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Investigation of the prevalence of toxoplasmosis as an important zoonotic disease in pregnant women referred to a hospital in Rasht

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Article Info	Abstract
<p>Article history: Received: 11 July 2024 Accepted: 25 September 2024</p> <p>Keywords: ELISA Gilan Iran Pregnant women Toxoplasmosis</p>	<p>Toxoplasmosis is a prevalent infectious disease among humans and animals. One of the ways of transmission to humans is vertically by transferring tachyzoites from mother to her fetus. Congenital infection in the first trimester of pregnancy is very dangerous, associated with severe symptoms in the fetus, specially, if it mainly occurs when a pregnant woman is infected with parasites for the first time during pregnancy. Due to the lack of information in this field in Gilan province, in this study, the seroprevalence of <i>Toxoplasma</i> infection in pregnant women in Rasht and some epidemiological aspects related to this infection were investigated. In this cross-sectional study, 102 blood samples of pregnant women who referred to a hospital in Rasht were investigated for IgG anti-<i>T. gondii</i> using an ELISA kit and statistical analysis of data was done using Chi-square statistical test. The prevalence rate of toxoplasmosis in pregnant women in Rasht was determined to be 37.3% and except of "contact with cat" ($p=0.045$), there was no significant correlation between infection and variables such as age, place of residence, education, occupation, history of abortion, and gardening ($p > 0.05$). This research revealed that 64 pregnant women (62.7%) were not previously infected with <i>Toxoplasma</i> and is vulnerable to being at high risk of toxoplasmosis during pregnancy.</p> <p>© 2024 Published by Amol University of Special Modern Technologies Press.</p> <p>This is an open-access article under the CC-BY 4.0 license. (https://creativecommons.org/licenses/by/4.0/)</p>

Introduction

Toxoplasmosis caused by *Toxoplasma gondii*, is one of the most common infectious diseases in humans and warm-blooded animals. The main ways of transmission to humans are through eating raw or half-cooked meat containing bradyzoites enclosed in tissue cysts, water or vegetables contaminated with infectious oocysts, and vertically by transferring tachyzoites from mother to her fetus. Congenital infection in the first trimester of pregnancy is associated with more severe symptoms in the fetus and is more dangerous than when the mother is infected with the parasite in the second or third trimester of pregnancy, although it mainly occurs

when a pregnant woman is infected with parasites for the first time during pregnancy. Usually, the parasite is localized in the nervous system or eyes, and as a result, its symptoms are hydrocephalus, convulsions, intracerebral calcification and retinochoroiditis, which is the least complication related to hydrocephalus and the most common complication is ocular problems (Hill and Dubey, 2002).

Research has shown that approximately 30-50% of the global population have anti-*Toxoplasma* antibodies in their blood, indicating past exposure to this

organism. This problem confirms the extensive spread and the strong ability of the parasite to infect humans. The prevalence rate is high, but serious disease occurs mainly in people with weak immunity (Flegr et al., 2014).

The prevalence of toxoplasmosis in Iran, like other parts of the world, depends on the geographical region and climatic conditions, lifestyle and food habits, health, and cultural status. The overall prevalence of *Toxoplasma* among the general population of Iran is estimated to be around 40%. The prevalence of toxoplasmosis in women of reproductive age varies from 5% to 70% (Daryani et al, 2014) and in Iranian pregnant women is estimated to be 41% (Foroutan-Rad et al., 2016). On the other hand, the seroprevalence of anti-*Toxoplasma* IgG among women with a recent miscarriage is estimated to be 32% [95% confidence interval (CI): 20-45%] (Kazemi et al., 2023). So far, no research has been done on the prevalence of toxoplasmosis in pregnant women in Gilan province, therefore in this study, the seroprevalence of *Toxoplasma* infection in the pregnant women in Rasht and some epidemiological aspects related to this infection were investigated.

Materials and Methods

In this cross-sectional study, the blood samples of 102 pregnant women who referred to a hospital in Rasht for routine monitoring tests were collected randomly. Before sampling, the objectives of the research were explained to these women and the consent forms were filled by them. Other information for the research was also collected through a questionnaire including age, place of residence, education, occupation, history of abortion, keeping or contacting with cat, and doing gardening. Isolated sera were kept at -20°C until assay. After collecting all samples, frozen sera were liquefied at room temperature and examined for anti-*T. gondii* IgG using a ELISA kit (Pishtaz Teb Co., Iran) according to the manufacturer's instructions. Statistical analysis of laboratory results and questionnaire data was analyzed using SPSS version 19 software and Chi-square statistical test. A statistical significance level of 0.05 was considered.

Results

Anti- *T. gondii* IgG was found in 38 out of 102 samples. So, the prevalence rate of toxoplasmosis in pregnant women in Rasht was determined to be 37.3%. There was no significant correlation between

infection and demographic variables such as age, place of residence, education, occupation, and history of abortion in statistical analysis ($p > 0.05$). In the behavioral factors, there was no significant correlation between "gardening" and the prevalence of infection, but there was a significant correlation between "contact with cat" and infection ($p=0.045$). Table 1 showed the factors investigated in this study and their relationship with the prevalence of toxoplasmosis.

Table 1. Prevalence of *Toxoplasma gondii* infection according to the studied factors in pregnant women referred to a private hospital in Rasht.

Demographic and behavioral factors		IgG+	IgG -	p-value
Age	<20	8	16	0.887
	20-30	15	25	
	>30	15	23	
Place	Urban	30	56	0.251
	Rural	8	8	
Education	High school	9	14	0.833
	College	29	50	
Occupation	House wife	15	28	0.672
	Employee	23	36	
History of abortion	Yes	10	13	0.483
	No	28	51	
Contacting with cat	Yes	16	40	0.045*
	No	22	24	
Gardening	Yes	14	25	0.823
	No	24	39	
Total		102	38	64

Discussion

Rasht is the capital of Gilan province, in the southern of the Caspian Sea, northern of Iran. Based on Köppen-Geiger climate classification, Rasht has a temperate climate full of rain with hot summers and no dry season. This type of climate in Iran can be seen only in the coastal strip of the Caspian Sea. In this climate, rainfall is distributed almost regularly in all months of the year and there is no absolute dry season. Due to regular rains throughout the year, this climate has mild winters, but hot and humid summers (Raziei, 2017). Therefore, according to the climate of Gilan province and Rasht city, the temperature and humidity are sufficient for the survival and sporulation of *Toxoplasma* oocysts in the environment.

On the other hand, one of the important factors in the rate of human infection is the level of infection in ruminant animals, which causes the transmission of infection either through eating half-cooked meat or through lack of hygiene in the manipulating of this meat. The prevalence of infection in Gilan sheep was determined by ELISA method to be 41.5% (Chaechi Nosrati et al., 2020), which is higher than the range prevalence reported from the different regions of Iran (3.3-36.8%) by Sharif et al. (2015).

Table 2. A summary of studies conducted on the prevalence of toxoplasmosis in pregnant women in different regions of Iran in the last 24 years.

Province/City	Year of study	Samples	IgG+ (%)	Test	Significant difference	Reference
Mazandarn/Ramsar	2017-2018	191	46.1	ELISA	-	Shabanian, 2023
Mazandaran/Ramsar and Tonekabon	2012	289	58.8	ELISA	-	Hosseini, 2013
Mazandaran/Chalus	2012-2013	50	52 56	ELISA CLIA	-	Elahian Firouz, 2014
Mazandaran/Amol	-	1057	69.9	ELISA	-	Siyadat Panah, 2013
Mazandaran/Babol	2012-2013	175	27.4	ELISA	-	Kalantari, 2014
Mazandaran/Sari	1997-1998	612	71	ELISA	-	Saffar, 1999
Golestan	2014-2015	440	35.2	ELISA	abortion	Shirdel, 2017
North Khorasan/Bojnurd	2013	211	30.8	ELISA	contact with cat	Jalai, 2013
North Khorasan/Shirvan	2013-2015	350	31.4	ELISA	age, residency, food habits, contact with cat, abortion	Mohaghegh, 2016
North Khorasan	-	1302	53	ELISA	-	Aliabadi, 2017
Khorasan Razavi/Mashhad	2010-2011	419	34.4	ELISA	age, residency, education, soil contact	Babaie, 2013
Khorasan Razavi	-	786	31.2	ELISA	age, education, food habitant	Teimouri, 2016
Khorasan Razavi/Mashhad	2016	250	23.2	ELISA	age	Sharifi, 2019
South Khorasan/Tabas	-	205	39	ELISA	occupation	Pashaei Naghdeh, 2015
Sistan Baluchistan/Zahedan	2000	337	49.8	IFA	-	Zangi Abadi, 2002
Sistan Baluchistan/Zahedan	-	221	30.8	ELISA	-	Ebrahimzadeh, 2013
Sistan Baluchistan/Nikshahr	2012	185	10.3	ELISA	age, residency, food habitant	Mousavi, 2014
Sistan Baluchistan/Saravan	2015-2016	208	42.3	ELISA	-	Rahmati-Balaghaleh, 2019
Sistan Baluchistan/Zabol	2016-2017	90	14	ELISA	abortion	Firoozi Jahantigh, 2020
Hormozgan/Bandar Abbas	2008	600	41.9	ELISA	food habits, stillbirth	Jamshidi Makiani, 2012
Hormozgan	2015-2016	360	27	ELISA	residency, contact with cat, food habitant, age, abortion, number of pregnancy	Khademi, 2019
Kerman	2008	112	17.8	ELISA	abortion	Ali, 2011
Kerman/Rafsanjan	2013	240	30.4	ELISA	education, occupation, residency, contact with cat	Zavari, 2015
Yazd	2011	181	32	ELISA	education, age	Anvari, 2013
Isfahan/Khomeinishahr	1998-2000	370	32.2	IFA	abortion, age, contact with cat	Talari, 2003
Isfahan/Kashan	2001	340	61	IFA	age, abortion, contact with cat, food habits	Arbabi, 2002
Isfahan/Kashan	-	798	42.7	ELISA	-	Rasti, 2015
Qom	2001	600	41 42.8	IFA-ELISA	education, abortion, age, contact with cat, residency	Mardani, 2004
Qom	2010	200	45.3	ELISA, IFA	age, contact with cat, contact with cat, residency	Akhlaghi, 2013
Tehran	2010-2013	785	31.1	ELISA	-	Ghasemloo, 2014
Alborz/Karaj	-	468	18.4	ELISA	-	Akhlaghi, 2016
Qazvin	2007	255	62.7	IFA	-	Eskandarian, 2009
Qazvin	2019	740	21.2	ELISA	soil contact	Abdi Gheslaghi,

						2022
Zanjan	-	500	37.2	ELISA	-	Hajsoleimani, 2012
Ardabil	2021-2022	244	27.4	ELISA	-	Sadegi Hariri, 2023
East Azerbaijan/Tabriz	-	300	26.3	ELISA	age	Dalimiasl, 2012
West Azerbaijan/Urmia	-	346	28.3	ELISA	residency	Hazrati Tappeh, 2015
West Azerbaijan/Urmia	2014	156	28.2	ELISA	-	Rostamzadeh Khameneh, 2016
West Azerbaijan/Urmia	2015-2016	620	18.4	ELISA	age	Eshratkhah Mohammadnejad, 2018
Kurdistan/Sanandaj	2019	146	30.1	ELISA	age	Sadeghi Dehkord, 2022
Kermanshah	2014-2015	386	34.5	ELISA	age, contact with cat	Zalei, 2016
Ilam	-	553	44.8	IFA	-	Abdi, 2008
Ilam	-	189	39.7	ELISA	contact with cat	Raissi, 2020
Lorestan/ Khoramabad	2006-2007	390	31	ELISA	age, education	Chraghipour, 2010b
Lorestan/Aleshtar	2008	331	39.2	ELISA	age, education, food habits, contact with cat	Chraghipour, 2010a
Lorestan	2008	496	31	ELISA	-	Rostami Nejad, 2013
Lorestan/Delfan	2012-2013	264	25	ELISA	age, contact with cat, food habits	Ahmadpour, 2017
Lorestan	2016	98	34.7	ELISA	abortion	Menati Rashno, 2019
Hamadan	2004	576	33.5	IFA	age, food habits	Fallah, 2008
Hamadan	-	350	30	ELISA	age, education, occupation	Maghsood, 2013
Hamadan	2019	340	29.4	ELISA	food habits, number of pregnancy	Azimi, 2022
Chaharmahal and Bakhtyari	2001-2002	394	27.4	IFA	food habits	Manouchehri, 2004
Khuzestan/Ahvaz	2005	79	35.4	ELISA	-	Sohrabi, 2007
Khuzestan/Kamyaran	2008	201	27	ELISA	education	Parvizpour, 2010
Khuzestan	2011	501	27.3	ELISA	contact with cat, age	Yad Yad, 2014
Khuzestan/ Khorramshahr	2019	88	38.6	ELISA	food habits	Soltani, 2022
Bushehr	2000	365	37.8	ELISA	-	Foulavand, 2001
Fars	2014	200	8.6	ELISA	number and trimesters of pregnancy, age	Norouzi Larki, 2017
Fars/Jahrom	2018	370	29.5	ELISA	number of pregnancy	Maani, 2020

The high prevalence of toxoplasmosis in Gilan sheep is due to the temperate and humid climate of this province. Although it is believed that infection in cattle is less prevalent than infection in sheep (Hill and Dubey, 2002), in the examination of slaughtered livestock in Rasht slaughterhouse by MAT (Modified Agglutination Test), the highest level of contamination belonged to sheep (24.7%) and cattle (16.7%). Goat meat showed the lowest level of contamination (3%) (Sokhanafarin *et al.*, 2019). The high prevalence of infection in farm animals of this region shows that the consumption of undercooked meat can play an important role in the transmission of infection to humans.

Furthermore, the contamination of Gilan's surface water with *Toxoplasma* was proven by the LAMP method (Loop Mediated Isothermal Amplification) and four positive cases for *Toxoplasma* were detected out of 34 water samples (Mahmoudi *et al.*, 2015). Contaminated water can be one of the important sources of infection for animals and humans.

In the present study, which was conducted for the first time in pregnant women in Rasht, the serum prevalence of toxoplasmosis was determined 37.3%. Shabaniyan *et al.* (2023) based on a serum survey of infection in pregnant women in Ramsar, the closest city of Mazandaran to Gilan province and Rasht city,

declared the prevalence rate to be 46.1%. Of course, in 2012, the rate of contamination in pregnant women in Ramsar and Tonekabon was determined to be 58% (Hosseini *et al.*, 2013).

In the general population of Iran, toxoplasmosis is highly variable under the influence of epidemiological factors in different provinces and infection is considered as one of the most important causes of abortion (Kazemi *et al.*, 2023). Foroutan-Rad *et al.* (2016) in a systematic review and meta-analysis on studies 1990-2015, estimated the overall prevalence of toxoplasmosis in pregnant women to be 41% (95% CI = 36-45%) and for IgG, 38% by a random effects model. They determined the lowest and highest prevalence of toxoplasmosis among the five geographical regions of Iran, east 33% (95% CI = 42-23%) and south 53% (95% CI = 30-77%). A summary of studies on infection in pregnant women in distinct parts of Iran in the last 24 years (1999 up to now) was shown in Table 2. They showed that two risk factors are more important than the others and there is a statistically significant correlation between infection and the risk factors: "residence" ($p= 0.005$) and "contact with cat" ($p=0.002$) (Foroutan-Rad *et al.*, 2016). In this study, a statistically significant correlation was observed between the prevalence of infection and contact with cat ($p=0.045$), although in other studies conducted in Mazandaran, northern Iran, no significant correlation was observed between infection and the investigated factors including contact with cat (Saffar *et al.*, 1999; Hosseini *et al.*, 2013; Siyadat Panah *et al.*, 2013; Kalantari *et al.*, 2014; Elahian Firouz *et al.*, 2014; Shabaniyan *et al.*, 2023). However, in northeastern Iran, Bojnurd and Shirvan, contact with cat is one of the important factors for the prevalence of toxoplasmosis (Jalai *et al.*, 2013; Mohaghegh *et al.*, 2016).

As the final host, felines, especially domestic cats, play an important role in the spread of infection, and during the first 1 to 2 weeks, they pass millions of oocysts into the environment through their feces and cause water and food contamination (Hill and Dubey, 2002). Although, accurate statistics of cats in Rasht are not available; the increase in veterinary clinics and labs, pet shops, animal care centers, and NGOs shows the increase in the population of pets, including cats. Also, no study has been conducted on the level of infection in cats in Gilan, according to a meta-analysis study, the prevalence rate of cat toxoplasmosis in various regions of Iran ranged from 1.2% to 89.2% and the pooled proportion by the random-effect model amongst cats was estimated at 33.6% (95% confidence

interval [CI] 22.05–46.41) in Iran (Rahimi *et al.*, 2015). Sharif *et al.* (2009) stated that the prevalence of toxoplasmosis in stray cats of Sari was 40%. Sari is the capital of Mazandaran province in the neighborhood of Gilan with almost similar climate to Rasht.

In conclusion, 62.7% of pregnant women in Rasht had never been infected with *Toxoplasma* and were therefore vulnerable to contracting toxoplasmosis during pregnancy. Therefore, preventive methods and awareness should be given more attention, and it is suggested that monitoring be done in the entire province to determine the prevalence of infection in the whole population, pregnant women and cats.

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Conflict of Interest

The authors do not have any potential conflict of interest to declare.

References

- Abdi Gheshlaghi, S; Babaeinejad, Z; Saraei, M; Mohammadi, N; Hajjalilo, E; Javadi, A; Heydarian; P and Samieerad, F (2022). Maternal serological screening for congenital toxoplasmosis during pregnancy and evaluating the pregnant women knowledge on toxoplasmosis in Qazvin, Iran. J. Kerman Univ. Med. Sci., 29: 428-435.
- Abdi, J; Shojaee, S; Mirzaee, A and Keshavarz, H (2008). Seroprevalence of toxoplasmosis in pregnant women in Ilam province, Iran. Iran. J. Parasitol., 3: 34-37.
- Ahmadpour, GR.; Ezatpour, B; Hadighi, R; Oormazdi, H; Akhlaghi, L; Tabatabaei, F; Azami, M; Nejad, MM and Mahmoudvand, H (2017). Seroepidemiology of *Toxoplasma gondii* infection in pregnant women in west Iran: determined by ELISA and PCR analysis. J. Parasit. Dis., 41: 237-242.
- Akhlaghi, L; Shirbazou, S; Maleki, F; Keyghobadi, A; Tabaraei, Y and Tabatabaie, F (2013). Seroepidemiology of *Toxoplasma* infection in pregnant women in Qom Province, Iran. Life Sci., 10: 322-325.
- Akhlaghi, L; Tabatabaie, F; Hadighi, R and Maleki, F (2016). Diagnosis of acute toxoplasmosis in pregnant women referred to therapeutic centers of Alborz Province (Iran) using immunoglobulin G avidity ELISA technique. Asian Pac. J. Trop. Dis., 6: 864-867.
- Aliabadi, J; Khamesi, S; Ghorbanpour, H and Rahimi Esboei, B (2017). Seroprevalence of IgG, IgM and IgA

- against *Toxoplasma gondii* in pregnant women in first trimester in northern Khorasan Province, Iran. J. North Khorasan Univ. Med. Sci., 9: 243-252.
- Ali, S; Fashihi Harandi, M; Nazari, E and Salari, Z** (2011). Comparison of the presence of anti-*Toxoplasma* antibodies in pregnancies leading to abortion and natural pregnancies. Iran. J. Obstet. Gynecol. Infertil., 14: 1-6.
- Anvari, MH and Ghafoorzadeh, M** (2013). Seroepidemiology study of maternal *toxoplasma* infection in pregnant women in Yazd. J. Dow Univ., 13: 116-125.
- Arbabi, M and Talari, SA** (2002). The prevalence of Toxoplasmosis in subjects involved in meat industry and pregnant women in Kashan. Feyz Med. Sci. J., 6: 28-38.
- Azimi, A; Parsaei, M; Soleymani, E; Mehranzadeh, E and Maghsood, AH** (2022). Diagnosis of acute toxoplasmosis in the first trimester of pregnancy by IgG avidity. Avicenna J. Clin. Med., 29: 50-56.
- Babaie, J; Amiri, S; Mostafavi, E; Hassan, N; Lotfi, P; Esmaeili Rastaghi, AR and Golkar, M** (2013). Seroprevalence and risk factors for *Toxoplasma gondii* infection among pregnant women in northeast Iran. Clin. Vaccine Immunol., 20: 1771-1773.
- Chaechi Nosrati, MR; Shemshadi, B; Shayan, P; Ranjbar Bahadory, Sh and Eslami, A** (2020). Serological determination of *Toxoplasma gondii* among sheep (*Ovis aries*) in Guilan province, Iran. Arch. Razi Inst., 75: 463-471.
- Cheraghipour, K; Sheikhian, A; Maghsoud, AH; Hejazi, Z; Rostaminejad, M and Moradpour, K** (2010a). Investigation of the prevalence of *Toxoplasma gondii* infection in pregnant women referring to health care centers Urban and rural Aleshtar in 2008. Yafteh JMS, 11: 65-73.
- Cheraghipour, K; Taherkhani, H; Fallah, M; Sheikhian, A and Sardarian, Kh** (2010b). Prevalence of anti-toxoplasma IgM and IgG serum antibodies in pregnant women referring to the health centers of Khorram Abad city. Sci. J. Hamdan Univ. Med. Sci., 17: 46-51.
- Dalimiasl, A and Arshad, M** (2012). Sero-epidemiology of *Toxoplasma* Infection in pregnant women referred to Al-Zahra hospital in Tabriz. J. Ilam Uni. Med. Sci., 20: 55-62.
- Daryani, A; Sarvi, S; Aarabi, M; Mizani, A and Ahmadpour, E; Shokri, A; Rahimi, MT and Sharif, M** (2014). Seroprevalence of *Toxoplasma gondii* in the Iranian general population: A systematic review and meta-analysis. Acta Trop., 137: 185-194.
- Ebrahimzadeh, A; Mohammadi, S; Salimi-Khorashad, A and Jamshidi, A** (2013). Seroprevalence of toxoplasmosis among pregnant women referring to the reference laboratory of Zahedan, Iran. Zahedan J. Res. Med. Sci., 15: 32-35.
- Elahian Firouz, Z; Kaboosi, H; Faghih Nasiri, A; Tabatabaie, SS; Golhasani-Keshtan, F and Zabolli, F** (2014). A comparative serological study of toxoplasmosis in pregnant women by CLIA and ELISA methods in Chalus City, Iran. Iran. Red Crescent Med. J., 16: e15115.
- Eskandarian, A** (2009). Seroepidemiology of toxoplasmosis in pregnant women admitted to the maternity ward of Kausar Qazvin Medical Education Center, 2007. Iran. J. Med. Microbiol., 3: 73-79.
- Eshratkhan Mohammadnejad, A; Eslami, G; Shamsi, F; Pirnejad, A; Samie, A; Safabakhsh, J; Sakhavan, A and Elloumi, M** (2018). Prevalence of food-borne *Toxoplasma* in pregnant women population of Urmia, Iran. J. Food Qual. Hazards Control, 5: 17-23.
- Fallah, M; Rabiee, S; Matini, M and Taherkhani, H** (2008). Seroepidemiology of toxoplasmosis in primigravida women in Hamadan, Islamic Republic of Iran, 2004. East. Mediterr. Health J., 14: 163-171.
- Firoozi Jahantigh, F; Rasekh, M; Ganjali, M and Sarani, A** (2020). Seroprevalence of *Toxoplasma gondii* infection among pregnant women and small ruminant populations in Sistan region, Iran. Iran. J. Vet. Med., 14: 239-250.
- Flegre, J; Prandota, J; Sovičková, M and Israili, ZH** (2014). Toxoplasmosis-A global threat. correlation of latent toxoplasmosis with specific disease burden in a set of 88 countries. PLoS One. 9: e90203.
- Foroutan-Rad, M; Khademvatan, S; Majidiani, H; Aryamand, S; Rahim, F and Malehi AS** (2016). Seroprevalence of *Toxoplasma gondii* in the Iranian pregnant women: A systematic review and meta-analysis. Acta Trop., 158: 160-169.
- Foulavand, MA and Jafari, SM** (2001). Prevalence of anti-*toxoplasma* antibodies in pregnant women in Bushehr, 2000. South. Med. J., 3: 113-116.
- Ghasemloo, H; Ghomashlooyan, M and Hooshyar, H** (2014). Seroprevalence of *Toxoplasma gondii* Infection among pregnant women admitted at Shahid Akbar Abadi hospital, Tehran, Iran, 2010-2013. J. Med. Microbiol. Infec. Dis., 2: 16-18.
- Hajsoleimani, F; Ataeian, A; Nourian, AA and Mazloomzadeh, S** (2012). Seroprevalence of *Toxoplasma gondii* in pregnant women and bioassay of IgM positive cases in Zanjan, Northwest of Iran. Iran. J. Parasitol., 7: 82-86.
- Hazrati Tappeh, Kh; Mousavi, SJ; Bouzorg Omid, A; AliNejad, V and Alizadeh, H** (2015). Seroepidemiology and risk factors of Toxoplasmosis in pregnant women in Urmia city. Urmia Med. J., 26: 296-302.
- Hill, D and Dubey, J** (2002). *Toxoplasma gondii*: transmission, diagnosis and prevention. Clin. Microbiol. Infect., 8: 634-640.
- Hosseini, SA; Dehgani, N; Sharif, M; Daryani, A and Gholami, S** (2013). Investigation of toxoplasmosis serology in pregnant women. J. Mazandaran Univ. Med. Sci., 24: 146-150.
- Jalali, N; Olfatian Gilan, B; Tavasoli, A; Tanomand, A and Reaghi, S** (2013). Seroepidemiology of Toxoplasmosis among pregnant women referring to health center laboratories of Bojnurd in 2013. J. North Khorasan Univ. Med. Sci., 5: 1101-1105.
- Jamshidi Makiani, M; Davoodian, P; Golsha, R; Dehghani, M and Rajaei, M** (2012). Seroepidemiology and risk factors of Toxoplasmosis in the first trimester among pregnant women. Int. Electron. J. Med., 1: 12-17.
- Kalantari, N; Ghaffari, S; bayani, M; Agapour, R and Zeinalzadeh, M** (2014). Serological Study of Toxoplasmosis in pregnant women in the city of Babol, northern Iran, 2012-2013. J. Ilam Univ. Med. Sci., 22: 102-108.

- Kazemi, F; Arjmand, R; Dousti, M; Fasihi Karami, M; Barzegar, Gh; Mohammadi, A and Shams, M (2023). *Toxoplasma* and risk of abortion: a meta-analysis in a population of Iranian women. *Int. J. Fertil. Steril.* 17: 7-11.
- Khademi, SZ; Ghaffarifar, F; Dalimi, AH; Davoodian, P and Abdoli, A (2019). Prevalence and risk factors of *Toxoplasma gondii* infection among pregnant women in Hormozgan province, South of Iran. *Iran. J. Parasitol.*, 16: 167-173.
- Maani, S; Kazemi, M; Solhjoo, K; Shadmand, E and Rezaeezhad, H (2020). Serological study of toxoplasmosis in pregnant women in Jahrom city, 2018. *Pars J. Med. Sci.*, 18: 1-8.
- Maghsood, A; Fallah, M; Moradi, H; Shanazi, H and Moradi, Y (2013). Seroepidemiology of toxoplasmosis in pregnant women referring to health centers in the city of Hamadan in 1391. *Pajouhan Sci. J.*, 11: 3-8.
- Mahmoudi, MR; Kazemi, B; Haghghi, A and Kanaris, P (2015). Detection of *Acanthamoeba* and *Toxoplasma* in river water samples by molecular methods in Iran. *Iran. J. Parasitol.*, 10: 250-225.
- Manouchehri Naeini, k; Deries, F and Zebardast, N (2004). The immunity status of the rural pregnant women in Chaharmahal and Bakhtyari province against *Toxoplasma* Infection, 2001-2002. *J. shahre-kurd Uni. Med. Sci.*, 6: 63-72.
- Mardani, A and Keshavarz, H (2004). Comparison of the two methods, IFA and ELISA, in seroepidemiological study of *Toxoplasma* infection in pregnant women of Qom city. *J. Sch. Public Health Inst. Public Health Res.*, 2: 57-64.
- Menati Rashno, M; Fallahi, Sh; Arab-Mazar, Z and Dana, H (2019). Seromolecular assess of *Toxoplasma gondii* infection in pregnant women and neonatal umbilical cord blood. *EXCLI J.*, 18: 1-7.
- Mohaghegh, MA; Kalani, H; Hashemi, M; Hashemi, S; Kamkar Yazdnezhad, S; Hejazi, SH and Hashemi, N (2016). Toxoplasmosis-related risk factors in pregnant women in the North Khorasan province, Iran. *Int. J. Med. Res. Health Sci.*, 5: 370-374.
- Mousavi, M; Jamshidi, A and Reisi, JM (2014). Serological study of toxoplasmosis among pregnant women of Nikshahr in 2012. *Al-Razi Univ. J. Med. Sci.*, 21: 45-53.
- Norouzi Larki, Y; Sarkari, B; Asgari, Q and Abdolahi Khabisi, S (2017). Molecular evaluation and seroprevalence of Toxoplasmosis in pregnant women in Fars province, Southern Iran. *Ann. Med. Health Sci. Res.*, 7: 16-19.
- Parvizpour, F; Hajighasemlo, S; Hasani, S; Olfati, L; Bahmani, A; Hoseini F and Gharibi, F (2010). Toxoplasmosis infection in the pregnant women in the first half of pregnancy, in Kamyaran in 2008. *Sci. J. Kurd. Univ. Med. Sci.*, 15: 72-78.
- Pashaei Naghdeh, A; Debirzadeh, M; Davodi, T and Hashemi, M (2015). Seroepidemiology of toxoplasmosis in pregnant women of Tabas city. *Med. Lab. J.*, 9: 119-126.
- Rahimi, MT; Daryani, A; Sarvi, S; Shokri, A; Ahmadpour E; Teshnizi, SH; Mizani, A and Sharif M (2015). Cats and *Toxoplasma gondii*: a systematic review and meta-analysis in Iran. *Onderstepoort J. Vetn. Res.*, 82: 01-10.
- Rahmati-Balaghaleh, M; Hosseini Farash, BR; Zarean, M; Hatami-Pourdehno, S; Mirahmadi, H; Jarahi, L; Sharifi, Y; Ahmadi, O; Shamsian, SA; Moghaddas, E and Hashemi Shahri, SM (2019). Diagnosis of acute toxoplasmosis by IgG avidity method in pregnant women referred to health centers in south-eastern. *Iran. J. Parasit. Dis.*, 43: 517-521.
- Raissi, V; Taghipour, A; Navi, Z; Etemadi, S; Sohrabi,, Z; Sohrabi, N; Getso, M; Shamsaei, S; Fasihi Karami, M and Raiesi, O (2020). Seroprevalence of *Toxoplasma gondii* and *Toxocara* spp. infections among pregnant women with and without previous abortions in the west of Iran. *J. Obstet. Gynaecol.*, 46: 382-388.
- Rasti, S; Hooshyar, H; Arbabi, M; Fatahian, A; Behrashi, M; Talebian, A; Bandehpour, M and Mousavi, SG (2015). Frequency of *Toxoplasma* infection among pregnant women and their newborn in Kashan, Iran. *Zahedan J. Res. Med. Sci.*, 17: e999.
- Raziei, T (2017). Köppen-Geiger climate classification of Iran and investigation of its changes during 20th century. *J. Earth Space Phys.*, 43: 419-439.
- Rostami Nejad, M; Fazeli, Z; Nazemalhosseini Mojarad, E; Cheraghipour, K; Pourhoseingholi, MA; Rostami, K; Barzegar, F and Zali, MR (2013). Prevalence of celiac disease and toxoplasmosis during pregnancy. *Med. Sci.*, 22: 288-293.
- Rostamzadeh Khameneh, Z; Hanifian, H and Rostamzadeh, A (2016). Seroprevalence of Toxoplasmosis in pregnant women in Urmia, Iran. *Int. J. Enteric Pathog.* 4: e33350.
- Sadeghi Dehkordi, Z; Partoandazanpour, A and Adolmalek, N (2022). Seroprevalence and risk factors of *Toxoplasma gondii* infection among pregnant women in Sanandaj, west of Iran: A Cross-Sectional Study. *JZD*, 6: 78-83.
- Sadeghi Hariri, S; Heidari, Z; Habibzadeh S and Shahbazzadeghan S (2023). Seroprevalence of *Toxoplasma gondii* among pregnant women in Ardabil, Iran (2021-2022). *Iran. J. Parasitol.*, 18: 93-99.
- Saffar, M; Ajami, A and Moslemizadeh, N (1999). Investigation of the prevalence of *Toxoplasma gondii* infection in pregnant women Sari city, 1997-98. *J. Mazandaran Univ. Med. Sci.*, 9: 1-5.
- Shabanian, H; Jafari-Shakib, R; Sharifdini, M; Atrkar-Roshan, Z and Majidi-Shad, B (2023). Toxoplasmosis seroepidemiology in pregnant women of Ramsar. *J. Guil. Uni. Med. Sci.*, 32: 106-115.
- Sharifi, K; Hosseini Farash, BR; Tara, F; Khaledi, A; Sharifi, K and Shamsian, SAA (2019). Diagnosis of acute toxoplasmosis by IgG and IgM antibodies and IgG avidity in pregnant women from Mashhad, Eastern Iran. *Iran. J Parasitol.*, 14: 639-645.
- Sharif, M; Daryani, A; Nasrolahei M and Ziapour, SP (2009). Prevalence of *Toxoplasma gondii* antibodies in stray cats in Sari, northern Iran. *Trop. Anim. Health Prod.*, 41: 183-187.
- Sharif, M; Sarvi, S; Shokri, A; Hosseini Teshnizi, S; Rahimi, MT; Mizani, A; Ahmadpour, E and Daryani, A (2015). *Toxoplasma gondii* infection among sheep and goats in Iran: a systematic review and meta-analysis. *Parasitol. Res.*, 114: 1-16.

- Shirdel, SS; Sharbatkhori, M; Pagheh, A; Dadimoghadam, Y; Soosaraie, M and Gholami, Sh** (2017). Seroepidemiology of *Toxoplasma gondii* Infection in pregnant women and risk factors of the disease in Golestan Province, Iran. *J. Mazandaran Univ. Med. Sci.*, 27: 63-71.
- Siyadat Panah, A; assadi, M; Bahman Soufiani, K; Barzegar, Gh; Gharachorlou, AA and Emami Zeydi, A** (2013). Seroprevalence of *Toxoplasma gondii* infection among pregnant women in Amol, Northern Iran. *Life Sci.*, 10: 164-168.
- Sohrabi, A; Samrabafzadeh, A; Mokundi, M; Moraghi, S; Razi, T and Darban, D** (2007). Seroepidemiological study of *Parvovirus* B19, *Toxoplasma gondii* and *Chlamydia trachomatis* in pregnant women referred to the maternity ward of Imam Khomeini Hospital in Ahvaz. *J. Reprod. Infertil.*, 8: 171-178.
- Sokhanafarin, T; Assmar, M and Massiha, A** (2019). Serological survey of toxoplasmosis in slaughtered livestock in Rasht slaughterhouse using modified agglutination test (MAT). *Vet. Microbiol.*, 15: 111-119.
- Soltani, SH; Dalir Ghaffari, A; Sagha Kahvaz, M; Sabaghan, M; Pashmforosh, M and Foroutan, M** (2022). Seroprevalence and associated risk factors of *Toxoplasma gondii* among pregnant women in southwest Iran. *Int. J. Infect.* 9: e116379.
- Talari, SA; Hejazi, SH; Rasti, S and Shadzi, S** (2003). Seroepidemiology of *Toxoplasma gondii* in pregnant females referring to Ashrafi Isfahani Hospital in Khomeinishahr, 1998-2000. *Feyz Med. Sci. J.*, 6: 32-37.
- Teimouri, A; Rahimi Esboei, B; Mousavi, P and Taghavi, M** (2016). Sero-prevalence of *Toxoplasma gondii* infection among women in first trimester of pregnancy of women in Razavi- Khorasan province. *J. Neyshabur Univ. Med. Sci.*, 3: 10-18.
- Zalei, B; Pourmand, D; Bilvaye, S and Jalilzadeh, H** (2016). Seroepidemiology of toxoplasmosis in pregnant women referred to reference laboratory in Kermanshah, 2014-2015. *J. Clin. Res. Paramed. Sci.*, 5: 125-131.
- Zangi Abadi, M; Salehi, M; Khazaei, HA and Khoushideh, M** (2002). Serological investigation of toxoplasmosis in pregnant women. *J. Zanjan Univ. Med. Sci.*, 3: 149-153.
- Zavari, T; Mirzaei, S; Rezaeian, M; Zainodini, N and Zare-Bidaki, M** (2015). A study of the seroprevalence of IgG and IgM immunoglobulins against *Toxoplasma gondii* in pregnant women referred to Niknafs Maternity Ward of Rafsanjan City and in umbilical cord of their infants in 2013. *J. Rafsanjan Univ. Med. Sci.*, 14: 507-518.
- Yad Yad, M J; Jomehzadeh, N; Jafar Sameri, M and Noorshahi, N** (2014). Seroprevalence of anti-*Toxoplasma gondii* antibodies among pregnant woman in south Khuzestan, Iran. *Jundishapur J. Microbiol.*, 7: e9998.