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## Prevalence of *Toxoplasma gondii* infection in women of child-bearing age in faculty of Medicine and health sciences Hodeida City, Yemen

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### Abstract

**Background:** *Toxoplasma gondii* (*T. gondii*), is an obligate intracellular protozoan parasite and prevalent worldwide that represents an actual public health problem. Prevalence and risk factors of toxoplasmosis in women of child-bearing age are unknown in Yemen. The current study was conducted with the objectives of estimating the seroprevalence and potential risk factors in acquiring *T. gondii* between women of childbearing in faculty of medical and health science Hodeidah University, Yemen.

**Objective:** This study aimed to determine the prevalence of *T. gondii* infection in women of childbearing age in Hodeidah city.

**Methods:** A cross-sectional study was conducted from September 2016 to June 2017. Sera of 90 women child-bearing age in Faculty of Medicine and Health sciences, Hodeidah University, Yemen were analyzed by enzyme linked immunosorbent assay (ELISA). A questionnaire survey was administered for all participants in this study to gather information on risk factors.

**Result:** Out of the 90 women of childbearing age 14.5% were seropositive for immunoglobulin G (IgG) and 14.4% for immunoglobulin (IgM) anti-toxoplasma antibodies. The highest prevalence of toxoplasma IgG was found to be 16.2% among working fathers of study sample. The seropositive of *T. gondii* IgG antibodies was 42.9% among childbearing women showing Khat whereas IgM antibodies were 14.3%.

**Conclusion:** We found from our study seroprevalence of *T. gondii* IgG 14.5% and 14.4% of IgM. These finding were lower than to other results reported from developing countries.

**Keywords:** *Toxoplasma gondii*, seroprevalence, cross-sectional, risk factors, hodeidah city, elisa

### Introduction

Toxoplasmosis is one of the common parasitic diseases, caused by an obligate intracellular protozoan parasite *T. gondii*. The infection is worldwide distribution influencing both animals and humans particularly in warm and moist climates [1, 2]. This parasite has cats as the definitive host, and warm-blooded animals as intermediate hosts [3]. *T. gondii* infects up to a third of the world's population [4] and is reported to be an opportunistic parasitic infection in immune compromised hosts [5]. High prevalence of the infection has been reported among pregnant women and women of childbearing age from different parts of the world [6].

*T. gondii* is transmitted to humans through ingestion of infective oocyst excreted in cat feces, which may have contaminated water or food stuff or by ingestion of tissue cysts in raw or undercooked meat from infected farm animals, including cattle, sheep, pig, goats, camels and poultry [7] and transmission from a mother to a fetus through the placenta (congenital infection) or by blood transfusion or organ transplantation. Most cases of primary infections are asymptomatic. The incubation period is 1 to 2 weeks. Congenital toxoplasmosis is caused by acute infection with *T. gondii* in a pregnant woman for the first time. One-third of primary toxoplasmosis cases occurring during pregnancy lead to transplacental transmission and involvement of the fetus with pathological effects such as microcephaly, hydrocephaly, blindness, calcification of brain cells and even death in utero. Signs of congenital infection may be observed at birth or develop over the first few months of life and its severity depends on the duration of infection in pregnant women. The prevalence rate of the disease is different in various parts of the world and is related to various factors such as age, socio-cultural and nutritional habits and contact with domestic cats. Seroepidemiological studies of female toxoplasmosis before delivering age will be very useful for designing preventional policies during child bearing age [7, 8, 9].

Toxoplasmosis is a disease affecting 500 million people worldwide.

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The seroprevalence varies from 5% to 90% depending on geographical location, age, habit of eating raw meat or unwashed fruit and vegetables, and general level of hygiene. The incidence of infections is higher in warmer and humid climate and increases with age [10].

Higher prevalence rates were reported in some Arab countries like Jordan 66.9% and Kuwait 53.1% (11). The difference in prevalence rate between different countries can be explained by variation of geographical and climatic conditions between different areas as the success of oocysts sporulation better in hotter and wetter areas [12]

In Yemen, only a few studies have investigated the prevalence of toxoplasmosis infection among women carried out in different areas; in Sana'a capital of Yemen a study of toxoplasmosis in pregnant women, recorded seropositive 47.4% IgG and 7.7% IgM [13]. High prevalence of 62% and 66% anti-toxoplasmosis IgG antibody by ELISA and Latex assay was already reported in pregnant women attending Thamar General Hospital and private laboratories [14]. Al-Shaebi reported 42.6% seroprevalence of toxoplasmosis by Latex technique and 45.7% by ELISA technique [15]. In Taiz Governorate a study reported 32.5% and 16.0% seroprevalence of toxoplasmosis among disabled children (DC) and apparently healthy children (AHC) respectively [16]. In Aden city a study of toxoplasmosis in woman, recorded seropositive 31% IgG and 14.0% IgM [17].

The aim of our study was to determine the seroprevalence of Toxoplasma IgG and IgM antibodies in women of childbearing age in Hodeidah city, Yemen.

**Materials and Methods**

**Study area**

Hodeidah Governorate is located on western a flat and narrow coastal plain between the foothills of the highlands and the Red Sea. It is the fourth largest Governorate in Yemen in the term of population which are (2,157,552), male: female ratio is 1:1, and children below 15 years are 50% of population, the total fertility rate in Hodeidah Governorate is 5.7. It is in a tropical zone, and the weather is typically hot and humid, summer months of April to November are very hot with temperatures sometimes exceeding 38 °C to 40 °C, during the rest of the year temperature range between 27-35° C. Most of Hodeidah population is underline of poverty, almost 22% of people living in urban areas. It was estimated that 38% of adults were illiterate, 40% of households had no access to sanitary services.

**Study design**

This is a cross-sectional, descriptive was conducted from September 2016 to June 2017, performed on women at childbearing age (between 18 to 32 years) in Faculty of

Medicine and Health Sciences, Hodeidah University, Yemen.

**Data collection**

A structured questionnaire was designed to collect information regarding socio-demographics and risk related data. Most the questions questionnaire was the yes/no questions which offer a dichotomous choice. The questionnaire was first developed in English and translated into Arabic language.

**Sample collection**

Five-ml blood sample was collected from 90 women by venipuncture, transferred into sterile anticoagulant-free sterile bottle, and allowed to clot. The clotted blood sample was centrifuged (3000 rpm, 5 min and the serum (the supernatant) was transferred into cry vials and stored at -20 °C until required for use.

**Serological testing**

Samples of serum were tested for anti-Toxoplasma IgG and IgM antibodies by using ELISA test kit (Diamedix, Miami, Florida, United States of America), all the samples, reagents and calibrators were brought to room temperature an hour before the performed test according to manufacturer's instruction

**Ethical approval**

Approval for this study was obtained from the Ethical Review Committee in Faculty of Medicine and Health Sciences in Hodeidah University.

**Statistical Analysis**

Statistical package for Social Science software (SPSS Version 15 Inc., Chicago) and Graph-pad Prism 3 was used in analyzing the results. Frequency distributions were performed and non-parametric Chi-square was used to test association between categorical variables. *p* value < 0.05 was considered to be statistically significant.

**Results**

In this study a total of 90 women of childbearing age with their age varied from 18-32 years old were tested for anti-toxoplasma IgG and IgM antibody by using ELISA technique, were randomly selected from Faculty of Medicine and Health Sciences, Hodeidah University, Yemen.

Table (1) Show the seroprevalence rate of IgG and IgM against toxoplasmosis by ELISA method among 90 females tested for toxoplasmosis antibodies in Hodeidah city, Yemen, it showed that 13 cases (14.4%) were seropositive and 77 cases (85.6%) were seronegative for each IgG and IgM antibodies.

**Table 1:** Distribution of anti-toxoplasma IgG and IgM antibodies

Antibody	Positive		Negative		Total	
	No.	%	No.	%	No.	%
IgG	13	14.4	77	85.6	90	100
IgM	13	14.4	77	85.6	90	100

Table 2 shows that the socio-demographic characteristics of the studied population. According to the age group there were 58 (64.4%) between 18-22 year, 30 (33.3%) were between 23-27 and 2 (2.2%) were between 28-32 year. Sixty-seven (74.4%) of these women were born in Hodeidah government and 12(13.3%) were born in Taiz, 1 (1.1%) was born in Al-Mahweet government and 10 (11.1%) were born in other

governments. More than half of the women 70 (77.8%) were live in urban area. Most of their mothers (88.9%) were unemployed (housewife).The illiterate mothers were less than half (52.2%) of total population of this study and most of woman of childbearing age 85 (94.5%) live in middle socio-economic status.

**Table 2:** Socio-demographic variables of participant women

Variables	Number (90)	Percentage (%)
<b>Age group (years)</b>		
18-22	58	64.4
23-27	30	33.3
28-32	2	2.2
<b>Place Of Birth</b>		
Hodeidah	67	74.4
Taiz	12	13.3
Al- Mahweet	1	1.1
Other Governorates	10	11.1
<b>Residence</b>		
Rural	20	22.2
Urban	70	77.8
<b>Occupation of Mother</b>		
House wife	80	88.9
Employee	10	11.1
<b>Occupation of Father</b>		
Working	80	88.9
Not working	10	11.1
<b>Education of Mother</b>		
Illiterate	47	52.2
Basic	10	11.1
Primary	12	13.3
Secondary	10	11.1
University	11	12.2
<b>Education of Father</b>		
Illiterate	14	15.5
Basic	18	20
Primary	11	12.2
Secondary	17	18.9
University	30	33.3
<b>Socio –Economic</b>		
High	3	3.3
Middle	85	94.5
low	2	2.2

Table (3) shows the relationship between seroprevalence of anti-toxoplasma antibodies and some socio-demographic characteristics. Evaluation of age specific subgroups indicated low *T. gondii* IgG seropositivity rate for all age group but there was not statistically significant. A similar result was obtained for *T. gondii* IgM seroprevalence ( $p>0.05$ ). Women who live in urban area indicated low seropositivity *T. gondii* IgG and IgM was 12 (13.3%), 10(12%) respectively, but there was not statistically significant. The distribution of prevalence

level of both IgG and IgM in relation to occupation of mothers was 10 (12%) and 12 (13.3%) respectively. The low prevalence of toxoplasma IgG was found to be 13 (14.4%) among working fathers of study sample. Most subject screened mother's was illiterate, there was no statistically significant difference between toxoplasma seropositive and those with lower levels of education. Whereas most seropositive among university level for those father's 8 (9%), 6 (7%) for IgG and IgM respectively.

**Table 3:** The relationship between seroprevalence of anti-toxoplasma antibodies and some socio-demographic characteristics

Variables	Number (90)	Percentage (%)	IgG Positive			IgM Positive		
			Positive	%	P value	Positive	%	P value
<b>Age</b>								
18-22	58	64.4	8	8.9	.812	9	10	.786
23-27	30	33.3	5	5.6		4	4.4	
28-32	2	2.2	0	0		0	0	
<b>Place Of Birth</b>								
Hodeidah	67	74.4	9	10	.170	5	5.6	.033
Taiz	12	13.3	1	1.1		4	4.4	
Al- Mahweet	1	1.1	0	0		0	0	
Aden	11	11.1	1	1.1		0	0	
Other Governorat	9	10	2	2.2		4	4.4	
<b>Residence</b>								
Rural	20	22.2	1	1.1	.173	3	3.3	.936
Urban	70	77.8	11	13.3		10	11.1	
<b>Occupation for Mother</b>								
House wife	80	88.9	10	11.1	.087	12	13.3	.870
Employee	10	11.1	3	3.3		1	1.1	
<b>Occupation for Father</b>								

working	80	88.9	13	14.4	.146	10	11.1	.196
Not working	10	11.1	0	0		3	3.3	
<b>Education for Mother</b>								
Illiterate	47	52.2	2	2.2	.030	7	7.8	.666
Basic	10	11.1	1	1.1		1	1.1	
Primary	12	13.3	4	4.4		3	3.3	
Secandry	10	11.1	3	3.3		1	1.1	
university	11	12.2	3	3.3		1	1.1	
<b>Education for Father</b>								
Illiterate	14	15.5	1	1.1	.188	1	1.1	.142
Basic	18	20	0	0		1	1.1	
Primary	11	12.2	1	1.1		5	5.5	
Secondary	17	19	3	3.3		0	0	
University	30	33.3	8	8.9		6	6.7	

Table (4) showed the prevalence of IgG (6.7%) and IgM (16.7%) in relation to presence of cats was this study show no significant association between *T. gondii* IgG (0%) and IgM (14.3%) and direct contact with cats. While no significant association between eating raw or undercooked minced meat. The association between eating outside of home was (14.5%, 16.3%) respectively for IgG and IgM seroprevalance of toxoplasma infection was significant among childbearing women and washing kitchen daily (15.8%) for both IgG and

IgM. Also the childbearing women asked about general knowledge of toxoplasmosis, the results show seropositive (16.9%, 10.1%) for IgG and IgM respectively. The percentage of acute toxoplasmosis (presence of IgM) among those using improve water as source of drinking water was (11.6%) compared with (15.1%) seropositive for IgG. The seropositive of *T. gondii* IgG antibodies was (42.9%) among childbearing women chewing Khat.

**Table 4:** The prevalence of toxoplasma antibodies in relation to life style

variable	number (90)	Percentage (%)	igG positive			IgM positive		
			no.	(%)	p-value	no.	(%)	p-value
<b>have a cats at home</b>								
yes	30	33.3	2	6.7	.085	5	16.7	.885
no	60	66.7	11	18.3		8	13.3	
<b>direct contact with cats</b>								
yes	7	7.8	0	0	.258	1	14.3	.990
no	83	92.2	13	15.7		12	14.4	
<b>washing kitchen daily</b>								
yes	76	84.4	12	15.8	.764	12	15.8	.764
no	14	15.6	1	7.1		1	7.1	
<b>consumed raw undercooking meet</b>								
yes	10	11.1	0	0	.401	0	0	.401
no	80	88.9	13	16.3		13	16.3	
<b>eating outside of home</b>								
yes	55	61.1	8	14.5	.885	9	16.4	.633
no	35	38.9	5	14.3		4	11.4	
<b>general knowledge on toxoplasmosis</b>								
yes	59	65.6	0	0	.499	6	10.2	.056
no	31	34.4	13	41.9		7	22.6	
<b>consumed untreated water source</b>								
yes	4	4.4	0	0	.401	3	7.5	.000
no	86	95.6	13	15.1		10	11.6	
<b>chewing khat</b>								
yes	7	7.8	3	42.8	.026	1	14.3	.990
no	83	92.2	10	12.1		12	14.5	

Table (5) show the relationship between seroprevalance of anti-*Toxoplasma gondii* antibodies and the medical symptoms, the rate of infection among seropositive for IgG with fever, lymphadenopathy, headache and arthralgia was

(9.8%, 8.3%, 12.1%, 12%) respectively, but there was not statistically significant. Whereas related to those symptoms and seropositive for IgM was (12.2%, 4.2%, 12.3%, 17.2%) respectively, but there was not statistically significant.

**Table 5:** The relationship between seroprevalance of anti-*Toxoplasma gondii* antibodies and the medical symptoms.

Variables	Number (n)	Percentage (%)	IgG Positive			IgM Positive		
			Positive	%	P value	positive	%	P value
<b>Mild fever</b>								
Yes	41	45.6	4	9.8	.411	5	12.2	.702
No	49	54.4	9	18.4		8	16.3	
<b>Lymphadenopathy</b>								
Yes	24	26.7	2	8.3	.411	1	4.2	.129
No	66	73.3	11	16.7		12	18.2	
<b>Headache</b>								
Yes	65	72.2	8	12.3	.352	8	12.3	.352
No	25	27.8	5	20		5	20	
<b>Arthralgia</b>								
Yes	58	64.4	7	12.1	.501	10	17.2	.237
No	32	35.6	6	18.8		3	9.4	

## Discussion

Toxoplasmosis is one of the most common infections of humans throughout the world [1, 2]. It caused by an intracellular protozoan called *T. gondii*. Although most cases of this infection in immunocompetent individuals are asymptomatic but if it has done in pregnant women, it can cause congenital toxoplasmosis with severe pathological effects on fetus [18, 19]. One of the useful ways to prevent congenital toxoplasmosis is to detect non-immune among women of child-bearing age before marriage. Women of child-bearing age are the best group to evaluate the immunity against toxoplasmosis. This is the first data concerning the prevalence of *T. gondii* infections among women of child-bearing age in Hodeidah city, Yemen.

In this study we found that 14.4% and 14.4% of women was seropositive for toxoplasma IgG and IgM antibody respectively. According to this results about 86% of women in faculty of Medicine and Health Sciences, Hodeidah city, did not have immunity against toxoplasmosis, therefore this group of population are at risk of acquired toxoplasmosis and if they acquire the infection during the pregnancy their fetus will be at risk of congenital toxoplasmosis [20, 21].

The results from this study were similar to previous studies in seroprevalance among women of childbearing age (15 to 44 years) of 15% in Saudi Arabia [22], and to several studies in different parts of in high school girl students in Isfahan province, Fasa district and Robatkarim district in Iran were 18.4%, 10% and 17.7% respectively, [18, 20].

Our result was lower than those reported in rates of near 20–30% are found in North America [23] and northern Europe [24], While higher prevalence of about 75–85% have been reported from Latin America [25] central [26, 27] and east Europe [28] and Southeast Asia [29]. Such seroprevalance variations could be due to differences in climatic conditions (dry climate, rainfall, temperature, soil type, altitude) and mothers' characteristics such as management of cats, educational level, hygienic practice and feeding habit [30-32]. Furthermore, differences in serological methods used and the sensitivity difference could explain such discrepancy [31, 32].

According to our results, although there was no significant correlation between toxoplasma seropositivity and age, but seropositivity is increased with decrease level of education. The results showed that about 7% of samples had history of contact with cat and there was no significant correlation between toxoplasma seropositivity and contact with cat, this result is not in accordance with several studies [20, 33, 34]. There was no significant correlation between toxoplasma seropositivity and some factors such as consumed untreated drinking water, eating outside of the hoe and showing khat,

this results was in accordance with several studies [35-38]. Although in this study 34.4% of women of child-bearing age did not have any information about toxoplasmosis but there was no correlation between toxoplasma seropositivity and primary information about toxoplasmosis, this result is in accordance with Mahmoudi *et al.* [20]

## Conclusion

Prevalence of *Toxoplasma gondii* infection in women of child-bearing age in faculty of Medicine and health sciences Hodeida City, Yemen is low (14.4%), this finding is similar to other results reported from neighboring countries. This study concurs with previous studies that have suggested all women of the child bearing age to be incorporated in routine antenatal screening profile.

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## References

1. Elvis Chongsi Wam, Leonard Fonkeng Sama, Innocent Mbulli Ali, Walter Akoh Ebile, Lucy Agyingi Aghangu, Christopher Bonglavnyuy Tume. Seroprevalance of *Toxoplasma gondii* Ig G and Ig M antibodies and associated risk actor in women of child-bearing age in Njinikom, NW Cameroon. BMC Res Notes, 2016; 9:406.
2. Kravetz JD, Federman DG. Toxoplasmosis in pregnancy. Am JMed. 2005; 118:212-216.
3. Dubey JP. Toxoplasmosis of animals and humans. 2. Beltsville: CRC Press, 2010.
4. Montoya JG, Liesenfeld O. Toxoplasmosis. Lancet. 2004; 363:1965-1976. doi: 10.1016/S0140-6736(04)16412-X. [PubMed] [Cross Ref]
5. Ferreira SM, Borges SA. Some aspects of protozoan infections in immune compromised patients-a review. Bio Line International System. [PubMed]. 2002; 97(4):443-457.
6. Pappas G, Roussos N, Falagas ME. Toxoplasmosis snapshots: global status of *Toxoplasma gondii* seroprevalance and implications for pregnancy and congenital toxoplasmosis. Int J Parasitol. 2009; 39:1385-1394. doi: 10.1016/j.ijpara.2009.04.003. [PubMed] [Cross Ref]
7. CDC. Parasites-Toxoplasmosis (*Toxoplasma* infection). 2013. [http://www.cdc.gov/parasites/toxoplasmosis/gen\\_info/ind](http://www.cdc.gov/parasites/toxoplasmosis/gen_info/ind)

- ex.html. Accessed 26 Aug 2014
8. Dubey JP, Lindsay DS, Speer CA. Structures of *Toxoplasma gondii* tachyzoites, bradyzoites, and sporozoites and biology and development of tissue cysts. *Clin Microbiol Rev.* 1998; 11:267-99.
  9. Dubey JP, Beattie CP. *Toxoplasmosis of animals and man.* Boca Raton, FL: CRC Press, 1988.
  10. Mohemid Al-Jebouri, Mohanad Al-Janabi<sup>1</sup>, Hassan Ismail. The prevalence of toxoplasmosis among female patients in Al-Hawija and Al-Baiji Districts in Iraq. *Open Journal of Epidemiology*, 2013; 3:85-88.
  11. James GS, Sintchenko VG, Dickeson DJ, Gilbert GL. Comparison of cell culture, mouse inoculation, and PCR fordetection of *Toxoplasma gondii*: effects of storage conditionson sensitivity. *J Clin Microbiol.* 1996; 34:1572-1575.
  12. Jumaian N F. Seroprevalence and risk factors for *Toxoplasma* infection in pregnant women in Jordan, Eastern Mediterranean Health Journal. 1996; 111-2, 2005, 45-51.
  13. Mubarak J. Toxoplasmosis in pregnant Yemeni Women. *Science Bull Sana'a Univ Yemen.* 2005; 18:13-19, 5.
  14. Al-Haifi AR *et al.* *Toxoplasma* among suspected pregnant woman. Faculty of Medicine & Health Sciences. Thamar University (unpublished), 2008.
  15. Al-Shaebi H. Epidemiological study of *Toxoplasma gondii* (Nicolle and Manceaux, 1908) with the study of immune response in pregnant women sero-afflicted with toxoplasmosis in Thamar Governorate. A thesis for the degree of Master. Thamar University, 2010, 84.
  16. Saleh MMS, AL-Shamiri AH, Qaed AA. Seroprevalence and incidence of *Toxoplasma gondii* among apparently healthy and visually or hearing disabled children in Taiz City, Yemen. *Kor J Parasitol.* 2010; 48(1):71-73.
  17. Muqbil N A, Al-Qubatii MA. Seroprevalence of toxoplasmosis among women in Aden city, Yemen. *Archives of Biomedical Sciences.* 2014; 2(2):42-50.
  18. Hatam GR, Shamseddin A, Nikouee F. Seroprevalence of *Toxoplasmosis* in high school girls in Fasa district, Iran. *Iranian J Immunol.* 2005; 2(3):177-181.
  19. Jones J, Lopez A, Wilson M. Congenital toxoplasmosis. *Am.Fam. Phys.* May. 2003; 15:67(10):2131-2138.
  20. Mahmoodi M, Mohebal M, Hejazi H, Keshavarz H, Alavi AM, IzadiSh. Seroepidemiological study on toxoplasmic infection among high-school girls by IFAT. *J Sch. Public Health Institute Public Health Res.* 2005; 3(1):29-42.
  21. Yang HJ, Jin KN, Park YK, Hong SC, Bae JM, Lee SH, *et al.* Seroprevalence of toxoplasmosis in the residents of Cheju island, Korea. *Korean J Parasitol.* 2000; 38(2):91-93.
  22. Al-Qurashi AR, Ghandour AM, Obied OE, Al-Mulhim A, Makki SM. Seroepidemiological study of *Toxoplasma gondii* infection in the human population in the Eastern Region, Saudi Medical Journal. 2000; 22(1):13-18, 2001.
  23. Jones JL, Ogunmodede F, Scheftel J, Kirkland E, Lopez A, Schulkin J *et al.* Toxoplasmosis-related knowledge and practices among pregnant women in the United States. *Infect Dis Obstet Gynecol.* 2003; 11:139-45. [PMC free article] [PubMed]
  24. Cunningham FG, Macdonald FC, Gan NF. *Williams obstetrics.* 20th ed. Stamford UK: Appleton and Lange, 1997, 1309-10.
  25. Spalding SM, Amendoeira MR, Klein CH, Ribeiro LC. Serological screening and toxoplasmosis exposure factors among pregnant women in South of Brazil. *Rev Soc Bras Med Trop.* 2005; 38:173-7. [PubMed]
  26. Jeannel D, Niel G, Costagliola D, Danis M, Traore BM, Gentilini M. Epidemiology of toxoplasmosis among pregnant women in the Paris area. *Int J Epidemiol.* 1989; 17:595-602. [PubMed]
  27. Ruiz Fons F, Vicente J, Vidal D, Höfle U, Villanúa D, Gauss C *et al.* Seroprevalence of six reproductive pathogens in European wild boar (*Sus scrofa*) from Spain The effect on wild boar female reproductive performance. *Theriogenology.* 2006; 65:731-43. [PubMed]
  28. Bobić B, Jevremović I, Marinković J, Sibalić D, Djurković-Djaković O. Risk factors for *Toxoplasma* infection in a reproductive age female population in the area of Belgrade Yugoslavia. *Eur J Epidemiol.* 1998; 14:605-10. [PubMed]
  29. Song KJ, Shin JC, Shin HJ, Nam HW. Seroprevalence of toxoplasmosis in Korean pregnant women. *Korean J Parasitol.* 2005; 43:69-71. [PMC free article] [PubMed]
  30. Zemene E, Yewhalaw D, Abera S, Belay T, Samuel A, Zeynudin A. Seroprevalence of *Toxoplasma gondii* and associated risk factors among pregnant women in Jimma town, southwestern Ethiopia. *BMC Infect Dis.* 2012; 12:337.
  31. Simpore J, Savadogo A, Ilboudo D, Nadambega MC, Esposito M, Yara J *et al.* *Toxoplasma gondii*, HCV, and HBV seroprevalence and co-infection among HIV-positive and -negative pregnant women in Burkina Faso. *J Med Virol.* 2006; 78(6):730-3
  32. Agmas B, Tesfaye R, Koye DN. Seroprevalence of *Toxoplasma gondii* infection and associated risk factors among pregnant women in Debre Tabor, Northwest Ethiopia. *BMC Res Notes.* 2015; 8:107.
  33. Manouchehri-Naeini K, Keshavarz H, Abdizadeh-Dehkordi R, Zebardast N, Kheiri S, Khalafian P, Salehifard AZ. Seroprevalence of anti-*Toxoplasma* antibodies among pregnant women from Chaharmahal and Bakhtyari province using indirect immunofluorescent. (In Farsi). *J Shahrekord. Uni. Med. Sci.* 2007; 8(4):74-80.
  34. Mohammadi P, Taherpur A, Mohammadi H. Seroprevalence of *Toxoplasmosis* in women during marriage consultation in Sanandaj. *J Infect. Trop. Dis.* 2008; 13(40):25-29.
  35. Daryani A, Sagha M. Seroepidemiology of *Toxoplasmosis* in women referred to medical health laboratory before marriage. Ardebil. (In Farsi). *J Ardabil. Univ. Med. Sci.* 2004; 4(13):19-25.
  36. Kamyabi Z, Atapour M. Investigation of the prevalence of *Toxoplasma* antibodies in women during marriage consultation in Kerman city. *J Kerman. UN. Med. Sci.* 1999; 6(3):127-133.
  37. ZiaeiKajbaf T, Taheri M. Evaluation of prevalence of seropositively against toxoplasmosis among childbearing age women in Ahwaz city in year 1382. *Scientific. Med.* 2008; 7(1):91-98.
  38. Ataeian A, Tadayyon P, Honilou A, Taran H, Mehrgan F, Azizi A. Prevalence of *Toxoplasma Gondii* antibodies in women of Zanjan Hakim-Hidajy Hospital. (In Farsi). *J Zanjan. Uni. Med. Sci.* 2000; 32:4-11.