

## Investigation of *Toxoplasma gondii* Seroprevalence in Pregnant Women in Çankırı

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**Abstract:** *Toxoplasma gondii* can be transmitted to humans through consumption of raw or undercooked meat containing live tissue cysts, consumption of water or food contaminated with oocysts shed from cat feces, and vertical transmission during pregnancy or through tissue, organ, and blood transfusion. The aim of this study was to investigate the seroprevalence of *T. gondii* in patients admitted to the Obstetrics and Gynecology Department of Çankırı State Hospital (ÇSH). In this study, anti-*T. gondii* IgG and IgM antibody levels of 62 pregnant women between the ages of 17 and 47 who applied to ÇSH gynecology and obstetrics outpatient clinic for normal pregnancy follow-up between June 2022 and January 2023 were investigated. According to the results of the studies, anti-*T. gondii* IgG positivity is 12.9% and negative 87.1% and anti-*T. gondii* IgM positivity is 0% while it was found to be 100% negative. According to these results, it is reported that the majority of pregnant women do not encounter *T. gondii* and; therefore, they should be more careful in terms of congenital toxoplasmosis. *T. gondii* can be transmitted to humans through consumption of water or food contaminated with oocysts excreted in cat feces and through vertical transmission or tissue, organ, and blood transfusion during pregnancy. Therefore, pregnant women should be carefully monitored for *T. gondii*.

**Keywords:** anti-*T. gondii* IgG, anti-*T. gondii* IgM, ELISA, Pregnant, *Toxoplasma gondii*.

### Çankırı İlindeki Gebe Kadınlarda *Toxoplasma gondii* Seroprevalansının Araştırılması

**Öz:** *Toxoplasma gondii*, canlı doku kistleri içeren çiğ veya az pişmiş et tüketimi, kedi dışkılarından atılan ookistlerin bulaştığı su veya gıdaların tüketilmesi, ayrıca hamilelik sırasında dikey geçiş veya doku, organ ve kan nakli yoluyla insanlara bulaşabilmektedir. Çalışmanın amacı Çankırı Devlet Hastanesi (ÇSH) kadın doğum servisine başvuran hastalarda *T. gondii* seroprevalansını araştırmaktır. Bu çalışmada Haziran 2022-Ocak 2023 tarihleri arasında ÇSH Kadın Hastalıkları ve Doğum polikliniğine normal gebelik takibi için başvuran 62 gebenin anti-*T. gondii* IgG ve IgM antikor değerleri araştırılmıştır. Çalışmalardan elde edilen sonuçlara göre anti-*T. gondii* IgG pozitifliği %12.9; negatif %87.1 ve anti-*T. gondii* IgM pozitif %0; negatif %100 olduğu belirlenmiştir. Bu sonuçlara göre gebelerin büyük çoğunluğunun *T. gondii* ile karşılaşmadığı ve bu nedenle konjenital toxoplazmoz açısından daha dikkatli olmaları gerektiği bildirilmektedir. Gebeler tarafından *T. gondii*'nin kedi dışkısı ile atılan ookistlerle kontamine olmuş su veya gıdaların tüketilmesi ve hamilelik sırasında dikey bulaşma yoluyla veya doku, organ ve kan nakli yoluyla insanlara bulaşabildiği bilinmelidir. Bu nedenle gebeler *T. gondii* açısından dikkatle takip edilmelidir.

**Anahtar kelimeler:** anti-*T. gondii* IgG, anti-*T. gondii* IgM, ELISA, Gebe, *Toxoplasma gondii*.

### 1. Introduction

*Toxoplasma gondii* is a zoonotic parasitic disease seen all over the world (Liu et al., 2020; Yücesan et al., 2021). It is known that approximately one billion people are infected with this parasite today (Xiao & Yolken, 2015). Toxoplasmosis maintains its importance today since it was first described in 1908 due to its high prevalence and the serious infections it causes in pregnant and immunosuppressed people (Dubey, 1996; Shapiro et al., 2019). *T. gondii* reproduces in both sexual and asexual stages. The sexual stage occurs only in cats and felines, which are the final hosts, by the fusion of gametocytes in the intestinal epithelium. Ultimately, cats shed oocysts containing four sporozoites (Kochanowsky & Koshy 2018).

*Toxoplasma gondii* can be transmitted to humans

through the ingestion of raw or undercooked meat containing live tissue cysts, the ingestion of water or food contaminated by oocysts excreted in cat feces, and also by vertical transmission during pregnancy or through tissue, organ, and blood transfusions. The diagnosis of toxoplasmosis is made serologically by detecting *Toxoplasma* antibodies which can also be made by mouse/cell culture inoculation experiments, histological evaluation from tissue sections, or by searching for tachyzoites in smears prepared from body fluids (Montoya, 2002).

In individuals with normal immune systems, toxoplasmosis is asymptomatic in 80-90% of cases. However, in those with conditions that cause immune deficiency, such as organ transplantation, AIDS,

lymphoma, or leukemia, or as a result of reactivation, bradyzoites stored in the organs can become active and cause fatal diseases (Blanchard et al., 2015). Organ transplant recipients have been proven to have acquired toxoplasmosis from an infected donor. Thus, it has been evaluated that some tissues host parasites (Galvan-Ramirez et al., 2018; Renoult et al., 1997; Montoya et al., 2001; Wreghitt et al., 1989). Elevation of IgG and IFN- $\gamma$  against *T. gondii* indicates an immune reaction. Therefore, when faced with immune-suppressing events such as chemotherapy, organ transplantation, or AIDS, tachyzoite may return to replication (Shariah et al., 2010; Zhao and Ewald, 2020).

Parasitemia, which develops as a result of mother's *T. gondii* infection during pregnancy, can result in abortion, still/premature birth, or congenital toxoplasmosis (Bobić et al., 2019; Galvan-Ramirez et al., 2012; Jones et al., 2003). In transplacental transmission, although the gestational age at the time of maternal infection is important, this risk can be reduced with prenatal treatment and protection (Berghold et al., 2016). Most infected newborns have no abnormalities. However, if left untreated, chorioretinitis and neurological damage may develop. Hypophrenia, epilepsy, retinchoroiditis, cardiovascular defects, and respiratory system damage may occur in children infected with *T. gondii* (Zhoun et al., 2011). Babies born with congenital toxoplasmosis infection may develop serious and potentially fatal sequelae such as intracranial calcifications, hydrocephalus, ascites, hepatosplenomegaly, pericardial or pleural effusions, hydrops fetalis, motor and hearing disorders, and chorioretinitis. Early diagnosis during pregnancy enables early initiation of treatment, thereby preventing negative clinical outcomes. Nevertheless, when determining whether to commence treatment in the neonatal period, it is imperative to assess the serological tests of infected mothers and babies (Akçalı et al., 2017; Saso et al., 2020).

## 2. Material and Methods

In this study, anti-*T. gondii* IgG and IgM values of 62 pregnant women aged between 17 and 47 years who applied to the Çankırı State Hospital (ÇSH) Gynecology and Obstetrics outpatient clinic for normal pregnancy follow-up between June 2022 and January 2023 were studied. Age groups of pregnant women were determined based on ten-year periods starting from the lowest age of pregnancy. The patients were divided into four age groups: 17-26, 27-36, 37-46, and over 47. The test samples

were evaluated by a student from Çankırı Karatekin University (ÇAKÜ), Faculty of Health Sciences, Department of Midwifery using the blood of pregnant women taken for testing along with sociodemographic data obtained from the archive records of ÇSH. The tests were performed using some of the serum samples stored as -20 °C blank samples in the Biochemistry archives of ÇSH. The blood samples were tested in the laboratory of Çankırı Karatekin University Center (ÇANKAM) under the supervision of supervisors and graduate students. The anti-*T. gondii* IgG and IgM values of the patients were determined using the Thermo Scientific Plate Inkubator and Thermo Scientific Multiscan Ascent Analyzer (Thermo Scientific/ USA) and anti-*T. gondii* IgG and anti-*T. gondii* IgM (Dia.Pro Diagnostic Bioprobes, Italy) ELISA kit.

This project was approved by the Çankırı Karatekin University Ethics Committee with the decision number 29 dated 23.11.2022.

**Statistical Analysis:** Analysis of the statistical data of this study was performed with SPSS version 23 software. Descriptive characteristics are given using frequencies and percentages.

## 3. Results

The sociodemographic data obtained in this study were presented in Table 1. In our study, it was determined that all pregnant women in Table 1 were married. In addition, it had been defined that pregnancies occur between the ages of 27 and 36 when pregnancy is the most common. The highest age group in which women became pregnant was found to be (62,9%). This was followed by the 17-26 (27,4%) and 37-46 (9,7%) age groups, respectively. When test positivity is evaluated according to age, the highest rate is 27-36 (9,7%) years old. It was found that this was followed by 17-26 (1,6%) years of age and 37-46 (1,6%) years of age. Anti-*T. gondii* IgM was not found positive in any patient. Most pregnant women had social security (95,2%) and the areas they lived in are urban (96,8%). In this study, it was also observed that pregnant women were mostly (77,5%) not working/housewives. The results of the tests performed on *T. gondii* were given in Table 1. At the same time, the anti-*T. gondii* IgG and anti-*T. gondii* IgM results of pregnant women were determined. The results of the studies indicated that 12,9% of the participants were positive for anti-*T. gondii* IgG, 87,1% were negative, and 0% were positive for anti-*T. gondii* IgM. It was found that 100% of the participants were negative for anti-*T. gondii* IgM.

Table 1. Sociodemographic findings and *Toxoplasma gondii* serological results in pregnant women.

Sociodemographic Information		n	%	Tests Detected Positive				Tests Detected Negative			
				Anti- <i>Toxoplasma gondii</i> IgG		Anti- <i>Toxoplasma gondii</i> IgM		Anti- <i>Toxoplasma gondii</i> IgG		Anti- <i>Toxoplasma gondii</i> IgM	
				n	%	n	%	n	%	n	%
Marital Status	Married	62	100	8	12.9	0	0	54	87.1	62	100
	Single	0	0	0	0	0	0	0	0	0	0
	Total	62	100	8	12.9	0	0	54	87.1	62	100
Age	17-26	17	27.4	1	1.6	0	0	16	25.8	62	100
	27-36	39	62.9	6	9.7	0	0	33	53.2	62	100
	37-46	6	9.7	1	1.6	0	0	5	8.1	62	100
	46 and over	0	0	0	0	0	0	0	0	0	0
	Total	62	100	8	12.9	0	0	54	87.1	62	100

Sociodemographic Information		n	%	Tests Detected Positive				Tests Detected Negative			
				Anti- <i>Toxoplasma gondii</i> IgG		Anti- <i>Toxoplasma gondii</i> IgM		Anti- <i>Toxoplasma gondii</i> IgG		Anti- <i>Toxoplasma gondii</i> IgM	
				n	%	n	%	n	%	n	%
Area of Origin	Rural	2	3.2	2	3.2	0	0	0	0	62	100
	Urban	60	96.8	6	9.7	0	0	54	87.1	62	100
	Total	62	100	8	12.9	0	0	54	87.1	62	100
Social Security	Yes	59	95.2	8	12.9	0	0	51	82.2	62	100
	No	3	4.8	0	0	0	0	3	4.9	62	100
	Total	62	100	8	12.9	0	0	54	87.1	62	100
Occupation	Not working /Housewife	48	77.5	7	11.3	0	0	41	66.2	62	100
	Employee	6	9.6	0	0	0	0	6	9.6	62	100
	Officer	8	12.9	1	1.6	0	0	7	11.3	62	100
	Retired	0	0	0	0	0	0	0	0	62	100
	Total	62	100	8	12.9	0	0	54	87.1	62	100

#### 4. Discussion and Conclusion

Toxoplasmosis passes asymptomatic or like a flu infection in normal people. Although toxoplasmosis generally continues to be asymptomatic and the disease goes unnoticed, it actually shows that this zoonotic disease has a high seroprevalence in every region of our country (Polat et al., 2002; Kölgelir et al., 2009; Demirci & Mor 2021; Aydoğmuş et al; 2022; Görkem et al., 2022). However, it is also known that extremely severe infections occur in symptomatic cases. In cases where acute infection is suspected, a single test should not be sufficient for diagnosis (Babür et al., 2021).

This study was conducted on pregnant women who applied to ÇSH gynecology outpatient clinic. The majority of pregnant women are women who have social security (59/95.2%) and live in urban life (60/96.8%). One of the difficulties in collecting data in this study is that the entire group consists of conscious pregnant women. The rate of *T. gondii* may increase because pregnant women from rural areas are more closely associated with animals. All pregnant women were married (62/100%). The highest age group in which women became pregnant was found to be 27-36 (39/62.9%). This is followed by the 17-26 (17/27.4%) and 37-46 (6/9.7%) age groups, respectively. 27-36 years of age is the age group with the highest positivity (6/9.7%). This is followed by the 17-26 (1/1.6%) and 37-46 (1/1.6%) age groups, respectively. Anti-*T. gondii* IgG positivity was detected in all pregnant women (8/12.9%). Anti-*T. gondii* IgM positivity was not detected in 62 pregnant women. The results of this study are similar to the data of Aydoğmuş et al., (2022), Keçecioğlu et al., (2022), Durdu and Mutlu (2017), Parlak et al., (2015), and Tamer et al., (2009). Additionally, Anti-*T. gondii* IgG and Anti-*T. gondii* IgM positivity values are shown in Table 1.

The ELISA method can detect antibodies against *T. gondii*, circulating immune complex structures containing *Toxoplasma* antigens, and free *Toxoplasma* antigens. Since ELISA is an easy-to-perform and automatic system that does not require expertise, multiple samples can be tested simultaneously. In the last 20 years, granule antigens such as GRA1, GRA2, GRA4, GRA6, GRA7, and GRA8; rhoptry proteins such as ROP1 and ROP2; microneme proteins such as MIC1, MIC2, MIC3, MIC4, and MIC5; and surface

antigens such as SAG1 and SAG2 have begun to be detected with ELISA methods. (Liu et al., 2015). In the ELISA method, the first marker seen in the blood of a person with acute infection is IgM. It occurs in the 1st week. It peaks in 2-3 weeks, gradually decreases, and can last up to 6-8 months. IgG type antibodies begin to appear in the 1st month. It remains at the highest titer for 6-8 weeks. It remains at the highest level for 6-8 months. It decreases to a low level in 12-18 months. Since IgA type antibodies are produced before IgMs, they can also be used as a marker in acute infections and can remain positive for months. IgE type antibodies may remain high for a very short time and may indicate acute infection (Robert-Gangneux & Dardé, 2012).

In studies, ELISA IgM, IgG, and ELISA IgG avidity methods can be used in the diagnosis of toxoplasmosis. With these methods, results can be achieved quickly and are reliable. Due to the risk of congenital toxoplasmosis, it has been proven in many studies that especially in pregnant women, in cases where ELISA gives IgM negative/positive and IgG positive results and high avidity is determined, infection occurs within 3-4 months and the method is reliable. However, it should be taken into consideration that interpreting suspicious or low avidity results using single methods may lead to incorrect results (Babür et al., 2021). In such cases, control and different verification tests are needed. In addition, knowing the avidity value along with the serological results against toxoplasmosis during pregnancy is also important in terms of excluding acute toxoplasmosis, anti-*T. gondii* IgM positivity can persist for a long time in some people. Besides, it is very important to evaluate the Toxo IgG-avidity test to determine the risk of congenital transmission in pregnant women who are being examined for toxoplasmosis and whose anti- *T. gondii* IgM and anti-*T. gondii* IgM are positive (Robert-Gangneux & Dardé, 2012).

In order to accurately evaluate the serological profiles detected in pregnant women, it is necessary to know the details about the antibody response that occurs during infection. Namely; IgA, IgE, and IgM antibodies begin to be produced in the first week after infection with *T. gondii*. While IgE disappears rapidly from the serum, IgA and IgM reach the maximum level at the end of the first month.

While IgM antibodies become negative before the sixth month in 25% of patients, they may remain positive for a year or even up to two years in other patients, depending on the sensitivity of the test method used. In some patients, IgM may become negative before three months or remain below detectable levels. IgA becomes negative more quickly than IgM; however, it is also stated that it can remain positive for up to nine months. IgG antibodies begin to become positive 1-3 weeks after IgM begins to rise, reach the maximum level in 2-3 months, and remain positive for life with titers that may vary from person to person. In line with this information, it is recommended that the IgG avidity test be performed in pregnant women with positive anti-*T. gondii* IgM and IgG tests to determine whether the infection is in the early or late stages. Although it varies depending on the method used, high IgG avidity values indicate that the person had the infection 3-5 months ago, while low avidity is considered an indicator of a new infection. However, since low-avidity antibodies can remain in the serum for months, when a low-avidity value is detected, it may not always mean a newly acquired infection. In such a case, laboratory diagnosis must be confirmed by PCR from amniotic fluid and also supported by clinical and ultrasonographic findings. In Türkiye, IgG varies between %18,9 and %82,9, IgM value varies between %0,02 and %9,87.

In this study, anti-*T. gondii* IgG and anti-*T. gondii* IgM

results in pregnant women were examined. Anti-*T. gondii* IgG 12.9%; negative 87.1% and anti-*T. gondii* IgM positive 0% while it was found to be 100% negative. Avidity tests are actually extremely important for pregnant women and should be followed. By determining the IgG avidity test, if there is an infection in pregnant women, it can be predicted when it was acquired. Thus, the history of the infection becomes clear. If there are false negative results that may occur as a result of ELISA tests or suspicious and risky situations that may cause false positives due to cross reactions, in addition to serological tests, it is also reliable to apply molecular tests by laboratories with suitable infrastructure (UMS, 2015).

Table 2 shows the results of studies conducted on pregnant women in Türkiye. In Türkiye, anti-*T. gondii* IgG values range between 17.5% and 82.9%, and anti-*T. gondii* IgM values range between 0.2% and 5.4%. In our study, anti-*T. gondii* IgG and anti-*T. gondii* IgM in pregnant women were studied together. Anti-*T. gondii* IgG was found to be % 12.9 positive and anti-*T. gondii* IgM was not positive in pregnant women. Since pregnant women could not be followed up in this study, no avidity test was performed or followed up on any pregnant woman. Normally, these women should be followed by their gestational age and anti-*T. gondii* IgG and IgM and avidity tests.

Table 2. Studies carried out in Türkiye according to the provinces in alphabetical order

DATE	PLACE	LOCALIZATION	METHOD	TOTAL PREGNANT	IgG	IgM	RESOURCES
Jan 2007- Dec 2008	Adıyaman	Adıyaman 82nd Year State Hospital	ELISA	455	%48	%0.65	(Kölgelir et al., 2009)
2010-2011	Afyon	Afyon University	ELISA	565/567	%22.7	%1.6	(Gülşah et al., 2013)
01 Jan 2012- 31 Dec 2014	Afyon	Afyon University	ELISA	1284	%23.4	%1.5	(Şimşek et al., 2016)
June 2000- Dec 2003	Afyon	Kocatepe University Faculty of Medicine Hospital	ELISA	244	%30.7	--	(Yılmaz et al., 2004)
2002	Afyon	Kocatepe University Faculty of Medicine Hospital		540	%28.9	%2.5	(Altındış & Tanır, 2002)
July 2019- June 2021	Aksaray	Aksaray Training and Research Hospital	CMIA	3218	%21	%1.4	(Çiçek et al., 2023)
Apr 2018- Marc 2021	Aksaray	Aksaray Training and Research Hospital	ELISA	456	%17.1	%0.60	(Bülbül & Bekmezci, 2022)
Jan 2021- Nov 2022	Ankara	Ankara Training and Research Hospital	ELISA	1000	%82.9	%0.60	(Aydoğmuş, 2022)
27 July 1998- 03 August 1998	Ankara	SSK Ankara Maternity Hospital	ELISA	362	%30.7	--	(Maral et al., 2002)
01 April 2010- 31 June 2013	Ankara	Ankara Numune Hospital	ELISA	4758	%27.1	%0.2	(Mumcuoğlu et al., 2014)
Jan 2018- Jan 2019	Ankara_Akyurt	Akyurt State Hospital	ELISA	259	%22.4	%0.4	(Kılıç et al., 2022)
01 April 2009- 31 April 2016	Antakya	Private Mozaik Maternity and Children's Hospital	ECLIA	11564	%48.7	----	(Çetin & Çetin, 2017)
March 2004- January 2006	Antakya	Antakya Maternity Hospital And 628 From Iskenderun Maternity Hospita	ELISA	1652	%52.1	%0.54	(Ocak et al., 2007)
Aug 2008- June 2011	Antalya	Antalya Training and Research Hospital	CMIA	7520	%33.4	%2.4	(Çekin et al., 2011)
Octo 2009- Octo 2012	Artvin	Artvin State Hospital	ELISA	1133	%30.3	%1.3	(Çeltek et al., 2014)
-----	Aydın	Adnan Menderes University Medicine School	ELISA/IF A	423	%30.1	%1.3	(Ertug et al., 2005)
Jan 2014 - Dec 2014	Balıkesir	Balıkesir University Faculty Of Medicine	ELISA	2947			(Usta et al., 2018)
2017-2018	Balıkesir	Balıkesir City Hospital	ELISA	6719	%24.1	%0.46	(Keçecioglu et al., 2022)
Dec 2011- Dec 2016	Bingöl	Bingöl Gynecology and Children's Diseases Hospital	ECLIA	10178	%63	%2	(Duran et al., 2017)
June 2012- Jan 2013	Çanakkale	Çanakkale Onsekiz Mart University Faculty Of Medicine	ELISA	196	%28.8	%2.70	(Gencer et al., 2014)
2016-2021	Çorum	Hitit University Faculty Of Medicine	ECLIA	8531	%18.9	%1	(Kahraman & Savcı, 2022)

DATE	PLACE	LOCALIZATION	METHOD	TOTAL PREGNANT	IgG	IgM	RESOURCES
01 August 2018-01 March 2019	Çorum	Hitit University Çorum Erol Olçok Gynecological Diseases	ELISA	76	25	4	(Görkem et al., 2022)
April 2008- April 2009	Denizli		ELISA	1268	%37	%1.40	(Karabulut et al., 2011)
Sep 2016- June 2018	Diyarbakır	Gazi Yaşargil Training and Research Hospital	ELISA	8175	%34.9	%1.10	(Bakacak et al., 2014)
2000-2009	Edirne	Trakya University Faculty of Medicine		1646	%31.9	%0.97	(Varol et al., 2011)
Jan 2013- Dec 2016	Erzurum	Erzurum Nenehatun Maternity Hospital	ELISA	25525	%31	%0.60	(Tanrıverdi et al., 2018)
01 August 2014 -17 August 2014	Gaziantep (Thesis)	Gaziantep Şehitkamil State Hospital (Thesis)	ELISA	150	%56.6	%2	(Eşkin, 2018)
2007-2012	Hatay	Mustafa Kemal University Research Hospital	ELISA	3340	%57	%3.60	(Okuyay et al., 2013)
Jan 2013- Dec 2013	Isparta	Isparta Gynecology and Children's Diseases Hospital	ELISA	3140	%28.4	%1.8	(Akpınar et al., 2017)
Jan 2008- Dec 2011	Isparta	Süleyman Demirel University	ELISA	726	%22.7	%5.40	(Ergün et al., 2013)
Feb 2006- Feb 2006	İstanbul	Bezmialem Vakif University, Faculty of Medicine	ELISA	102	%42.9	0	(Durdu & Mutlu, 2017)
2000-2005	İstanbul	Gata Haydarpaşa Training Hospital	ELISA	4226	%26.1	%0.6	(Dündar et al., 2009)
2012-2014	İstanbul	Gata Haydarpaşa Training Hospital	CMIA	1737	%48.4	%0.7	(Selek et al., 2015)
2002	İstanbul	Istanbul University, Cerrahpaşa Faculty of Medicine	ELISA	428	%43	%0.7	(Polat et al., 2002)
Nov 2011- Feb 2013	İstanbul_ Bayrampaşa	Bayrampaşa State Hospital-Istanbul.	ELISA	2900	%31.2	%0.9	(Keskin, 2013)
Sep 2013- Jan 2015	İstanbul_Haydarpaşa	Haydarpaşa Training and Research Hospital	ELISA	1101	%31	0	(Numan et al., 2015)
Jan 2008- Jan 2013	İst-Bakırköy	Bakırköy Training and Research Hospital	ELISA	2011	%31.4	%0.80	(Doğan et al., 2014)
Jan 2012- Dec 2013	Kahramanmaraş	Kahramanmaraş Sütçü İmam University	ELISA	11324	%47.1	%2.26	(Bakacak et al., 2014)
Jan 2012- Jan 2021	Kahramanmaraş	Necip Fazıl City Hospital		29.424	%41	%1.60	(Hansu et al., 2021)
Sep 2018- March 2019	Kars	Kafkas University	ELISA	308	%44.8	%0.3	(Demirci & Mor, 2021)
Jan 2018- Jan 2022	Kastamonu	Kastamonu Training and research Hospital	CIAM	1294	%20.3	%1.10	(Tüfekçi et al., 2022)
01 Jan 2017- 01 Jan 2018	Kayseri	Kayseri Training and research Hospital	ELISA	10.200	%28.9	%1	(Madendağ et al., 2018)
Jan 2006- Dec 2008	Kayseri	Kayseri Maternity Hospital	ELISA	1813/1676	%33.9	%2.5	(Kayman & Kayman, 2010)
-----	Kırıkkale	Kırıkkale University Faculty of Medicine Hospital	ELISA	310	%38.4	%0.97	(Aksoy et al., 2005)
March 2005- January 2007	Kocaeli	Kocaeli University Hospital	ELISA	1972	%48.3	%0.4	(Tamer et al., 2009)
01 March 2017- 28 Feb 2022	Konya	Meram Medical Faculty Hospital	ELFA	982	%28.3	%9.87	(Ezer et al., 2023)
April 2013- Nov 2013	Konya	Konya Ereğli State Hospital	CMIA	419	%30.3	%0.20	(Gündem & Ağır, 2014)
April 2004- Nov 2005	Malatya	İnönü University Faculty of Medicine Turgut Özal Medical Center	ELISA/IFA	312	3.trim esterde	%37.5	(Doğan et al., 2012)
August 92- August 95	Malatya	İnönü University Faculty of Medicine	ELISA	510			(Kafkash et al., 1996)
2012-2017	Mersin	Mersin University Faculty of Medicine		3474		%7.66	(Durukan & Killi, 2019)
Jan 2019- Dec 2019	Mersin	Mersin Erdemli State Hospital	ELFA	1832/1844	%28.7	%0.70	(Gonca et al., 2021)
2012-2020	Muğla	Sıtkı Koçman University Training and Research Hospital		5158/5728	%21.6	%1.60	(Kıncı et al., 2023)
01 Nov2018- 14 May 2020	Muş	Muş State Hospital	ELISA	6435	%28.9	%2.2	(Ceylan & Benli, 2009)
01 Jan 2012- 01 Jan 2014	North-Western Türkiye	-----	CMIA		%43.9	%2.5	(Aynioğlu et al., 2015)
01 July 2013- 01 July 2014	Ordu	Ordu University Faculty of Medicine Training and Research Hospital	ECLIA-CMIA	2791	%27.6	%1.60	(Çalgın et al., 2017)
31 July 2009- 01 August 2014	Rize	Recep Tayyip Erdoğan University Faculty of Medicine	CMIA	325/1046	%41.1	%1.1	(Şentürk et al., 2015)
2018-2019	Sivas	Sivas Cumhuriyet University Faculty of Medicine Hospital	ELISA	1.150	%26.7	%1.3	(Çubuk et al., 2020)
01 Jan 2007- 31 Dec 2009	Şanlıurfa	Şanlıurfa Gynecology and Obstetrics Hospital	CMIA	12084	%68.9	%2.8	(Çiçek et al., 2012)
Sep 2009- Feb 2012	Tokat	Third Stage in Tokat Province	ELISA	3162	%32	%2	(Çeltek et al., 2014)

DATE	PLACE	LOCALIZATION	METHOD	TOTAL PREGNANT	IgG	IgM	RESOURCES
Jan 2014- Dec 2018	Trabzon	Trabzon Kanuni Training and Research Hospital	ELISA	15985	%25.9	%1.53	(Kulaksız et al., 2021)
----	Urfa	Obstetrics And Gynecology Department	ELISA	1149	%60.4	%3	(Harma et al., 2004)
01 July 2010- 30 June 2011	Uşak	Uşak State Hospital	ELISA	1465	%18.3	%3.0	(Toklu, 2013)
Sep 2015- Sep 2017	Van	Van Training and Research Hospital	ELISA	300	%49.3	%0.70	(Gürbüz & Baran, 2021)
Sep 2007- August 2008	Van	Van Women's and Children's Diseases Hospital	ELISA	625	%36	%0.30	(Efe et al., 2009)
2012-2013	Van	Van Training and Research Hospital	ELISA	9809	%37.6	%1.10	(Parlak et al., 2015)
Sep 2015 - Sep 2017	Van (Thesis)	Van Yüzyüncü Yıl University Dursun Odabaş Medical Center (Thesis)	ELISA	300	%56.3	%7.6	(Hazan, 2018)
Jan 2012- Dec 2012	Yozgat	Sorgun State Hospital	ELFA	804	%36.9	%0.2	(Kiriş Satılmış et al., 2014)

## Conclusion

We think that with the results of this study, *T. gondii*, which is an important issue especially for pregnant women, will fill an important gap in Çankırı province. We think that this study should be repeated with more pregnant women.

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