries significant risks for vertical transmission, potentially resulting in congenital toxoplasmosis [36].

Congenital anomalies and miscarriage were the most common outcomes in the studies reviewed, but this does not necessarily mean that they are the most common consequences of toxoplasmosis. Their severe manifestation increases the likelihood of investigating and reporting them. Congenital anomalies are characterized by fetal complications such as hydrocephalus, chorioretinitis, or intracranial calcifications [40]. Miscarriages and abortion, on the other hand, are

consequences of acute toxoplasmosis during pregnancy [33,38]. However, toxoplasmosis is one of the causes of these congenital anomalies and miscarriage among many diseases and conditions. Early diagnosis of *Toxoplasma gondii* infections in pregnant women is therefore crucial to prevent the serious complications. In this review, many studies combined maternal symptoms with fetal outcomes. However, lymphadenopathy and flu-like symptoms are early warning signs in the mother, while miscarriage and congenital defects are the results of vertical transmission of the infection to the fetus.

The significant risk factor reported in the review is exposure to cat faeces. It is the major transmission route, emphasizing the importance of preventive practices such as safe litter handling, regular handwashing, and avoiding contact with stray cats during pregnancy [24]. Other risk factors include: consumption of undercooked or raw meat, poor food hygiene, contact with contaminated soil, and exposure to unsafe water sources. The differences in the reported risk factors could be explained by the diversity of geographical regions where the included studies were conducted [23,37]. Regional diversity influences cultural food habits, human and animal interactions, farming practices, sanitation levels, access to clean water, and awareness of toxoplasmosis [42]. However, most of the studies reviewed were cross-sectional, so the results indicate only the frequency with which these factors were mentioned, rather than their actual association with infection. These risk factors highlight the need for awareness campaigns targeting pregnant women to reduce infection rates by promoting simple preventive measures, such as proper meat cooking, hand hygiene, and avoidance of direct contact with cat feces [41].

Most of the studies included in this review primarily use the enzyme-linked immunosorbent assay (ELISA) to detect anti-*Toxoplasma gondii* antibodies in sera of pregnant women, but it cannot detect recent infections. IgG avidity was rarely used in the studies reviewed, yet it is essential for differentiating acute and chronic toxoplasmosis. The IgG avidity test can detect acute toxoplasmosis during early pregnancy and is important for controlling vertical transmission, which can cause congenital infection [39]. Limited studies reviewed, used PCR to detect *T. gondii* DNA, and the underutilization of these advanced diagnostic tools across the reviewed studies leads to inaccuracy of case classification and underreporting of the prevalence of acute toxoplasmosis. The underuse of PCR across the reviewed studies in varied regions could be explained by the fact that, despite it being highly sensitive, its utilization is often limited by cost and the need for specialized laboratory facilities and trained personnel [40]. However, polymerase chain reaction (PCR) can enhance the specificity of toxoplasmosis diagnosis in pregnancy as it detects *T. gondii* DNA in maternal blood, amniotic fluid, or placental tissues, providing direct evidence of active infection and complementing serological findings [33,40]. Future studies should integrate IgG avidity assays and molecular diagnostics alongside serology to improve the detection of recent infections and strengthen early warning systems to prevent congenital toxoplasmosis. These tests enable clinicians to identify pregnant women at the highest risk and to implement preventive or therapeutic measures, such as spiramycin treatment or close fetal monitoring [40].

## 5. Conclusion and Recommendation

In conclusion, this review highlights that early detection of toxoplasmosis in pregnant women requires an integrated diagnostic strategy combining the history of the pregnant woman to capture possible risk factors, clinical examination for signs/symptoms, serology, and, where possible use of molecular diagnostic methods.

It is therefore recommended that improving education, strengthening laboratory diagnosis, and promoting early screening during pregnancy are essential to reduce congenital toxoplasmosis.

### *Limitation of this Review*

A formal risk-of-bias assessment was not conducted, meaning the methodological quality of individual studies was not systematically evaluated, and the likelihood of biases related to study design, sampling methods, and diagnostic accuracy may not have been clearly addressed.

The studies reviewed differed significantly in their design, diagnostic methods, reporting format, and outcome definitions. The cross-sectional nature of the studies limits conclusions about symptoms and their effects. Some studies used only IgG or IgM tests, while others used IgG avidity or PCR, leading to misclassification of infections. In addition, outcomes such as “toxoplasmosis infection” or “pregnancy complications” were defined differently across studies. These differences reduce comparability and may partly explain the wide variation in reported results. A meta-analysis could not be performed, and the findings are based on narrative synthesis, which may be more susceptible to subjective interpretation than pooled statistical analysis.

Despite these limitations, the review provides valuable insight into current diagnostic practices, reported clinical features, and research gaps, and highlights the need for more robust, standardized study designs in future toxoplasmosis research.

**Supplementary Materials:** The following supporting information can be downloaded at the website of this paper posted on Preprints.org.

**Author Contributions:** Conceptualization, C.J.T., N.E.M., J.C.N, K.N., D.K.N.; methodology, C.J.T. and B.E.L.; validation, C.J.T. and B.E.L.; formal and data analysis, C.J.T. and B.E.L.; data curation, C.J.T.; writing original draft preparation, C.J.T.; writing review and editing, C.J.T.; supervision, N. M., J.C.N, K.N., D.K.N. A. P. N.N; funding acquisition, K.K.A., G.I.M. and B.B. All authors have read and agreed to the published version of the manuscript.

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**Data Availability Statement:** The datasets generated and analyzed during the current study are available from the corresponding author on request. No publicly archived datasets were created or analyzed in this study.

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## Abbreviations

**ELISA:** Enzyme-Linked Immunosorbent Assay

**IgG:** Immunoglobulin G

**IgM:** Immunoglobulin M

**MAT:** Modified Agglutination Test

**PCR:** Polymerase Chain Reaction

**EIA-Enzyme Immunoassay**

***T. gondii:*** *Toxoplasma gondii*

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