IMMUNOLOGICAL DIAGNOSIS OF *TOXOPLASMA GONDII* AMONG PREGNANT WOMEN IN ERBIL CITY

A THESIS

SUBMITTED TO THE COUNCIL OF THE FACULTY OF MEDICAL ANALYSIS, TISHIK INTERNATIONAL UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR IN MEDICAL ANALYSIS

BY

MARDIN FAREEQ SABER

PAYMAN FAHD AZIZ

DAHEN FAREQ MAGHDID

ILAF ALI ADI

SUPERVISOR

ASSIST. PROF. DR. HEMDAD HAWEZ MAWLOOD

MARCH	JOZERDAN	RABI' AL-THANI
2024 AD	2724 K	1446 AH

بِسْمِ اللَّـهِ الرَّحْمَـٰنِ الرَّحِيمِ

وَلَا تَقْتُلُوٓاْ أَنفُسَكُمْ ۚ إِنَّ ٱللَّهَ كَانَ بِكُمْ رَحِيمًا

صَدَقَ اللهُ العَظيم

سورة النساء الآية: 29

Certification of the Supervisor

I confirm that this Bachelors thesis, titled "Detection of *Toxoplasma gondii* Infection, in Pregnant Women in Erbil City " was written by Mardin Fareeq Saber, Payman Fahd Aziz, Dahen Fareq Maghdid and Ilaf Ali Adi under my guidance at the Faculty of Medical Analysis, Tishik International University. This thesis was finished as part of the criteria, for obtaining a Bachelor of Science degree in Medical Analysis.

Supervised by:
Assist. Prof. Dr. Hemdad Hawez Mawlood
Date: 28/5 / 2024

Dedication

In recognition of the divine direction and benefits that they have bestowed upon us along our journey, we would like to dedicate this great achievement to the Almighty Allah and Prophet Muhammad.

Acknowledgement

We want to express our thanks to everyone who helped us complete this thesis. We are especially grateful, to Dr. Hemdad Hawez Mawlood, Assistant Professor for his guidance and support that played a role in shaping the success of this project.

Our gratitude also goes out to the faculty and staff at the Faculty of Medical Analysis at Tishik International University for their assistance in our research endeavors.

We truly appreciate the efforts, innovative ideas and unwavering support of our peers and colleagues throughout this journey, which have greatly enriched our experience and contributed to our work. We also thank supervisors and panel members for their feedback.

Lastly, we extend our thanks to our families whose love, patience and understanding have been the bedrock of our achievements. Their unwavering support has been a source of strength and inspiration, for us.

Abstract:

Background: In pregnant women, the intracellular parasite known as *Toxoplasma gondii* poses considerable health hazards owing to the likelihood of congenital transmission and severe difficulties for the developing fetus associated with the infection. There is a shortage of localized data, particularly concerning the immunological response in pregnant women in Erbil city, despite the fact that the worldwide effect has been well documented. The purpose of this research is to investigate the incidence of Toxoplasma gondii among pregnant women in Erbil city as well as the immune response to the parasite.

Methodology: Cross-sectional research was carried out with a total of two hundred pregnant women from the city of Erbil, who were chosen via prenatal clinics respectively. All of the demographic information was acquired via the use of a detailed questionnaire, and blood samples were taken for immunological testing. Serological analyses using specific ELISA kits were performed. Data analysis employed SPSS software version 26, utilizing Pearson's correlation coefficient and multiple linear regression to examine relationships between infection levels, antibody presence, and demographic factors.

Results: Among the 200 participants, 42.5% tested positive for IgG antibodies, indicating past exposure, and 25% tested positive for IgM antibodies, suggesting recent infection. Significant correlations were found between antibody levels and stages of pregnancy, with the first trimester showing a higher prevalence of IgG positivity at 59.1% ($\beta = 0.24$, $p < 0.01$). A strong positive correlation was observed between IgM and IgG levels ($\beta = 0.29$, $p < 0.001$). Demographic factors showed notable relationships with IgG levels; the gestation period had a significant positive association ($\beta = 0.19$, $p = 0.01$), while abortion history had a negative correlation ($\beta = -0.32$, $p < 0.001$).

Conclusion and recommendation: The study highlighted a significant relationship between gestation period and *Toxoplasma gondii* seroprevalence in pregnant women in Erbil. Therefore, policymakers should prioritize public health guidelines for such screenings and bolster educational initiatives on toxoplasmosis prevention and management. Additionally, resources should be allocated for research on the long-term effects of Toxoplasma infection during pregnancy to enhance maternal-child health protocols.

Key Words:

Toxoplasmosis, Seroprevalence, IgG/IgM Antibodies, Pregnant Women, Erbil City

List of Abbreviations:

1- **IgG**: Immunoglobulin G

2- **IgM**: Immunoglobulin M

3- **ELISA**: Enzyme-Linked Immunosorbent Assay

4- **PCR**: Polymerase Chain Reaction

5- **SPSS**: Statistical Package for the Social Sciences

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1. Introduction

1.1. Introduction and Problem Statement

The protozoan parasite known as *Toxoplasma gondii* is capable of infecting a broad variety of warm-blooded species, including humans (Uddin *et al*., 2021). This parasite is responsible for toxoplasmosis, which is one of the most prevalent zoonotic illnesses seen all over the globe. It is possible to get infected by ingesting undercooked meat that contains tissue cysts, as well as by consuming food or water that is contaminated with oocysts that are found in the faces of infected cats, who are the definitive hosts (Overgaauw, 2020). Congenital abnormalities such as hydrocephalus, intracranial calcifications, and retinochoroiditis may be caused by maternal toxoplasma infection during pregnancy (Bollani *et al*., 2022, Fallahi *et al.*, 2018). These complications can have significant repercussions for the growing fetus, including the possibility of a miscarriage, stillbirth, or other congenital abnormalities. The main infection that occurs during the third trimester of pregnancy is associated with the greatest risk of congenital transmission, according to Leeper and Lutzkanin (2018). Because of this, it is vital for pregnant women to have fast treatment and an early diagnosis of toxoplasmosis in order to avoid or minimize the negative consequences that the disease may have on the fetus.

According to Robert-Gangneux and Guegan (2021), the diagnosis of toxoplasmosis is often accomplished by the use of serological assays that identify particular antibodies developed against Toxoplasma antigens. The Sabin-Feldman dye test, the enzyme-linked immunosorbent assay (ELISA), the indirect fluorescent antibody test (IFAT), and immunochromatographic assays are all included in these tests. According to Elsheikha et al. (2020), the choice of diagnostic procedure is determined by a number of criteria, including the clinical presentation, the disease stage, and the resources available in the laboratory. The diagnosis of toxoplasmosis is of utmost significance during pregnancy because it permits adequate care and therapy, which in turn reduces the risk of congenital transmission (Paquet and Yudin, 2018). Serological assays have the ability to identify the existence of Toxoplasma-specific antibodies, which may indicate either a current or a previous infection (Simon *et al*., 2020). IgM antibodies are indicative of a recent or acute infection, while IgG antibodies are indicative of an illness that occurred in the past or is chronic.

It is suggested in many countries that pregnant women who are at risk of spreading the illness to their unborn children undergo prenatal screening for toxoplasmosis (Ahmed *et al*., 2020). This allows for earlier identification and management of the situation. The incidence of congenital toxoplasmosis and the difficulties that are associated with it may be considerably reduced with

early identification and fast treatment with effective antiparasitic medications such as spiramycin or a combination of pyrimethamine and sulfadiazine (Khan and Khan, 2018). it is essential to keep in mind that serological tests on their own may not be able to offer a conclusive diagnosis because of the likelihood of obtaining false-positive or false-negative findings (Bastos *et al*., 2020). As a result, further diagnostic procedures, such as polymerase chain reaction (PCR) or amniocentesis, could be used in some instances in order to validate the diagnosis and evaluate the potential for congenital transmission.

In many countries, prenatal care includes serological testing for toxoplasmosis during pregnancy. This testing is considered an essential component of it. the prevalence of *Toxoplasma gondii* infection and the risk factors associated with it might vary greatly from one demographic and geographical location to another region and population (Safarpour *et al*., 2020). There is a lack of epidemiological data about the seroprevalence of toxoplasmosis among pregnant women in Erbil City, which is situated in the Kurdistan Region of Iraq. As a result, the primary purpose of this research is to explore the incidence of Toxoplasma gondii in pregnant women in Erbil City as well as the immunological response to the parasite.

1.2. Aim of the study

1.2.1. Main Objective

To examine how common and the immune response, to *Toxoplasma gondii* is among women in Erbil city.

1.2.2. Specific Objectives

1. To determine how many pregnant women in Erbil city have *Toxoplasma gondii* antibodies (IgG and IgM).
2. To explore the link between antibody levels and different pregnancy stages among the participants.
3. To investigate how demographic factors relate to the presence of *Toxoplasma gondii* IgG and IgM antibodies in women in Erbil city.

1.3. Research Hypothesis

1. A notable number of women, in Erbil city may have been exposed to *Toxoplasma gondii* as shown by the presence of IgG and/or IgM antibodies.
2. The levels of *Toxoplasma gondii* antibodies (IgG and IgM) in women might vary significantly at pregnancy stages.

3. Demographic factors such as age, residency, and socioeconomic status will be significantly correlated with the seroprevalence of *Toxoplasma gondii*-specific antibodies in pregnant women.

Literature review

This chapter contains the theoretical and conceptual framework of research

2a. Theoretical and conceptual framework

The framework of this study is a conceptual framework and, in this regard, topics such as Toxoplasmosis, Toxoplasmosis in Pregnant Women, Immunological Response to *Toxoplasma gondii*, types of diagnosis were described.

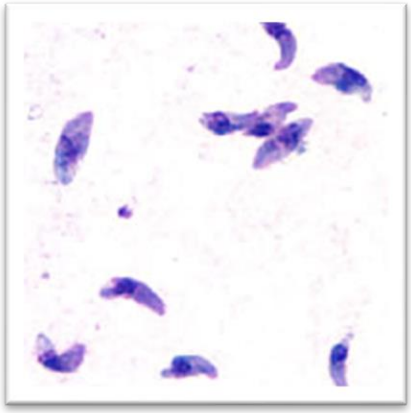
2a.1. *Toxoplasma gondii* history

Toxoplasma gondii, the causative agent of toxoplasmosis, was first discovered in 1908 independently by Nicolle and Manceaux in Tunisia and Splendore in Brazil. Initially found in a rodent, it was distinguished from Leishmania and named due to its curved infective stage. The first analysis of T. gondii using virus analysis techniques occurred in 1937. Janku recorded the first case of congenital toxoplasmosis in 1923, though T. gondii's role wasn't recognized until 1937. The parasite's identification as a human pathogen came in 1939, with the first human case reported in 1940. Sabin and Feldman developed a serological dye test in 1948, now a gold standard in diagnosis. The parasite's life cycle was elucidated in 1970, identifying cats as definitive hosts. By the 1980s, T. gondii became known as a significant risk for immunocompromised individuals, especially those with HIV. Studies in the early 2000s, including Lehmann *et al*.'s in 2006, revealed genetic variability in T. gondii, noting geographical differences and varying virulence (Dubey, 2016, Ferguson, 2009).

2a.2. Overview of Toxoplasmosis

Toxoplasmosis is an infectious disease caused by the protozoan parasite *Toxoplasma gondii*. This parasite has a remarkable ability to infect virtually all warm-blooded animals, including humans, making it a concern in both veterinary and human medicine. While often

asymptomatic, toxoplasmosis can cause significant health issues in certain groups, particularly in fetuses and immunocompromised individuals. Transmission to humans can occur through various means, including the ingestion of undercooked contaminated meat, exposure to infected cat feces, or congenitally from mother to child during pregnancy. Globally, a large proportion of the human population is estimated to carry the parasite, though the prevalence rates vary widely among different regions and communities (IMAM *et al*., 2022, Rainova *et al*., 2022).



2a.3. Toxoplasmosis in Pregnant Women

Toxoplasmosis in pregnancy has serious consequences because of the particular hazards it presents to both the pregnant woman and the growing child. When a pregnant woman becomes infected with *Toxoplasma gondii*, the parasite has a chance of crossing the placenta and infecting the baby, a disease known as congenital toxoplasmosis (Deganich *et al*., 2022). It is possible for the implications of such disorders to differ greatly depending on the time of pregnancy in which they become apparent. Some of the more serious consequences that may occur as a result of infections that occur during the early stages of pregnancy include miscarriage, stillbirth, and substantial developmental problems in the infant. Even while infections that occur later in pregnancy are less likely to cause severe developmental difficulties, they may still result in substantial health problems for the kid. These health problems can include impairments in vision and hearing, intellectual disability, and seizures. The significance of early and correct diagnosis, as well as the adoption of suitable risk-mitigation strategies, is brought into focus and highlighted by this statement. Regular screening and education are also very important in the early detection and prevention of toxoplasmosis in pregnant women (Oyeyemi *et al*., 2020, Saso *et al*., 2020). This is further supported by the fact that toxoplasmosis in pregnant women often does not exhibit any symptoms.

2a.4. Immunological Response to *Toxoplasma gondii*

Toxoplasma gondii immunity, in humans involves an interplay between the adaptive immune systems. The innate immune system is the responder to an infection detecting and reacting to the parasite. Following this the adaptive immune response kicks in deploying antibodies and T cells to fight off the infection. Given the risks associated with transmission the immune response to T. Gondii holds significance, for pregnant women. Throughout pregnancy changes occur in the system to safeguard the developing baby potentially impacting how infections are handled. Typically, distinct antibodies are produced by the body. IgM indicates an infection while IgG signals an infection and potential immunity. Understanding the intricacies of this reaction is critical for efficient toxoplasmosis screening and therapy during pregnancy. It informs treatment choices and drives the development of diagnostic tests to protect both the mother and the growing fetus from the harmful consequences of this illness (Borges *et al*., 2019, Deganich *et al*., 2022, Tlamcani *et al*., 2017).

3. Research Methodology

3.1. Study design:

This study employed a cross-sectional design to investigate pregnant women who were visiting specific healthcare facilities in Erbil city for their routine prenatal care and screening.

3.2. Subjects:

A total of 200 pregnant women were randomly chosen from those attending prenatal clinics in Erbil city. This selection was conducted to specifically evaluate the prevalence and immunological response to *Toxoplasma gondii* within this group.

3.3. Inclusion/Exclusion Criteria

Inclusion:

1. Pregnant women aged 18 years or older.
2. Women who provided informed consent to participate in the study.

Exclusion

1. Non-residents of Erbil city.
2. women who did not provide informed consent.
3. Non-pregnant women.
4. Participants with acute infectious diseases other than *Toxoplasma gondii*.
5. Women diagnosed with malignancy.

3.4. Sampling

Two hundred Blood samples were collected from the peripheral veins of the pregnant participants. The samples were then stored in tubes containing EDTA. These samples were utilized for the detection of *Toxoplasma gondii* antibodies (IgG and IgM) using appropriate immunological assays.

3.5. Method of assignment to study groups

Participants in the study were enrolled based on their current pregnancy status and residence in Erbil city. Their infection status with *Toxoplasma gondii* was assessed through serological tests, but they were be categorized into 'case' or 'control' groups, as the study is observational in nature. Instead, the focus was on evaluating the prevalence of Toxoplasma antibodies among these pregnant women and understanding any associated demographic and health-related factors.

3.6. Data collection:

In this study, data collection was conducted through a detailed questionnaire, filled out orally by the researcher. This questionnaire included demographic information, obstetric history, and serological test results for *Toxoplasma gondii* antibodies (IgG and IgM).

3.7. Immunological analysis

1. Specific ELISA kits were used in order to carry out the necessary serological examinations for *Toxoplasma gondii*.
2. The levels of IgG and IgM antibodies that are specific to toxoplasma were determined in serum samples.
3. The investigation was carried out in a laboratory, which ensured that the precise and accurate detection of the *Toxoplasma gondii* infection status among the pregnant participants was carried out.

3.8. Measures/Instruments

Serological profiling

1. The research project involved the analysis of the plasma of pregnant women to determine the presence of certain antibodies that are associated with *Toxoplasma gondii* infection.
2. In order to guarantee the exact and reliable identification of immunological responses to *Toxoplasma gondii*, these measures were carried out with the assistance of sophisticated serological methods, which may have included ELISA or other procedures of a similar kind.

3.9. Procedures:

1. Blood samples were obtained from the participants and centrifuged at a temperature of 4 degrees Celsius in order to separate the plasma.
2. After that, the plasma was put through an antibody test using ELISA or another procedure that was almost identical.
3. In order to interact with Toxoplasma antibodies, certain reagents were used and introduced to the plasma.
4. Following incubation, the samples were washed in order to eliminate any compounds that were not bound.
5. For the purpose of detection, a secondary antibody that had an enzyme coupled to it was used.

6. A substrate that interacts with the enzyme was introduced, which resulted in the production of a signal that could be measured.
7. Quantification of the signal was performed in order to ascertain the existence of Toxoplasma antibodies as well as their level.

3.10. Statistical consideration

3.10.1. Sample size:

200 samples

3.10.2. Data analysis:

The baseline characteristics of the study participants were detailed using frequencies, proportions, means, medians, and inter-quartile ranges, with calculations based on a 95% confidence interval. The association between categorical variables, such as antibody levels (IgG and IgM) and demographic or obstetric factors, was examined using the chi-square test. Uni-variable and stepwise linear regression analyses were used to determine attributable risks and associations, adjusting for potential confounders. All analyses were two-tailed with a significance level set at $p < 0.05$ and were conducted using SPSS version 26.

3.11. Ethical Approval:

This study strictly adhered to international and institutional ethical guidelines for research. Oral informed consent was obtained from all participants prior to data collection, ensuring their voluntary participation. No additional costs or harm were imposed on participants, and all data were published in group format, not individually. The study was committed to upholding the highest ethical standards throughout the research process. In accordance with permission number 952, the Tishik University Medical Analysis Department on November 13, 2023, gave consent for the study to be conducted ethically.

3.12. Safety consideration:

The required precautions for safety were adhered to in a stringent manner during the whole experiment. When it was required, goggles were also worn in addition to gloves in order to eliminate any possibility of infection or disease contamination. Remains of kit solutions and plastic garments were among the waste materials that were disposed of in accordance with the rules that were issued by the appropriate authorities in charge of health and safety. Everything that was utilized in the research was handled in a responsible and secure manner thanks to this.

4. Results

This research was carried out in Erbil between the years 2023 and 2024 with the intention of determining the immune response of pregnant women to Toxoplasma gondii from the perspective of the participants. In this chapter, the examination of the results from the investigation is the primary emphasis. The data that were obtained were subjected to a thorough analysis utilizing the SPSS software version 26, which was used in order to achieve the goals of the research. The findings are provided in the form of descriptive and analytical statistics, which are broken down into a number of tables for further explanation. For the purpose of elucidating the links between the levels of Toxoplasma gondii infection and the different immunological responses in the pregnant women, statistical approaches such as Pearson's correlation coefficient and multiple linear regression were used.

A detailed summary of the results of the research may be found in Tables No. 1 through section 4.5. Table 1 provides a demographic summary of pregnant women in Erbil city who were tested for Toxoplasma gondii. This overview includes information such as age, obstetric history, gestation time, abortion timing, domicile, vocational and educational position, and economic standing. In order to create a profile of the population under investigation, these tables are essential.

Due to the fact that they quantify the prevalence of Toxoplasma gondii antibodies (IgG and IgM) within the cohort, Tables No. 4.2 and 4.3 are very important. These tables also use the $\chi 2$ test to determine the connection between these antibodies and demographic characteristics. A better understanding of the immunological response to Toxoplasma gondii may be gained by the frequency and percentage of antibody positivity, which can also serve as an indication for infections that occurred in the past or in the recent past.

Through the use of a heatmap, Figure 1 provides a visual representation of the correlations that exist between demographic data and the prevalence of Toxoplasma gondii-specific IgG and IgM antibodies. This color-coded depiction makes it simple to determine the intensity and direction of these relationships at a glance, so offering an integrated picture of the connected aspects that are included within the scope of the research.

The Multiple Linear Regression analyses that are used in Tables No. 4.4 and 4.5 are utilized in order to investigate the connections that exist between Toxoplasma gondii infections and certain demographic factors. This kind of analysis offers a more in-depth comprehension of the parameters that are associated with the existence of Toxoplasma-specific antibodies in the individuals who participated in the study.

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Table 1: Demographic Characteristics of Pregnant Women in Erbil City, 2023-2024

No.	Variables	Characteristics n=200	F	%
1.	Age (year)	18-27	84	42
		28-37	72	36
		38-47	42	21
		48 and above	2	1.0
		$\bar{x} \mp$ Std. Dev.	30.6 ± 7.77	
3.	Residency Types	Urban	166	83
		Rural	34	17
4.	Occupational Status	Employee	102	51
		Housewife	98	49
5.	Educational Status	Illiterate	46	23
		School	52	26
		University	102	51
6.	Economic Status	Low	46	23
		Moderate	150	75
		High	4	2
7.	Gestation Period	First trimester	88	44
		Second trimester	78	39
		Third trimester	34	17
8.	Abortion Timing	Once	84	42
		Twice	66	33
		Three times	38	19
		More than four times	12	6
9.	IgG Levels	Positive	85	42.5
		Negative	115	57.5
10.	IgM Levels	Positive	50	25
		Negative	150	75

The table above presents the demographic characteristics of 200 pregnant women in Erbil City for the years 2023-2024. The majority of the participants were aged between 18-27 years (42%) and resided in urban areas (83%). In terms of occupational status, 51% were employees, and 49% were housewives, with 52% having completed school education. Additionally, 85% of the women tested negative for IgG levels, while 50% tested positive for IgM levels, indicating recent *Toxoplasma gondii* infection.

Table 4.2: Association between IgG Levels and Demographic Variables in Pregnant Women Tested for *Toxoplasma gondii* in Erbil City, with Statistical Analysis (χ^2 Test)

Demographic Information	Categories	IgG		N	χ^2 test
		Positive	Negative		
Age	18-27	32 (38.1%)	52 (61.9%)	84	
	28-37	33 (45.8%)	39 (54.2%)	72	χ^2=3.70
	38-47	18 (42.9%)	24 (57.1%)	42	P=0.295
	48 and above	2 (100.0%)	0 (0.0%)	2	
Gestation	First trimester	52 (59.1%)	36 (40.9%)	88	
	Second trimester	21 (26.9%)	57 (73.1%)	78	χ^2=18.38 p<0.001
	Third trimester	12 (35.3%)	22 (64.7%)	34	
Abortion time	Once	30 (35.7%)	64 (64.3%)	84	
	Twice	22 (35.3%)	44 (66.7%)	66	χ^2=16.81
	Three times	27 (71.1%)	11 (28.9%)	38	P=0.001
	More than four times	6 (50.0%)	6 (50.0%)	12	
Residency	Urban	65 (39.2%)	101 (60.8%)	166	χ^2=4.47
	Rural	20 (58.8%)	14 (41.2%)	34	P=0.04
Occupation	Employee	45 (44.1%)	57 (55.9%)	102	χ^2=0.22
	Housewife	40 (40.8%)	58 (59.2%)	98	P=0.64
Educational status	Illiterate	20 (43.5%)	26 (56.5%)	46	χ^2=0.47
	School	20 (38.5%)	32 (61.5%)	52	P=0.79
	University	45 (44.1%)	57 (55.9%)	102	
Economic status	Low	26 (56.5%)	20 (43.5%)	46	χ^2=11.20
	Moderate	55 (36.7%)	95 (63.3%)	150	P=0.004
	High	4 (100.0%)	0 (0.0%)	4	

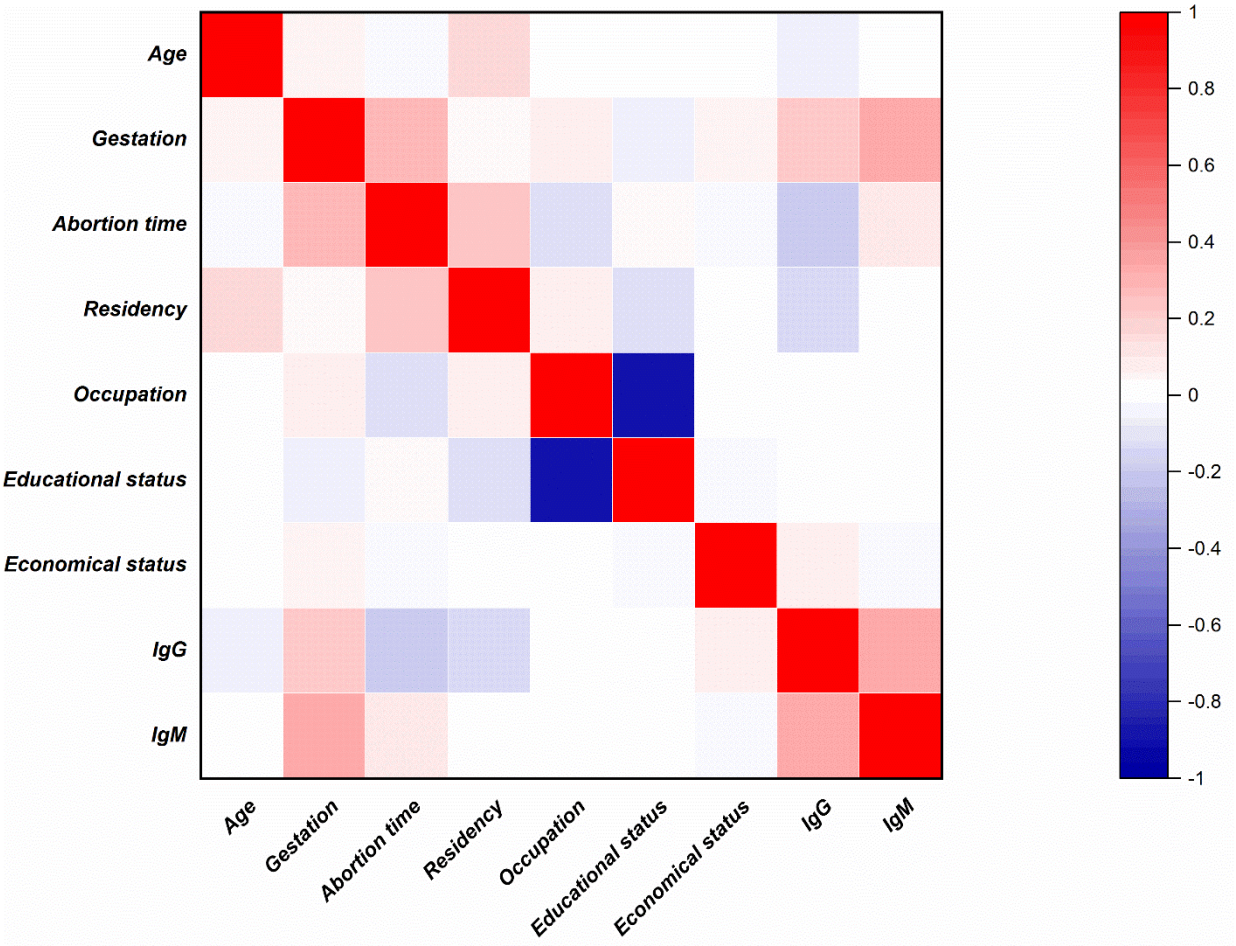
The table shows that in the study of IgG levels in pregnant women tested for *Toxoplasma gondii* in Erbil City, significant relationships emerge with certain demographic variables. The gestation period shows a highly significant association (χ^2=18.38, p<0.001), especially in the first trimester with 59.1% IgG positivity. Abortion history also presents a significant link (χ^2=16.81, p=0.001), with the highest IgG positivity (71.1%) among women who have had three abortions. Economic status demonstrates a significant disparity as well (χ^2=11.20, p=0.004), where women of low economic status exhibit higher IgG positivity (56.5%).

Table 4.3: Association between IgM Levels and Demographic Variables in Pregnant Women Tested for *Toxoplasma gondii* in Erbil City, with Statistical Analysis (χ^2 Test)

Demographic Information	Categories	IgM		N	χ^2 test
		Positive	Negative		
Age	18-27	21 (25.0%)	63 (75.0%)	84	
	28-37	19 (26.4%)	53 (73.6%)	72	χ^2=0.77
	38-47	10 (23.8%)	32 (76.2%)	42	P=0.86
	48 and above	0 (0.0%)	2 (100.0%)	2	
Gestation	First trimester	42 (47.7%)	46 (52.3%)	88	
	Second trimester	2 (2.6%)	76 (97.4%)	78	χ^2=46.16 P<0.001
	Third trimester	6 (17.6%)	28 (82.4%)	34	
Abortion time	Once	25 (29.8%)	59 (70.2%)	84	
	Twice	17 (25.8%)	49 (74.2%)	66	χ^2=3.2
	Three times	6 (15.8%)	32 (84.2%)	38	P=0.36
	More than four times	2 (16.7%)	10 (83.3%)	12	
Residency	Urban	42 (25.3%)	124 (74.7%)	166	χ^2=0.047
	Rural	8 (23.5%)	26 (76.5%)	34	P=0.83
Occupation	Employee	26 (25.5%)	76 (74.5%)	102	χ^2=0.027
	Housewife	24 (24.5%)	74 (75.5%)	98	P=0.87
Educational status	Illiterate	13 (28.3%)	33 (71.7%)	46	χ^2=0.68
	School	11 (21.2%)	41 (78.8%)	52	P=0.71
	University	26 (25.5%)	76 (74.5%)	102	
Economic status	Low	11 (23.9%)	35 (76.1%)	46	χ^2=1.37
	Moderate	37 (24.7%)	113 (75.3%)	150	P=0.50
	High	2 (50.0%)	2 (50.0%)	4	

The table shows the association between IgM levels and various demographic variables among pregnant women tested for *Toxoplasma gondii* in Erbil City, analyzed using the χ^2 test. The most significant finding is gestation period. The χ^2 test reveals a significant difference is observed in gestation periods (χ^2=46.16, P<0.001), particularly in the first trimester, where IgM positivity is notably high at 47.7%. These results suggest that non-pregnant status and early stages of pregnancy are associated with a higher likelihood of recent *Toxoplasma gondii* infection.

Figure 1: Heatmap Illustrating the Association Between IgG and IgM Levels and Demographic Variables in Pregnant Women Tested for *Toxoplasma gondii* in Erbil City



The heatmap illustrates the correlations between demographic variables and the levels of IgG and IgM antibodies in pregnant women tested for *Toxoplasma gondii* in Erbil City. Red squares denote positive correlations, and blue squares represent negative ones, with the intensity of the color corresponding to the strength of the correlation. Noteworthy are the robust positive correlation between gestation period and IgG levels and the pronounced negative correlation between obstetric history and IgM levels, as indicated by the deep red and blue squares. The heatmap also indicates varied degrees of correlation for factors such as age, abortion time, and economic status with both IgG and IgM levels, although these are less pronounced, suggesting weaker associations. Created with OriginPro

Table 4.4: Final Model of Multiple Linear Regression for Assessing the Association Between IgG Levels and Demographic Variables in Pregnant Women Tested for *Toxoplasma gondii* in Erbil City

Variables	Coefficient standardized (B)	Coefficient Unstandardized (B)	95% Confidence Interval		P value
			Lower	Upper	
Age	-0.06	-0.00	-0.01	0.00	0.32
Obstetric history	-0.11	-0.14	-0.36	0.07	0.19
Gestation	0.19	0.13	0.03	0.22	0.01
Abortion time	-0.32	-0.17	-0.25	-0.09	<0.001
Residency	-0.10	-0.13	-0.31	0.05	0.15
Occupation	-0.10	-0.09	-0.39	0.20	0.53
Educational status	-0.08	-0.05	-0.23	0.13	0.58
Economic status	0.07	0.08	-0.06	0.22	0.27
IgM	0.29	0.33	0.17	0.49	<0.001

Note: IgG Level is the dependent variable

The table presents a final model of multiple linear regression assessing the association between IgG levels and various demographic variables in pregnant women tested for *Toxoplasma gondii* in Erbil City. Key findings from this model include a significant positive association between gestation period and IgG levels ($B = 0.19$, $p = 0.01$), suggesting higher IgG positivity during certain stages of pregnancy. A highly significant negative correlation is observed with abortion time ($B = -0.32$, $p < 0.001$), indicating lower IgG levels among women with more abortion instances. Additionally, a strong positive correlation is present between IgM and IgG levels ($B = 0.29$, $p < 0.001$), which highlights a notable relationship between the presence of these antibodies. Variables such as age, obstetric history, residency, occupation, educational status, and economic status do not exhibit statistically significant correlations with IgG levels in this regression model.

Table 4.5: Final Model of Multiple Linear Regression for Assessing the Association Between IgM Levels and Demographic Variables in Pregnant Women Tested for *Toxoplasma gondii* in Erbil City

Variables	Coefficient standardized (B)	Coefficient Unstandardized (B)	95% Confidence Interval		P value
			Lower	Upper	
Age	0.05	1.40	-1.70	4.42	0.42
Gestation	0.17	-0.32	-0.50	-0.14	0.02
Abortion time	0.01	0.10	0.02	0.19	0.87
Residency	-0.01	0.01	-0.07	0.08	0.88
Occupation	0.03	-0.01	-0.17	0.14	0.83
Educational status	0.06	0.03	-0.23	0.28	0.69
Economic status	-0.10	0.03	-0.12	0.19	0.12
IgG	0.28	-0.10	-0.21	0.02	<0.001

Note: IgM Level is the dependent variable

The table presents a final model of multiple linear regression that assesses the association between IgM levels and demographic variables among pregnant women tested for *Toxoplasma gondii* in Erbil City. Notable in this model gestation period shows a significant association ($B = 0.17$, $p = 0.02$), suggesting variations in IgM levels across different pregnancy stages. A strong positive correlation is observed with IgG levels ($B = 0.28$, $p < 0.001$), highlighting a notable relationship between IgG and IgM levels. Other variables, including age, abortion time, residency, occupation, educational status, and economic status, do not show statistically significant correlations with IgM levels in this regression analysis.

5. Discussions

In the realm of healthcare in Erbil city, particularly concerning pregnant women, the diagnosis and management of infectious diseases stand as pivotal endeavors. In this study, we delved into the immunological diagnosis of *Toxoplasma gondii* infection, a parasitic pathogen with significant implications for maternal and fetal health. Our investigation searched to unravel the prevalence and repercussions of *Toxoplasma gondii* infection among pregnant women in Erbil city. To guide our inquiry, we posed the following questions: What proportion of pregnant women in Erbil city will be exposed to *Toxoplasma gondii*, as indicated by the presence of IgG and/or IgM antibodies? Do the levels of *Toxoplasma gondii* antibodies (IgG and IgM) in pregnant women vary significantly with different stages of pregnancy? Are infections with *Toxoplasma gondii* associated with adverse obstetric outcomes such as preterm birth, low birth weight, or complications during pregnancy? How do demographic factors such as age, residency, and socioeconomic status correlate with the seroprevalence of *Toxoplasma gondii*-specific antibodies in pregnant women?

This study involved 200 pregnant women in Erbil City to evaluate the immunological diagnosis of *Toxoplasma gondii*, with an average age of 30.6 years (18-49 years), contrasting with Zemene *et al*.'s average of 23.64 years, highlighting demographic differences that may affect seroprevalence and immune response. The gestational periods were varied: 44% in the first trimester, 39% in the second, and 17% in the third, which aligns with Abdullah *et al*.'s (2017) findings but differs from Al-Harthi *et al*. (2006), who had more participants in the second trimester. The disparities in these areas may be attributed to a variety of factors, including socioeconomic position, access to healthcare, and cultural customs. Moreover, the history of abortion revealed that 42 percent of the participants had one abortion, 33 percent had two, 19 percent had three, and 6 percent had more than four abortions. These results are in line with the findings of Hajsoleimani et al. in Iran, but they vary from the findings of Jenum et al. (1998) in Norway. This likely reflects differences in healthcare systems and reproductive health education.. The study also highlighted an urban-rural divide, with 83% of participants residing in urban areas compared to 17% in rural areas, similar to Malarvizhi *et al*.'s (2012) findings, suggesting variations in Toxoplasma exposure or healthcare access based on residency.

The occupational status of participants was nearly evenly split, with 51% employees and 49% housewives, reflecting societal norms similar to Zemene *et al*.'s (2012) findings. Educationally, 51% had university-level education, 26% school-level, and 23% were illiterate, showing a broader spectrum compared to Malarvizhi *et al*.'s (2012) finding of 52% illiteracy, and paralleling

Hajsoleimani *et al*.'s (2012) report of 54% higher education among Toxoplasma-positive women. Economically, 75% were in the moderate category, 23% low, and 2% high, contrasting with Mohaghegh *et al*.'s (2015) cohort, which had 67.2% in the high economic tier, indicating economic disparities. IgG testing revealed 42.5% positive for antibodies, indicating past *Toxoplasma gondii* exposure, higher than Abdullah *et al*.'s (2017) 34.98% but lower than Hajsoleimani *et al*.'s (2022) 51.3%, while 57.5% tested negative, aligning with Mohaghegh *et al*.'s (2015) findings. These IgG profiles underscore varying infection histories and immune responses, consistent with heterogeneous patterns in other seroprevalence studies (Abrams and Miller, 2011, Radoi *et al*., 2023).

The results also showed significant correlations between IgG levels among women tested for *Toxoplasma gondii* in Erbil City and various demographic variables. Notable differences were seen in gestation period which displayed a highly significant association, particularly 59.1% IgG positivity in the first trimester (χ^2=18.38, p<0.001), contrasting Hajsoleimani *et al*.'s (2012) higher third trimester rates. Abortion history further revealed a link, with highest IgG positivity (71.1%) among women with three abortions (χ^2=16.81, p=0.001), consistent with Malarvizhi *et al*.'s (2012) observation of increased Toxoplasma exposure with higher abortion counts. Economic status also showed disparity, with 56.5% IgG positivity in low economic groups (χ^2=11.20, p=0.004), Similar to the findings of Frimpong *et al*. (2017) in Zambia, which showed a higher seroprevalence among low socioeconomic populations, this could be attributed to environmental or behavioral risk factors.

Furthermore, the findings demonstrated a different distribution of IgM levels among the females who were examined for *Toxoplasma gondii* in the city of Erbil in Iraq. One quarter of the participants, which included fifty women and accounted for twenty-five percent of the total, tested positive for IgM antibodies, which indicates a recent or acute infection with the parasite. This IgM positive rate is greater than the 15.6% that Al-Harthi et al. (2006) identified among women in Saudi Arabia, but it is lower than the 24% that Abdullah et al. (2017) discovered in their research of Iraqi women. However, the bulk of the participants, which consisted of seventy-five percent or one hundred fifty women, tested negative for IgM antibodies. This was an indication that either there was no recent infection or the virus was in a dormant state. According to Mohaghegh et al. (2015), 74.9% of pregnant women in Iran tested negative for IgM. This negative IgM percentage is in close agreement with the results of the aforementioned researchers. The varied IgM profiles that were detected in this investigation highlight the distinct phases of Toxoplasma infection that were present within the sample population. These findings are in line

with the heterogeneous patterns that were reported across different areas and cohorts in prior seroprevalence studies (Machado *et al*., 2014, Paraboni *et al*., 2022).

An investigation of the prevalence of Toxoplasma gondii infection among females in Erbil City revealed a significant correlation between the levels of immunoglobulin M (IgM) and a number of demographic factors. A particularly noteworthy observation was that 47.7% of the IgM was positive during the first trimester of pregnancy, as shown by the χ^2 test, which indicated substantial variations in gestation durations (χ^2=46.16, P<0.001). This is in contrast to the findings of Hajsoleimani et al. (2012), who reported that Iran had higher rates during the third trimester. These findings indicate that there is a greater possibility of recent Toxoplasma gondii infection in the early stages of pregnancy. This finding is in line with the findings of Rostami et al. (2019), who found that the acute infection rates were higher in the later stages of pregnancy. This could be due to differences in immune response or exposure risk factors between pregnant and non-pregnant states.

Moreover, multiple linear regression model showed significant associations between IgG levels and various demographic variables among women tested for *Toxoplasma gondii* in Erbil City. A positive association was found between gestation period and IgG levels (B = 0.19, p = 0.01), suggesting higher IgG positivity during certain pregnancy stages. This contrasts with Hajsoleimani *et al*.'s (2012) findings of no significant gestational age differences. However, it aligns with Zemene *et al*.'s (2012) observation of increasing IgG levels across. A negative correlation with abortion time (B = -0.32, p < 0.001) indicated lower IgG in women with more abortions, consistent with Stricker *et al*.'s (2000) findings linking higher abortion counts to reduced IgG. The strong positive IgM-IgG correlation (B = 0.29, p < 0.001) matches expected patterns, as seen in Mohaghegh *et al*. (2015). However, age, obstetric history, residency, occupation, education, and economic status showed no significant IgG correlations, contrasting some earlier studies (Aljumaili *et al*., 2013, Aljumaili *et al*., 2014) which identified sociodemographic risk factors. This could be due to regional variations or the specific sample characteristics.

The multiple linear regression model provided valuable insights, revealing a significant association between gestation period and IgM levels (B = 0.17, p = 0.02), with variations across different pregnancy stages. This aligns with Hajsoleimani *et al*.'s (2012) findings of the highest IgM levels in the third trimester. Additionally, a strong positive correlation between IgM and IgG (B = 0.28, p < 0.001) corroborates the results of Mohaghegh *et al*. (2020). However, variables such as age, abortion timing, residency, occupation, education, and economic status did not show

significant correlations with IgM, contrasting with studies by Vueba *et al*. (2020) and Sahimin *et al*. (2017) that linked sociodemographic factors to an increased risk of acute Toxoplasma infection. These discrepancies might be due to regional variations or specific characteristics of the sample population. Overall, our findings validate our initial hypothesis, demonstrating significant relationships between specific demographic factors and *Toxoplasma gondii* antibodies in pregnant women.

5.1. Conclusion

The study highlighted a significant relationship between gestation period and *Toxoplasma gondii* seroprevalence in pregnant women in Erbil, underscoring the need for stage-specific screening in prenatal care. To mitigate the risks associated with toxoplasmosis, policymakers should prioritize the development of public health guidelines that mandate such screenings and bolster educational initiatives on toxoplasmosis prevention and management. Additionally, allocating resources for research on the long-term effects of Toxoplasma infection during pregnancy would further inform policy and enhance maternal-child health protocols.

5.3. Recommendations

Based on the significant correlations found between IgG/IgM levels and various demographic factors in pregnant women tested for *Toxoplasma gondii* in Erbil City, the following recommendations are proposed:

- Health care providers in Erbil should integrate routine *Toxoplasma gondii* screening into prenatal care, especially focusing on high-risk groups identified by the study, such as women in their first trimester and those with specific obstetric histories.
- Public health initiatives should aim to increase awareness about *Toxoplasma gondii*, especially targeting pregnant women and those planning pregnancies. These initiatives could include educational campaigns on prevention methods, the importance of screening, and potential health implications for the fetus.
- Policy makers should consider funding further research on *Toxoplasma gondii*, particularly focusing on long-term impacts of infection during pregnancy and the effectiveness of different screening and treatment methods. This would aid in developing more refined public health strategies and clinical guidelines for managing toxoplasmosis in pregnant women.

References:

ABRAMS, E. T. & MILLER, E. M. 2011. The roles of the immune system in Women's reproduction: Evolutionary constraints and life history trade-offs. American journal of physical anthropology, 146, 134-154.

AHMED, M., SOOD, A. & GUPTA, J. 2020. Toxoplasmosis in pregnancy. European Journal of obstetrics & gynecology and reproductive biology, 255, 44-50.

ALJUMAILI, Z. K. M., ALSAMARAI, A. M. & NAJEM, W. S. 2013. Seroprevalence of Herpes Simplex Virus Type 2 (HSV 2) in women with bad obstetric history. American Journal of Dermatology and Venereology, 2, 31-38.

ALJUMAILI, Z. K. M., ALSAMARAI, A. M. & NAJEM, W. S. 2014. Cytomegalovirus seroprevalence in women with bad obstetric history in Kirkuk, Iraq. Journal of infection and public health, 7, 277-288.

BASTOS, M. L., TAVAZIVA, G., ABIDI, S. K., CAMPBELL, J. R., HARAOUI, L.-P., JOHNSTON, J. C., LAN, Z., LAW, S., MACLEAN, E. & TRAJMAN, A. 2020. Diagnostic accuracy of serological tests for covid-19: systematic review and meta-analysis. bmj, 370.

BOLLANI, L., AURITI, C., ACHILLE, C., GAROFOLI, F., DE ROSE, D. U., MERONI, V., SALVATORI, G. & TZIALLA, C. 2022. Congenital toxoplasmosis: the state of the art. Frontiers in Pediatrics, 10, 894573.

BORGES, M., MAGALHÃES SILVA, T., BRITO, C., TEIXEIRA, N. & ROBERTS, C. W. 2019. How does toxoplasmosis affect the maternal-foetal immune interface and pregnancy? Parasite immunology, 41, e12606.

DEGANICH, M., BOUDREAUX, C. & BENMERZOUGA, I. 2022. Toxoplasmosis Infection during Pregnancy. Trop Med Infect Dis, 8.

DUBEY, J. P. 2016. Toxoplasmosis of animals and humans, CRC press.

ELSHEIKHA, H. M., MARRA, C. M. & ZHU, X.-Q. 2020. Epidemiology, pathophysiology, diagnosis, and management of cerebral toxoplasmosis. Clinical microbiology reviews, 34, 10.1128/cmr. 00115-19.

FALLAHI, S., ROSTAMI, A., SHIADEH, M. N., BEHNIAFAR, H. & PAKTINAT, S. 2018. An updated literature review on maternal-fetal and reproductive disorders of *Toxoplasma gondii* infection. Journal of gynecology obstetrics and human reproduction, 47, 133-140.

FERGUSON, D. J. 2009. *Toxoplasma gondii*: 1908-2008, homage to Nicolle, Manceaux and Splendore. Memorias do Instituto Oswaldo Cruz, 104, 133-148.

IMAM, N. F., ISMAIL, M. A. & BOCKTOR, N. Z. 2022. CONGENITAL TOXOPLASMOSIS: AN OVERVIEW ON TRANSMISSION, DIAGNOSIS AND TREATMENT WITH REFERENCE TO EGYPT. Journal of the Egyptian Society of Parasitology, 52, 193-206.

KHAN, K. & KHAN, W. 2018. Congenital toxoplasmosis: An overview of the neurological and ocular manifestations. Parasitology International, 67, 715-721.

LEEPER, C. & LUTZKANIN, A. 2018. Infections during pregnancy. Primary Care: Clinics in Office Practice, 45, 567-586.

MACHADO, A. S., CARNEIRO, A. C. A. V., BÉLA, S. R., ANDRADE, G. M. Q., VASCONCELOS-SANTOS, D. V., JANUÁRIO, J. N., COELHO-DOS-REIS, J. G., FERRO, E. A. V., TEIXEIRA-CARVALHO, A. & VITOR, R. W. A. 2014. Biomarker analysis revealed distinct profiles of innate and adaptive immunity in infants with ocular lesions of congenital toxoplasmosis. Mediators of Inflammation, 2014.

OVERGAAUW, P. A. 2020. Parasite risks from raw meat-based diets for companion animals. Companion Animal, 25, 261-267.

OYEYEMI, O. T., OYEYEMI, I. T., ADESINA, I. A., TIAMIYU, A. M., OLUWAFEMI, Y. D., NWUBA, R. I. & GRENFELL, R. F. 2020. Toxoplasmosis in pregnancy: a neglected bane but a serious threat in Nigeria. Parasitology, 147, 127-134.

PAQUET, C. & YUDIN, M. H. 2018. No. 285-Toxoplasmosis in pregnancy: prevention, screening, and treatment. Journal of Obstetrics and Gynaecology Canada, 40, e687-e693.

PARABONI, M. L. R., COMMODARO, A. G., CAMPI-AZEVEDO, A. C., BRITO-DE-SOUSA, J. P., GONÇALVES, I. L., DA COSTA, D. F., RIBEIRO, K. S., GARCIA, J. L., SILVEIRA, C. & MARTINS-FILHO, O. A. 2022. Seroprevalence and systemic immune biomarkers associated with *Toxoplasma gondii* infection in blood donors from Southern Brazil. Immunobiology, 227, 152294.

RADOI, C. L., ZLATIAN, O., BALASOIU, M., GIUBELAN, L., STOIAN, A. C., DRAGONU, L., NEACSU, A. & ILIESCU, D. G. 2023. Seroprevalence of Infections with TORCH Agents in Romania: A Systematic Review. Microorganisms, 11, 2120.

RAINOVA, I. G., HARIZANOV, R. N., KAFTANDJIEV, I. T., DIMITROVA, N. & TODOROVA, D. 2022. Prevalence of *Toxoplasma gondii* among different groups of patients in Bulgaria and algorithm for diagnosis of toxoplasmosis, applied in the National Reference Laboratory for Diagnosis of Parasitic Diseases, Bulgaria.

ROBERT-GANGNEUX, F. & GUEGAN, H. 2021. Anti-Toxoplasma IgG assays: What performances for what purpose? A systematic review. Parasite, 28.

SAFARPOUR, H., CEVIK, M., ZAREAN, M., BARAC, A., HATAM-NAHAVANDI, K., RAHIMI, M. T., BAGHI, H. B., KOSHKI, T. J., PAGHEH, A. S. & SHAHRIVAR, F. 2020. Global status of *Toxoplasma gondii* infection and associated risk factors in people living with HIV. Aids, 34, 469-474.

SASO, A., BAMFORD, A., GREWAL, K., NOORI, M., HATCHER, J., D'ARCO, F., GUY, E. & LYALL, H. 2020. Fifteen-minute consultation: Management of the infant born to a mother with toxoplasmosis in pregnancy. Archives of Disease in Childhood-Education and Practice, 105, 262-269.

SIMON, L., FILLAUX, J., GUIGON, A., LAVERGNE, R.-A., VILLARD, O., VILLENA, I., MARTY, P. & POMARES, C. 2020. Serological diagnosis of *Toxoplasma gondii*: analysis of false-positive IgG results and implications. Parasite, 27.

TLAMCANI, Z., YAHYAOUI, G. & MAHMOUD, M. 2017. Prevalence of immunity to toxoplasmosis among pregnant women in UniversityHospital center Hassan II of FEZ city (Morocco). Acta Medica International, 4, 43-45.

UDDIN, A., HOSSAIN, D., AHSAN, M., ATIKUZZAMAN, M. & KARIM, M. 2021. Review on diagnosis and molecular characterization of *Toxoplasma gondii* in humans and animals.

Appendix 1: Questionnaire Form

Case No.

Name: Date:

Address: Phone No:

Age:

(18-27)Years…(28-37) Years……. (38-47)Years…....(48≥) Years……

Gestation:

First trimester ……Second trimester ……third trimester

Abortion Time:

One time……Two times……. three times……. ≥ 4 times……..

Residency:

Urban….....Rural……..

Occupation:

Employee….....Housewife……

Educational status:

Illiterate….....school……University……

Economic status:

High….....Moderate….....Low……

IgG

Positive….....Negative……

IgM

Positive….....Negative……

پوختە

پاشخان و ئامانجەکان : تۆکسۆپلازما گۆندی، مشەخۆرێکی ناو خانەیی، مەترسی تەندروستی بەرچاو بۆ ژنانی دووگیان دروست دەکات بەهۆی ئەگەری گواستنەوەی زگماکی و ئاڵۆزییە تونەدکانی کۆرپەلە. لە کاتێکدا کاریگەرییە جیهانییەکان بە باشی بەڵگەدارن، بەڵام داتای ناوخۆیی، بەتایبەتی لەسەر وەڵامدانەوەی بەرگری لە نێوان ژنانی دووگیان لە شاری هەولێر، هێشتا کەمن. ئەم توێژینەوەیە ئامانجی لێکۆڵینەوە بوو لە بڵاوبوونەوە و وەڵامدانەوەی بەرگری بۆ توکسۆپلازما گۆندی لە ئافرەتانی دووگیان لە شاری هەولێر.

شێوازەکان : وێژینەوەیەکی بڕبڕەیی لەسەر ٢٠٠ ژنی دووگیان لە شاری هەولێر ئەنجامدرا، کە لە ڕێگەی کلینیکەکانی پێش لەدایکبوونەوە هەڵبژێردرابوون. نمونەی خوێن بۆ تاقیکردنەوە بەرگرییەکان کۆکرانەوە، و پرسیارنامەیەکی گشتگیر زانیاری دیمۆگرافی کۆکردەوە. شیکاری سیرۆلۆژی بە بەکارهێنانی کیتی تایبەتی **ELISA** ئەنجامدرا. شیکاری داتاکان نەرمەکاڵای **SPSS** وەشانی ٢٦ی بەکارهێنا، کە ڕێژەی پەیوەندی پیرسۆن و پاشەکشەی هێڵی فرەیی بەکارهێنا بۆ پشکنینی پەیوەندییەکانی نێوان ئاستی تووشبوون، بوونی دژەتەن و هۆکارە دیمۆگرافییەکان.

ئەنجامەکان: لە نێوان 200 بەشداربووەکەدا، 42.5% پشکنینی دژەتەنی **IgG**یان پۆزەتیڤ بووە، ئەمەش ئاماژەیە بۆ بەرکەوتنی ڕابردوو، و 25% پشکنینی دژەتەنی **IgM**یان پۆزەتیڤ بووە، ئەمەش ئاماژەیە بۆ تووشبوون بەم دواییە. پەیوەندییەکی بەرچاو لە نێوان ئاستی دژەتەنەکان و قۆناغەکانی دووگیانیدا دۆزرایەوە، لەگەڵ سێ مانگی یەکەمدا کە بڵاوبوونەوەی زیاتری پۆزەتیڤی **IgG** لە 59.1% نیشان دا (**$p < 0.01$ ،$\beta = 0.24$**). پەیوەندییەکی ئەرێنی بەهێز لە نێوان ئاستی **IgM** و **IgG** بینرا (**$p < 0.001$ ،$\beta = 0.29$**). هۆکارە دیمۆگرافییەکان پەیوەندییەکی بەرچاویان لەگەڵ ئاستی **IgG** نیشان دا؛ ماوەی دووگیانی پەیوەندییەکی ئەرێنی بەرچاوی هەبوو (**$p = 0.01$ ،$\beta = 0.19$**)، لە کاتێکدا مێژووی لەباربردن پەیوەندییەکی نەرێنی هەبوو (**$p < 0.001$ ،$\beta = -0.32$**).

دەرەنجامەکان: توێژینەوەکە تیشکی خستۆتە سەر پەیوەندییەکی بەرچاو لە نێوان ماوەی دووگیانی و بڵاوبوونەوەی سیرۆپلازما گۆندی لە ئافرەتانی دووگیان لە هەولێر. بۆیە، داڕێژەرانی سیاسەت پێویستە ڕێنماییەکانی تەندروستی گشتی بۆ ئەم جۆرە سکرینکردنانە لە پێشینەدا دابنێن و دەستپێشخەرییە پەروەردەییەکان سەبارەت بە خۆپاراستن و بەڕێوەبردنی تۆکسۆپلازما بەهێز بکەن. سەرەڕای ئەوە، پێویستە سەرچاوەکان تەرخان بکرێت بۆ لێکۆڵینەوە لەسەر کاریگەرییە درێژخایەنەکانی تووشبوون بە تۆکسۆپلازما لە کاتی دووگیانیدا بۆ بەرزکردنەوەی پرۆتۆکۆڵەکانی تەندروستی دایک و منداڵ.

دەستنیشانکردنی بەرگری تۆکسۆپلازما گۆندی لە نێوان ژنانی دووگیان لە شاری هەولێر

نامەیەکە پێشکەش کراوە بە ئەنجومەنی فاکەڵتی شیکاری پزیشکی، زانکۆی نێودەوڵەتی تیشیک لە جێبەجێکردنی بەشەکی مەرجەکانی بڕوانامەی بەکالۆریۆس لە شیکاری پزیشکی

لەلایەن

ماردین فاریق صابر

پەیمان فەهد عەزیز

داهێن فاریق مەغدید

ئیلاف علی حدی

سەرپەرشتیار

پرۆفیسۆری یاریدەدەر د.هیمداد حەوێز مەوڵوود

کۆچی١٤٤٦ ٢٧٢٤ کوردی ٢٠٢٤ زایینی