RESEARCH ARTICLE

SEROPREVALENCE OF IgG AND IgM ANTI-TOXOPLASMA GONDII ANTIBODIESAMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA

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ARTICLE INFO	ABSTRACT
	Toxoplasmosis is a zoonotic disease caused by *T. gondii*, an ubiquitous, Apicomplexan single-celled, obligate intracellular protozoan parasite. *T. gondii*infection during pregnancy represents the risk for congenital infection and developing cerebral toxoplasmosis for HIV patients. In many countries including Ethiopia, serological screening is not a routine procedure and there is little information about toxoplasmosis. Therefore, the present study was designed to assess the seroprevalence of *T. gondii* infection and related risk factors among pregnant women attending antenatal clinic at TikurAnbessa Specialized Hospital, Addis Ababa Ethiopia. A cross-sectional study was carried out among pregnant women who came for their antenatal care follow up at TikurAnbessa Specialized Hospital from December 1, 2011 to February 1 2012. IgG and IgM antibodies to *T.gondii* in one hundred ninety two serum samples of pregnant women were analyzed bycommercially- available enzyme linked immunoassay technique. Pre-validated structured questionnaire was used to obtain information on risk factors associated with infection. Out of the one hundred ninety two pregnant women, 169 (88%) were positive for anti-*T. gondii* IgG antibodies and none were positive for anti *T.gondii* IgM antibodies. The IgG antibody was found in 37/41 (90.2%) HIV infected pregnant women and 132/151 (87.6%) in HIV uninfected pregnant women, with no statistical significance (p>0.05). Multivariate analysis using logistic regression showed that *T. gondii* infection was associated with consumption of raw vegetables (adjusted OR=4.39; 95% CI: 1.49-12.94), consumption of raw meat (adjusted OR=3.81; 95% CI: 1.18-12.26) and number of pregnancies (adjusted OR=3.85; 95% CI: 1.43-10.33). In conclusion, the results of the present study revealed that the sero-prevalence of latent *T. gondii* infection was high among pregnant women. HIV-positive and HIV-negative pregnant women had similar exposure to T. gondii infection. The study also revealed that consumption of raw meat and raw vegetables was found to be the major risk factorsfor *T. gondii* infection. Therefore, burden of *T. gondii* infection should not be overlooked and educating people to prevent acquisition of new infection has great importance. Efforts should also be made to minimize the risk of subsequent reactivation and disease manifestation among HIV-positive pregnant women with latent *Toxoplasma* infection.

INTRODUCTION

Toxoplasmosis isa zoonotic disease caused by *Toxoplasma gondii*, an ubiquitous, Apicomplexan single-celled, obligate intracellular protozoan parasite. (Ayi *et al*., 2009). Worldwide, around one third of human population is estimated to carry a *Toxoplasma* infection. In Ethiopia, the general prevalence is about 80% in the adult population (FHAPCO, 2007).The *T. gondii* seroprevalence estimated for human population varies greatly among different countries, among different geographical areas within the same country, and among different ethnic groups living in the same area. This variation related to, life style, age, nutritional habits and other sociocultural factors (Moradali *et al*., 2009). Seroprevalence of *T. gondii*in women of child-bearing age in African countries range between 20-84%, and73.1% in Sudan (Mohamed, *et al*., 2009), 92.5% in Ghana of pregnant women (Ayi, *et al*., 2009). In (HIV)–infected and HIV-uninfected at-risk US women the

prevalence of latent *Toxoplasma* infection was 15% (Falusi *et al.*, 2002), 54% from AIDS patients in Uganda,72 % among HIV positive pregnant women in brazil (Nogueira, *et al.,* 2010) and 90 % of latent *Toxoplasma* infection among HIV-infected and HIV-uninfected people Addis Ababa Ethiopia (Shimelis *et al.,* 2009).

The mortality of *T. gondii* infection in adult human is very low, but it could cause devastating effects including eye blindness, neurological impairment and mental retardation in congenitally infected children and in recent years, with the emergence of HIV, in patients with AIDS, it has been implicated as one of the most important opportunistic pathogens and severe life threatening disease. Cerebral toxoplasmosis is one of the most or the more frequent opportunistic infections and the most common cause of brain focal lesions complicating the course of AIDS (Nissapatorn *et al.,* 2002; Deji-Agboola *et al.,* 2011).Toxoplasmosis in patients with AIDS is usually the result of reactivation of latent infection. In HIV positive patients, without previous exposure to *T. gondii*, the acute infection could not be well controlled and in these susceptible hosts a wide range of infection is expected, although, toxoplasmosis occurs mostly in brain that is the frequent clinical finding even in those patients with latent toxoplasmosis (Nissapatorn *et al.,* 2002).

T. gondii infection may be acquired or congenital. In congenital form pathogenic agent is transmitting to the fetus through the maternal placenta. Acquired infection is due to ingestion of the oocysts, which are exacted by cats or transmitted through the contaminated meat. Congenital infection can lead to fetal death, pathological changes of CNS or the eye disease. The acquired form of the disease often is no sign, or is characterizes by general lethargy, swallow of lymphatic nodes and chorioretintis. In the compromised patient or the patient with malignancy or tissue plants, lethal and acute infections take place (Garedaghi and Safarmashae, 2011).

Toxoplasmosis is very important in pregnant women, because it can lead to transplacental transmission and involvement of the fetus with pathological effects such as abortion, microcephaly, hydrocephaly, blindness, calcification of brain cells and even death in uterus. Based on local and regional studies, the Centers for Disease Control and Prevention (CDC) estimates that there are 400–4000 cases of congenital toxoplasmosis per year and that toxoplasmosis is the third leading cause of food borne deaths in the US (Jeffrey *et al.,*2003). Women who have already infected with *Toxoplasma* parasites have immunity against toxoplasmosis in their pregnancy period and their fetus will be protected against congenital toxoplasmosis and women who do not have such immunity will be at risk of congenital toxoplasmosis (Swalland Schoonman, 2009). Congenital toxoplasmosis usually results from acquired infection in non-immune women infected for the first time during pregnancy. However, severely immunocompromised women chronically infected with the infection can transmit the disease to the fetus as a result of reactivation (Bachmeyera *et al.,* 2009).The severity of the illness is also related to the trimester period. It was observed that congenital infections acquired during the first trimester are more severe than those acquired in the second and third trimester (Deji-Agboola *et al., 2011*).

Among the various diagnostic techniques available, convetional ELISA is by far the most suitable and is commonly employed for diagnosis . Infection elicits primarily IgM and IgG class of antibodies . IgM indicating recent infection and IgG latent past infection . Systematic serological screening for *T. gondii* IgG and IgM antibodies in all pregnant women as early in gestation as feasible (ideally during the first trimester) and in seronegative women each month or trimester thereafter would be optimal. Such screening allows for detection of seroconversion and early initiation of treatment. Although screening is not performed in Ethiopia, such screening is mandated by law in some countries (e.g., France and Austria), to facilitate early detection of recently acquired infection (Jose *et al.*, 2008).

In many countries as well as our country, serological screening is not a routine procedures and there is little information about toxoplasmosis. Therefore, the present study was designed to assess the seroprevalence of *T. gondii* infection and related risk factors among pregnant women attending antenatal clinic at TikurAnbessa Specialized Hospital, Addis Ababa, Ethiopia.

MATERIAL AND METHODS

Study Area

The study was conducted in TikurAnbessa Specialized Hospital, ANC clinic, Addis Ababa. Addis Ababa is the Capital City of Ethiopia, is located at 9^0 2'N, 38^0 42'E with an elevation of about 2500 m.a.s.l. with an area of 540 km^2. According to the report of Central Statistics Authority, Addis Ababa has a total a cosmopolitan population of 2,738,248,000 in 2007 which represents 3.7 % of the total population of the country of which 1,304,518 were males and 1,433,730 were females (CSA, 2007). The town therefore attracts people from all regions of the country. TikurAnbessa Specialized Hospital is the referral and teaching hospital. It is located in Lideta sub city in Addis Ababa, the hospital works under Addis Ababa University providing multidisciplinary clinical service for all patients who come from different parts of the country. The Hospital started antiretroviral treatment service since March 2005.It is a reference center for gynecology and obstetrics. The gynecology and obstetrics centerhas 67 beds, a neonatal and maternal intensive care unit, and units for maternal–fetal medicine, obstetrics, and high-risk pregnancies. The number of births per year at this facility is estimated at 2500-3000.

Study Design and population

Cross sectional study was conducted to assess the seroprevalence of *T. gondii* infection among Pregnant Women attending antenatal clinic at TikurAnbessa Specialized Hospital, Addis Ababa, Ethiopia from December 1, 2011 to February 1, 2012. The study subjects consisted of randomly selected pregnant women attending this Hospital and who met the inclusion criteria.

Sample size determination

Sample size was estimated with the assumed toxoplasmosis prevalence of 86.8%on the basis of previous study (Shimelis *et al.,* 2009), effect size of 5% and 95%confidence interval. On the sample size 15 % contingency (26) was added, therefore, the total sample size was 202.However, 10 patients were excluded because of insufficient quantity and quality of serum and an incomplete questionnaire. Based on this a total of 192 subjects were enrolled in the study.

Sampling method

After reviewing daily-patient flow to the hospital expected patient population in the study period was taken as a sampling

frame. Systematic random sampling method was used to recruit the required sample size over the study period.

Questionnaire survey

Pre-validated structured questionnaire was used to obtain information on Socio-demographic and risk factors associated with infection. The questionnaire was translated to the local language (Amharic) and Pre-tested before the main study on clients. The data was collected by thee trained professionals (Nurse and Laboratory technicians). No personal identifier was included and individuals were given a unique code numbers to be attached on the questionnaire and their laboratory specimens.

Laboratory studies

After informed consent 5 ml of venous blood was collected from each pregnant woman. It was centrifuged at 3000 rpm for 10 min to remove serum. A serum was stored at -20 ^{0}c, until use. IgG and IgM antibodies to *T.gondii* from serum samples were quantified byusing toxo-lgG "classic" and toxo-IgM "μ-capture" enzyme linked immunoassay technique respectively, according to the manufacturer's instructions (HUMAN-ELISA, Demeditec Diagnostics GmbH, Germany), using a micro plate spectrophotometer reader.

Data processing and analysis

Data was entered into Microsoft Excel sheets and exported the software SPSS version 20.0 for analysis. The data was summarized and organized using graphs, tables and texts. Chi-squared or Fisher Exact tests, when appropriate, were used to verify the statistical significance. Bivariate and multivariate logistic regression analyses were used to assess the crude and adjusted effect of seemingly significant predicators of the *T.gondii* infection. Odds ratio with 95% confidence interval was used to measure the strength of association and p-value of <0.05 was considered to be significant

Ethical consideration

Before the commencement of this research project, the proposal was approved by the Institutional Review Board (IRB) of the Aklilu Lemma Institute of Pathobiology of Addis Ababa University and the Institutional Review Board (IRB) of the School of Medicine, Addis Ababa University. Support letter from TikurAnbessa Specialized Hospital was obtained following approval by the ethical clearance committees. Every participant had a unique identifier code and the data on the subjects was kept strictly confidential. Each individual was briefed about the objective of the study and informed written consent was obtained before blood collection and interview. They were also informed that they have the right to withhold information, refuse to participate or to drop out of the study at any time without the need to explain the reason to anyone and that their withdrawal will not have any repercussions on theirright to treatment and support. As the study requires blood sampling and the researchers were employed strict aseptic techniques and ensure subject safety. They were also informed that their results will be kept confidential.

RESULTS

Socio-demographic of study subjects

A total of 192 informed and consented pregnant women with aged 18-43 years (mean age: 28.61 years; std. dev.: 4.89 years) who came for their antenatal follow up were enrolled in this study. The 26-30 years age group recorded the highest participation, 88 (45.8%) and the 40-45 year-olds had the least of 3(1.6%). Most, 122 (63%), of the pregnant women participated in this study had Secondary and above followed by primary school 63(32.8 %) and Illiterate 7(13.3%).The main occupation of the study participants were gov't/private employees 103 (53.7%) followed by housewives 72(37.5%), and merchants 10 (5.2%). Regarding their religion, Orthodox Christianity was the dominant religion consisting of 140 (72.9%), followed by Muslims 32 (16.7%), Protestants 18(9.4%).and others 2(1%). With regard to gestational age 36 (18.5) of the pregnant women were in their first trimester, 64 (33.3 %) in the second trimester and 92 (47.9 %) in the third trimester. The distribution of the pregnant women according to parity showed that 67 (34.9%) of the pregnant women were primigravida (had no previous pregnancies) while 125(65.1 %) were Multigravida (has been pregnant more than once). of the total study participants 36(18.8%) them had bad obstetrics history (Table 1).

Risk Factors

The risk factors associated with *T.gondii* infection; raw meat consumption, presence of cat in the house, consumption of cat in the house, primary information about *T. gondii* and habit washing hands before eating identified by the questionnaire, and were further evaluated. The survey showed that 84.9% (163/192) had a history of consumption of raw vegetatable, 48.4 % (93/192) had a history consumption of raw meat, 37.5% (72 /192) had a history of contact with cat and 7(3.6%) and no habit of washing hands before eating . Only four pregnant women (health professionals) had primary information about toxoplasmosis (Table 2).

ELISA results among study participants

The ELISA results illustrated the relative concentration of circulating anti-*T. gondii*antibodies in the seropositive pregnant women as a measure of OD.

Out of the 192 pregnant women studied, 169 (88%) were positive for anti-*T. gondii* IgG antibodies and none were positive for anti *T.gondii* IgM antibodies (Table 3).

Seroprevalence of IgG among anti-*Toxoplasma* antibodies in relation to socio- demographic characteristics.

Seroprevalence of IgG was assessed based on socio-demographic characteristics of the study subjects (age, education, occupation, religion, trimester, number of pregnancies and had bad obstetrics history) (Table 1). The result showed that:

Seroprevalence as categorized by age groups, in years, was as follows: 15-20, 87.5%; 21-25, 85.4%; 26-30, 90.9%; 31- 35, 84.6%; 36-40, 84.6%; and 41-45,100%. Seroprevalence was generally high (84.6-100%) within all the age groups but the difference in IgG positivity across the various age groups was not significant (P >0.05*)*

Seroprevalence of *Toxoplasma* infection among the women within the different gestation periods were 93.1% (27/29) for first, 92.9% (65/70) for second and 91.7% (55/60) for third trimesters. A very high prevalence was observed for all trimesters and there was no significant difference (p >0.05) in the prevalence values.

The Seroprevalence of IgG anti-*Toxoplasma*antibodies was much higher (97.2%) among those who had bad obstetrics

history than those without it (85.9%), although there was no statistically significant difference (P>0.05).

The seroprevalence IgG was 94% (43/47) in primigravidas (had no previous pregnancies) and 18[45%] in Multigravida (has been pregnant more than once). Significant association was found to exist between seroprevalence and gravidity in the case of *Toxoplasma* IgG (P= 0.014).

Other risk socio- demographic characteristics in this study did not show any association. This include; occupation (x^2=2.4, p=0.494), religion (x^2=5.1=p= 0.281) and educational status (x^2=2.1 p=0.357).

There was also a statistically significant association of IgG *Toxoplasma* antibody seropositivity and presence of cat in the house (p =0.039).

The Seroprevalence of IgG anti-*Toxoplasma* antibody was much higher among those who had no knowledge about *T. gondii* (88.8%) than those who had knowledge about *T. gondii* (50%) although the difference was not statistically significant(P>0.05).

Table 1 Sero-prevalence of IgG anti-*Toxoplasma* antibodies in relation to socio-demographic characteristics of the study participants.

Characteristics	No (%)	Positive for anti-Toxoplasma IgG antibody	Chi square test value	P-value
Age group (in years)				
< 20	8 (4.2)	7 (87.5.)	1.9	0.856
21 – 25	41 (21.4)	35 (85.4)		
26 – 30	88 (45.8)	80 (90.9)		
31 – 35	39 (20.3)	33 (84.6)		
36 – 40	13 (6.8)	11 (84.6)		
41-45	3 (1.6)	3 (100)		
Education				
Illiterate	7 (3.7)	7 (100.0)	2.1	0.357
Primary school	63 (32.8)	53 (84.1)		
Secondary and above	122(63.5)	109 (89.3)		
Occupation				
Gov't/private employee	103(53.7)	88(84.4)	2.4	0.494
Housewife	72 (37.5)	65 (90.3)		
Merchant	10 (5.2)	10(100)		
No work	7 (3.6)	6(85.7)		
Religion				
Orthodox	140 (72.9)	126 (90.0)	5.1	0.281
Muslim	32 (16.7)	28 (87.5)		
Protestant	18 (9.4)	13 (72.2)		
Other	2 (1)	2 (100.0)		
Trimester				
1st Trimester	36 (18.5)	23(88.5%)	2.2	0.332
2nd Trimester	64 (33.3)	62 (83.8)		
3rd Trimester	92(47.9)	84 (94.3)		
Number of pregnancies				
One pregnancy	67(34.9)	53(79.1)	7.8	0.005*
More than one pregnancy	125(65.1)	116 (92.8)		
Bad obstetrics history				
Yes	36(18.8)	35(97.2)	3.6	0.059
No	156(81.2)	134(85.9)		

Seroprevalence in relation to related risk Factors

A summary of risk factors associated to the presence of IgG anti-*Toxoplasma* antibody body in pregnant women at TikurAnbessa Specialized Hospital, Addis Ababa Ethiopia is presented in Table 2. The result showed that:

From 93 participants who consumed raw meat, 89 % individuals had IgG anti-*Toxoplasma* antibody and statistical analysis showed significant relationship between seropositivity of toxoplasma IgG antibody and consumption of raw meat (P=0.002).

The seroprevalence of *T.gondii* infection is significantly higher (95.7%) amongst those pregnant women those who consumed raw vegetables and significantly lower (80.8%) amongst those who do not consumed raw vegetables (P=0.001).

Table 2 also shows that the prevalence of *T. gondii* infection was higher among those who had not a habit of washing hands before eat than those who had a habit of washing hands before eat, although there was no statistically significant difference with these predisposing risk (P>0.05).

Table 2 Seroprevalence of IgG anti-Toxoplasma antibodies in relation to related risk factorsof the study subjects

Characteristics	No (%)	Positive for anti-Toxoplasma IgG antibodies No. (%)	P-value
Consumption of raw vegetables			
Yes	163(84.9)	149(91.4)	0.001[*]
No	29 (15.1)	20(69.0)	
Consumption of raw meat			
Yes	93(48.4)	89(95.7)	0.002[*]
No	99(51.6)	80(80.8)	
Presence of cat in the house			
Yes	72(37.5)	68(94.4)	0.039[*]
No	120(62.5)	101(84.2)	
Habit of Washing hands before eating			
Yes	185(96.4)	162(87.6)	0.320
No	7(3.6)	7(100)	
Knowledge about toxoplasma gondii			
Yes	4(2.1)	2(50)	0.071
No	188(97.9)	167 (88.8)	

Seropositivity of Anti-Toxoplasma IgG antibodies in relation to HIV status

The IgG antibody was found In 37/41 (90.2%) HIV infected pregnant women and 132/151 (87.6%) in HIV uninfected pregnant women, with no statistical significance (p>0.05) (Table 3).

DISCUSSION

Seroprevalence of IgG and IgM anti-*Toxoplasma* antibodies and risk factors among pregnant women participants was determined in the present study.

Table 3 Seropositivity of Anti-*Toxoplasma IgG* antibodies in relation to HIV status of study participants.

HIV STATUS	Total N (%)	Anti-*Toxoplasma* IgG antibody		P-value
		Positive No. (%)	Negative No. (%)	
HIV INFECTED	41 (21.4)	37 (90.2)	4 (9.8)	
HIV UNINFECTED	151 (78.6)	132(87.4)	19 (12.6)	0.621
Total N (%)	192(100)	169(88)	23 (12)	

In bivariate analysis (Table 1 and 2), four variables were identified as the possible risk factors and sociodemographic characteristics associated with *T.gondii* infection: 1) Consumption of raw vegetatable (p=0.001); 2) consumption of raw meat (p=0.002); 3) Presence of cat in the house (p=0.039) and 4)Number of pregnancies (p=0.005). The rest sociodemographic characteristics and risk factors of the studied women did not show any likely association with *T.gondii* infection.

Table 1 and 2 show the results of the bivariate analysis of selected variables and the result of *T.gondii*seropositivity. As seen in Table 4, by using multivariate analysis only three variables were associated with *T.gondii*seropositivity: 1) consumption of raw vegetatable (adjusted OR=4.39; 95% CI: 1.49-12.94); 2) Consumption of raw meat (adjusted OR=3.81; 95% CI: 1.18-12.26); 3) Number of pregnancies (adjusted OR=3.85; 95% CI: 1.43-10.33).

There were 192 pregnant women in this study and of these 41 cases (21.4%) were HIV infected.88% were found to be positive for *T. gondii* IgG antibodies. The seroprevalence of 88% obtained in this study for *T. gondii*IgG is comparable to results previously reported in St. Paul's Hospital, Addis Ababa, Ethiopia, where an IgG Seroprevalence of 86.8 was obtained among women with and without HIV (Shimelis *et al.,* 2009), 80% among HIV-infected and HIV-uninfected people in Addis Ababa (Woldemichael *et al.,* 1998) and 85.4 % among pregnant women in Addis Ababa tested byusing latex agglutination test (Gelaye *et al.,* 2011). However the results of this study is significantly higher than that of pregnant women in Brazil (53.03%, Vaz, *et al.,* 2010) in South America, Portugal (57.4%, Ivana, *et al.,* 2003) in Europe, China (10.6%, 25/235;Liu, *et al.,* 2009) in Asia, Burkina Faso (25.3%, 85/336;Jacques *et al.,* 2006), and Nigeria (32.6%, 90/276; Deji-Agboola *et al.,* 2011) in West Africa, Libya (44.8%, 64/143;Mousa *et al.,* 2011) in North Africa, Mozambique (18.7% , 28/150;Sitoe*et al.,* 2010) in East Africa.

Table 4 Multivariate analysis on apparently significant predictors of *Toxoplasma gondii*infection in bivariate analysis

Characteristics		Crude odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)	P-value
Consumption of raw vegetables	No	1	1	0.007
	Yes	4.79 (1.84-12.49)	4.39 (1.49-12.94)	
Consumption of raw meat	No	1	1	0.025
	Yes	5.28 (1.73-16.19)	3.81 (1.18-12.26)	
Presence of cat in the house	No	1	1	0.067
	Yes	3.20 (1.04-9.81)	3.10 (0.92-10.41)	
Number of pregnancies	One pregnancy	1	1	0.008
	More than one pregnancy	3.22 (1.32-7.91)	3.85 (1.43-10.33)	

* P – value obtained in multivariable logistic regression analysis

The high sero-prevalence of IgG anti-*Toxoplasma* antibodies in this study may be due to feeding habits of eating raw or undercooked meat, consumption of foods contaminated with cat feces containing *T. gondii* oocysts, unhygienic conditions in handling food and the climate being favorable to favor development and survival of the parasite.

None of the study subjects was found to be positive for anti-*Toxoplasma* IgM antibodies. This is consistent with other studies: 2.73% in Cameroon (Anna *et al.*, 2011), 0% in Burkina Faso (Jacques *et al.,* 2006), 0% in Mexico (Cosme *et al.*, 2006), 0% in Sri Lankan (Subasinghe *et al.*, 2011).However, it is lower than of 7.3% reported in Nigeria (Deji-Agboola *et al.*, 2011) and 8.4% in Libya (Mousa *et al.,* 2011). It is possible that some cases of acute *Toxoplasma* infection may have been found negative for IgM particularly in the more profoundly immunodeficient, or where testing was carried out several months after infection has been carried out several months after infection has been acquired. (Minoo *et al.*, 2010). Generally IgM antibodies are detected within the first 2 weeks of infection and reduce to negligible levels within 6 months after exposure. However, in toxoplasmosis, IgM titres can remain elevated up to a year or even more. Thus, the mere presence of IgM antibodies is not diagnostic of an acute toxoplasmosis infection. However, a negative IgM antibody test rules out recently acquired infection unless the serum is tested too early after exposure so that antibodies have not as yet developed. A single positive IgG antibody test indicates chronic infection, which might have been acquired before conception (Subasinghe *et al.*, 2011) .None of the women tested in our study group were positive for acute infection.

In this study, there was no apparent association between *Toxoplasma* infection and age of the pregnant women. This result is in agreement with several studies with several studies (Shimelis *et al.,* 2009; Ayi, *et al.*, 2009; Anna *et al.*, 2011). Although frequency of *T.gondii* infection has been reported to increase in olderage groups in other studies (Beta *et al.*, 2009;Deji-Agboola*et al.*, 2011). The non-significant effect of age on *T. gondii* infection in our study subjects may suggest that exposure was irrespective of the risk behaviors pertinent to specific age group.

In the present study, sero-prevalence of IgG anti-*Toxoplasma* antibodies was also assessed in relation to bad obstetrics history. There was no relationship between bad obstetrics history and seropositivity. This is also consistent with previous report (Libya (Mousa *et al.,* 2011).

In this study there was a significance association between infection by *T. gondii* and the number of pregnancies. Women who had been pregnant more than once presented a greater chance of infection by *T. gondii* (p=.008), adjusted OR (95%CI): 3.85 (1.43-10.33) (Table 1). This finding is similar to that observed in Brazil (Dias *et al.*, 2011; Mariza *et al.*, 2004), Nigeria (Deji-Agboola *et al.*, 2011). This greater vulnerability of pregnant women to the parasite is probably due to alterations in the immune mechanisms inherent to gestation, resulting from suppression of immune response because of the necessity of tolerance to the graft (fetus) and/or as a consequence of hormone imbalances characteristic of the gestational condition (Mariza *et al.*, 2004).

The observed seroprevalence in this study did not depend on gestational age and this finding correlates with an earlier report in Cameroon (Ana *et al.*, 2011), Saudi Arabia (Saeed *et al.*, 2006) and Ghana (Ayi, *et al.*, 2009).

Similar to other studies in previously reported in St. Paul's Hospital, Addis Ababa, Ethiopia (Shimelis *et al.,* 2009) , Ghana (Ayi, *et al.*, 2009), India (19) and in Iran(Minoo *et al.*, 2010) we demonstrated that there is no association between the prevalence of *T. gondii* infection and sociodemographic characteristics (Education, Occupation and religion) .

Although some researchers found significant relationship between *T. gondii* infection prevalence and Presence of cat in the house (Negash *et al.*, 2008; Lopes, *et al.*, 2009), in our study, there was no significant association was found between *T. gondii* seroprevalence and Presence of cat in the house. Similar results were found by (Deji-Agboola *et al.*, 2011, Elnhas, *et al.*, 2003 and Dias *et al.*, 2011) in pregnant women in Nigeria and Brazil respectively. These contradictory results could be explained by having a cat at home, by itself, was not enough to increase the risk of acquiring a *T. gondii* infection. The risk of infection might exist when there is contact with the feces of cats that are eliminating oocytes after the primary infection, and the feces of these animals could remain in the environment for at least 24 hours so that the oocytes sporulate and become infectant (Dias *et al.*, 2011).The other possible explanations might be due to the consumption of raw vegetables and meat as a significant high prevalence amongst those who eat raw vegetables not properly washed and who consumed raw meat.

The habit of eating raw vegetables was also considered to be a factor associated with a greater chance of *T. gondii* infection. Our findings are in agreement with several studies those reported in Cameroon (Anna *et al.*, 2011), Nigeria (Deji-Agboola *et al.*, 2011) and Brazil (Lopes, *et al.*, 2009).

Another variable associated to infection by *T. gondii* was consumption of raw meat. Pregnant women who gave history of eating raw meat were found significantly sero-positive than those who did not (p=.025), adjusted OR (95%CI): 3.81 (1.18-12.26). This result was similar to that observed by (Negash *et al.*, 2008,) in Ethiopia, (Elnahas, *et al.*, 2003) in Sudan.

Similar to other studies in Cameroon (Anna *et al.*, 2011) and Saudi Arabia (Saeed *et al.*, 2006) we demonstrated that there is no association betweensome knowledge on *T.gondii* infection and *T.gondii*seropositivity. This was due to majority of women who had some knowledge on *T. gondii* infection were either in the health sector or had university education implying that they might have known of *T. gondii* infection ever before they became informed of it.

This study showed higher *Toxoplasma* seropositivity among patients who had no habit of washing hands before eating. Nevertheless, there was no significant difference in infection rate.

Moreover, the present study showed that HIV-positive and HIV-negative pregnant women had similar exposure to *T. gondii* infection, as reported by others (Woldemichael *et al.,* 1998; Shimelis *et al.,* 2009; Daryani *et al.*, 2011 and Falusi *et al.*, 2002). The high prevalence of latent *T. gondii* infection in these risk groups, particularly among HIV-infected pregnant women, is of great concern. Presence of *Toxoplasma* IgG antibody indicates previous infection and possible existence of cysts within the tissues. In immunocompromised patients, rupture of a tissue cyst may result in liberation of bradyzoites and regeneration of parasites. The secondary reactivation of a previous chronic or quiescent *Toxoplasma* infestation in those with declining immunity might be an explanation of a higher

seroprevalence among HIV infected pregnancies. This information implied a greater risk of maternal-fetal transmission of *Toxoplasma* in pregnant women who were dually infected with both agents (Wanachiwanawin *et al.*, 2001).

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