Sero–Prevalence, and Associated Risk Factors of *Toxoplasma gondii* Infection in Pregnant Women and HIV/AIDS Patients in Selected Cities of Ethiopia

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Abstract: Toxoplasma gondii infection is main cause of abortion, congenital defects and fatality in pregnant women and HIV/AIDS infected individuals respectively. The seroprevalence and risk factor assessment of toxoplasmosis in pregnant women and HIV/AIDS infected individuals in Addis Ababa, Jinka, Mojo and Awash towns of Ethiopia was conducted in this study. The study also assessed knowledge and perception of health professionals including physician, nurses and gynecologist, working in antenatal care in selected health institution of different parts of Ethiopia. A cross–sectional study was conducted from October 2011 to March 2012. Sera of 293 pregnant women and 190 in HIV/AIDS infected individuals were analyzed by serological method called Indirect Enzyme Linked ImmunoSorbent Assay [ELISA]. The total seropostivity of IgG and IgM *T. gondii* were 89.9% and 28.3% respectively. From 293 pregnant women of study 9.5% were IgG negative and IgM positive and 25.5% were both IgG and IgM positive, which means 28.6% of pregnant women had detectable IgM antibodies during pregnancy. Univariate logistic regression analysis showed that study areas, age, residential places, educational status, HIV/AIDS status, ART utilization, pregnancy status, number of pregnancy, stage of pregnancy, history of abortion and number of abortion, cat at home, contact with cat, separate cat house, raw milk and vegetables consumption were significantly associated with seropositivity of *T. gondii*. From health professionals, 63% know health risk of domestic animals like cat with regards to toxoplasmosis. Consumption of raw or undercooked meat and vegetables (71.2%) were recognized as common source of *T. gondii* infection by health professionals consumption of raw milk (18.4%), contact with cat faces (14.3%), and drinking unboiled water (6.1%) were also mentioned as important modes of transmission. In this study, 52.7% of health professionals thought toxoplasmosis as important pathogen in HIV infected patients and pregnant women. Seropositivity of *T. gondii* infection in HIV/AIDS infected individuals and pregnant women in Addis Ababa, Jinka, Mojo and Awash towns of Ethiopia is high. Abortion, exposure to cat faces and HIV/AIDS status are main determining risk factors to acquire *T. gondii* infection in study population. There is also urgent need of incorporating zoonotic diseases concept in medical education and training. These findings are helpful for optimal design of strategies in contribution of health professionals in relation to toxoplasmosis, pregnant women and immunocompromised individuals. Furthermore, health Education, screening pregnant women during their antenatal care and in depth epidemiological studies are recommended.

Key words: Cats; HIV/AIDS; Pregnancy; Health professionals; T. gondii, Zoonosis

Introduction

Toxoplasmosis is one of major global zoonotic diseases [TORGERSON and MACPHERSON, 2011; PETERSEN *et al*, 2010].
Toxoplasma gondii can be transmitted to human after consuming raw or undercooked meat, by ingesting cat shed oocysts via contaminated soil, food or water, or congenitally by transplacental transmission of tachyzoites [TORGERSON and MACPHERSON, 2011; DUBEY, 2010].

Congenital toxoplasmosis is a major

problem in most communities with a high prevalence of *T. gondii* infection.

T. gondii infection in pregnant women can result in still birth, congenital defects, such as microcephalus, congenital defects and chorioretinitis.

Trans–placental transmission mostly occurs during acute maternal infection. In newborns, *T. gondii* infection is asymptomatic [REMINGTON *et al.,* 2006].

In immunosupresed patients deaths due to Toxoplasmosis usually results from rupture of cysts that lead to continued multiplication of tachyzoites.

Hence, encephalitis is reported to be predominant sign and symptom of toxoplasmosis in HIV/AIDS patients and is known to be due to reoccurrence of latent infection [MONTOYA and LIESENFELD, 2004; DUBEY, 2010]. Detection of *T gondii* antibodies in sera of pregnant women and HIV/AIDS patients allows its magnitude and those at risk of getting infection. A study shows magnitude of toxoplasmosis in Ethiopia population ranges from 20.2% to 97.7% [ESHETE *et al.,* 1994]. But still no adequate study has reported its prevalence in pregnant women of study areas in Ethiopia.

Because of asymptomatic nature of primary toxoplasmosis infection, counseling of pregnant women is of paramount importance to reduce risk of fetal infection. Knowledge of most likely sources of infection in a given population is a prerequisite for development of effective strategies to decrease, and perhaps eliminate, infection risks.

Effective counseling for prevention requires knowledge of risk factors associated with transmission of parasite.

Knowledge of life cycle of *T. gondii* is necessary to understand how to advice women to decrease their risk of primary toxoplasmosis [KRAVETZ and DANIEL, 2005; JONES *et al.,* 2003].

The knowledge and perception of health professionals towards toxoplasmosis is best tool to reduce risk of infection in human. In few surveys carried out elsewhere among obstetricians, a deficit in knowledge about diagnostic, clinical, and epidemiological aspects of toxoplasmosis was demonstrated, with inherent risk of inadequate management [LAURA BERRIEL da SILVA *et al.,* 2011]. Alvarado–Esquivel [ALVARADO–ESQUIVEL *et al.,* 2011] indicated that physicians surveyed showed an incomplete knowledge about diagnosis and treatment of toxoplasmosis. A survey showed that vast majority of obstetricians counseled pregnant women on avoiding cat litter and undercooked or raw foods, but fewer provided counseling on safe gardening and over 50% responded that keeping a cat outdoors would lower risk of toxoplasmosis [JONES *et al.,* 2001].

Education of obstetricians, nurses and physician on risk factors for toxoplasmosis transmission is needed and may lower rate of congenital toxoplasmosis as well as decrease frequency of cat abandonment during pregnancy. There are few studies addressing degree of knowledge on toxoplasmosis of health professionals.

In these regards, assessing knowledge and perception of health professionals towards to toxoplasmosis in Ethiopia is very crucial but no similar study conducted in country before.

Lack of adequate studies on sero–epidemological pictures, potential risk factors and knowledge and perception of health professionals towards toxoplasmosis in country justified importance of this study.

In Ethiopia, causes of most abortions, stillbirths and neonatal mortalities in human are unexplored and relationship with seroprevalence of toxoplasmosis not well studied.

In addition, segmented or not well known on epidemiology and public health importance of *T. gondii* infection in Ethiopia. Particularly importance of this disease in pregnant women and HIV/AIDS infected individuals is not studied well in Ethiopia.

Besides, there is tradition of eating raw meat, unavoidable contact between humans and small ruminant's animals and very high prevalence of HIV/AIDS.

Therefore, objectives of this study were to determine prevalence and identify potent risk factors associated with *T.*

gondii infection in pregnant women and HIV/AIDS infected individuals in Addis Ababa, Jinka, Awash and Mojo towns of Ethiopia. This study will also explore knowledge and perception of health professionals working in antenatal care in selected health institution in mentioned towns.

Material and methods
2.1 Study Areas and Population

The study was done at selected health facilities of Addis Ababa, Jinka, Mojo and Awash towns of Ethiopia from October 2011 to March 2012. Addis Ababa, capital city of Ethiopia, is described by a biannual rainfall. Jinka is capital of South Omo Zone of South nation, nationality people. Mojo and Awash are located in East Shoa Zone 74 and 202 kms from Addis Ababa respectively.

2.2 Study Population

The current study done on pregnant women and HIV/AIDS patients who were visiting health institution for seroprevalence and risk factor assessment were all patients who were visiting health institution for follow up of antenatal care services.

Blood samples were taken from pregnant women and HIV/AIDS patients who were visiting selected health institution of respective study areas for antenatal follow up or medication.

For assessment of knowledge and perception of health professionals, we considered health professionals who are gynecologist, physician and nurses working in prenatal and Anti–Retroviral Treatment services of selected health institution of different parts of Ethiopia.

Therefore, in current study 100 health professionals were included for knowledge and perception study towards toxoplasmosis.

Those health professionals who are physician, nurses and gynecologist and had more than or equal to two years' work experience were included in study but others health professionals except aforementioned health professionals who had less than two years work experience were excluded.

2.3 Study Design

The cross–sectional study was conducted from October 2011 to March 2012 by using design. The formula on Thrusfield (2007) formula was used to calculate required sample size According to Yimer [YIMER *et al.,* 2005] prevalence of *T. gondii* infection in different parts of Ethiopia was 74.4% and according to prevalence of *T. gondii* infection in HIV infected was 93.3%. Accordingly, 293 sera of pregnant women were included in this study. The calculated sample size was distributed to four towns using a proportional allocation based on annual pregnant women flow to respective selected health institution. In addition, calculation resulted 156 samples from HIV/AIDS infected individuals. However, increase representativeness, sample size was inflated by 20% to enhance precision of study. Therefore, a projected sample size of 190 HIV infected patients was used to collect sera samples.

2.4 Blood Specimen Collection and Transportation Method

Five ml of Blood Specimen were collected from study population by using sterile plain Vacutainer tubes [BD Vacutainer systems, Plymouth, UK].

Specimen were collected from eight health facilities namely Addis Ababa Black line specialized and referral hospital, Kebena health center, Jinka hospital, Jinka health center, Awash Health Center, Mojo health center, werrer health center]. At room temperature Blood samples were put overnight to allow clotting and centrifuged for 10 minutes at 3000 rpm. Finally sera were collected in Eppendorf tubes [Eppendorf–AG, Hamburg, Germany] and stored at 4°C for 48–78 hours until transported in an ice box to Microbiology laboratory of college of veterinary medicine and agriculture, Addis Ababa University, where they were kept at –20°C until tested.

2.5 Indirect Igg and Igm ELISA

Serologically serum was tested for presence of anti– *T. gondii* IgG and IgM antibodies by indirect enzyme linked immunosorbent assay [ELISA] kit [Demeditec Diagnostics GmbH, Germany]. According to manufacturer instruction kit has reported

sensitivity and specificity of 98% and 99%, respectively.

At a wavelength of 450 nm optical densities of wells were measured by a photometer. To be result is positive Values should be higher than cut–off [10IU/mL]. Where as values ±20% of cut–off were equivocal.

2.6 Questionnaire Survey

A pretested and organized questionnaire was used to identify risk factors, which were: sociodemographic variables, host related factors, feeding habit and hygienic condition, study participants awareness about toxoplasmosis and HIV status.

A separate questionnaire was used to collect data from health professionals to collect information on their age, sex, academic qualification, area of work, awareness of toxoplasmosis, exposure of toxoplasmosis case on patient, clinical sign and symptoms, prevalence of case and provision of health education to pregnant women. The other important part of study was questionnaire survey based investigations to assess various risk factors to acquire *T. gondii* infection in study participants and knowledge and perception of health professionals.

2.7 Data Management and Analysis

Once data were recorded in Microsoft Excel spreadsheet [Microsoft Corporation], it is transferred and analyzed using STATA version 20.0 for Windows.

By dividing number of serologically positive samples by total number of samples tested seroprevalence was calculated. To identify predictive values of potential risk factors A logistic regression model was employed.

To determine associations between seropositivity and potential risk factors chi–square test was used. Odds ratios and 95% confidence intervals [CI] were also used. Results were considered statically significant at $P \leq 0.05$.

2.8 Ethical Clearance

The principal investigator were made brief explanation for all study population about study protocol and after that written informed consents were obtained from all study population.

By using codes confidentiality was maintained. The study proposal ethically approved by Ethical clearance committee from School of Medical Laboratory Sciences Addis Ababa University.

Results and discussion

3.1 Seroprevalence of Toxoplasmosis

The mean age of study population was 20.4 ± 5.04 years. A total of 483 sera; 293 pregnant women and 190 HIV/AIDS patients were included.

During study, total anti–*T. gondii* IgG and IgM seropositivity were 89.9% and 28.3% respectively. Tested sera, 137/483 [28.3%] were positive for IgM antibodies suggestive of recent infection.

Among IgM positive study population 28.6% accounts for pregnant women. *T. gondii* IgG positive and IgM negative results [7%] indicate chronic exposure to parasite infection, whereas IgM positive results were [28.3%].

From serologically tested pregnant women of study 9.5% were IgG negative and IgM positive and 25.5% were both IgG and IgM positive, which means 28.6% of women had detectable IgM antibodies during pregnancy. Most of, 89.8%, women were reactive for IgG and non–reactive for IgM; 25.2% were both IgG and IgM reactive. It can be observed that most of study population had pre–existing infection with parasite [89.8%]. Around 10.1% [seronegative] of study population is has chance of getting infection in future. The prevalence of latent toxoplasmosis [IgG] in Pregnant women and HIV/AIDS patients in study areas were 92.1% in Awash, 91% in Jinka, 90.4% in Mojo and 87.2 % in Addis Ababa.

3.2 *T. gondii* Seropositivity Risk Factors

Analysis of e risk factors to get *T. gondii* among study population was done using logistic regression analysis.

Univariate logistic regression analysis indicated that study areas, age (years), residential places, educational status, HIV/AIDS status, ART utilization, pregnancy status, number of pregnancy, stage of pregnancy, history of abortion and number of abortion, cat at home,

contact with cat, separate cat house, raw milk and vegetables consumption were

statically significant association with *T. gondii* seropositivity [P<0.05] (Table 1).

Table 1.

Seroprevalence of IgG and IgM anti–*T. gondii antibodies* in pregnant women and HIV infected patients in different parts of Ethiopia

Sero reaction	Total [N=483]		Pregnant [N=293]		HIV infected [N=190]		P–value
	Positive	%	Positive	%	Positive	%	
IgG positive only	434	89.8	256	87.3	178	93.6	0.283
IgG and IgM Positive	122	25.2	75	25.5	47	24.7	0.099
IgG pos and IgM Neg	34	7	28	9.5	6	3.1	<0.001
IgG Neg and IgM pos	15	3.1	9	1.8	6	3.1	0.005
Total seronegativity	49	10.1	37	12.6	12	6.3	0.008

Out of 293 tested pregnant women 87.3% [256] and 28.6% [84] were positive for IgG and IgM *T–gondii* antibodies respectively. Among IgG positive pregnant women, seropostivity of

IgG antibody increased with duration of pregnancy but that of IgM or recent *T. gondii* infection was relatively higher in second trimester [Figure 1].
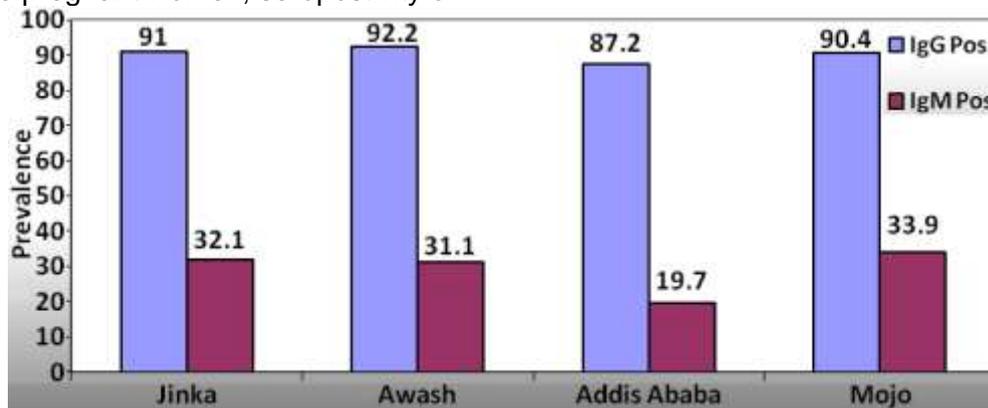

Figure 1. Seroprevalence of *T.gondii* IgG and IgM in pregnant women and HIV infected patients in Addis Ababa, Jinka, Mojo and Awash towns of Ethiopia

Among IgM positives pregnant women 24.5 % were in first trimester, 31.2 % second trimester and 24.6% third trimester [Figure 2].

According to current study, seropositivity of *T. gondii* infection had statistically significant association with stage of pregnancy [P=0.022].
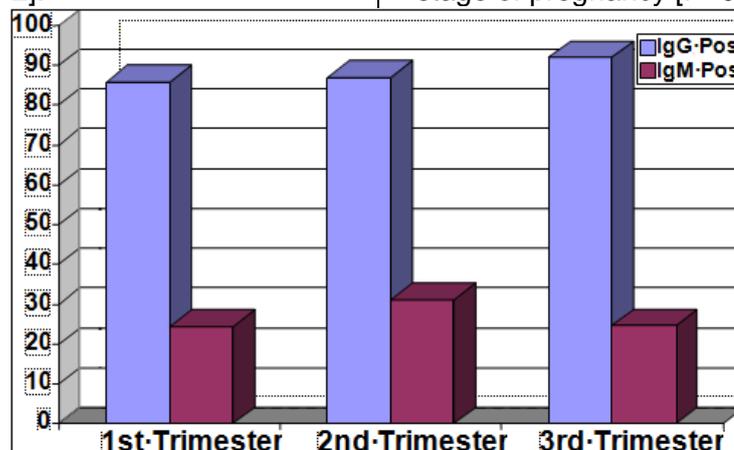

Figure 2. T. gondii seropositivity in pregnant women verses with stage of pregnancy
Using multivariate analysis, study area [P = 0.005], Residential place [P = 0.002], HIV/AIDS status [P = 0.015], Pregnancy status [P = 0.001] consumption of raw vegetables [P = 0.000], Raw meat consumption [P = 0.029], Raw milk consumption [P = 0.000] and Abortion [P = 0.048] were independent predictors of toxoplasmosis according to Multivariate logistic analysis [Table 2]

From current study, it is also observed that chance of getting *T. gondii*

infection is enhanced with number of children. The seropostivity of *T. gondii*

infection is 76.6%, 77.7% and 100% in those female study populations who had one, two and three and above children respectively. This difference was found to be statistically significant [p<0.05].

Questionnaire survey showed that all study participants do not have any prior knowledge about toxoplasmosis and health risk of petting cats [Table 2].

Table 2.

Potential risk factors *T. gondii* infection in pregnant women and HIV infected patients by logistic analysis

Variable	Category	IgG+/total [%]	Univariate OR[95% CI]	P–value	Multivariate OR[95% CI]	P–value
Study Areas	Mojo	104/115[90.4]	–	–	–	–
	Addis Ababa	137/157[87.2]	1.08[0.291,2.371]	0.760	0.59[0.251,1.4]	0.005
	Awash	71/77[92.2]	5.2[0.209,3.531]	0.017	0.34[0.237,1.919]	0.003
	Jinka	122/134[91]	9.58[0.185,3.237]	0.890	1.99 0.59 ,1.85]	0.012
Sex	Male	34/35[97]	–	–	–	–
	Female	400/448[89]	2.66[0.305,23.27]	0.375	6.5[1.4,11.6]	0.68
Age[years]	≤ 24	131/153[85.6]	–	–	–	–
	25–48	285/312[91.3]	2.95[1.46, 5.97]	0.003	4.5[1.4,14.6]	0.112
	>48	18/18[100]	0.476[0.182,1.245]	0.130	0.35[1.195,6.652]	0.78
Residential place	Urban	241/270[88.8]	–	–	–	–
	Rural	193/213[90.6]	2.88[0.908,0.992]	0.05	2.62[0.419–4.828]	0.002
Educational status	Tertiary	8/14[57]	–	–	2.02[2.127–9.631]	–
	Secondary	118/133[88.7]	4.8[1.42,16.48]	0.012		0.97
	Primary	138/151[91.3]	5.9[0.48,72.622]	0.162	1.05[4.59 – 8.85]	0.66
	Illiterate	167/182[92]	4.9[0.198,12.87]	0.329	0.541[1.337–8.8]	0.45
HIV/AIDS status	No	256/293[87.3]	–	–	–	–
	Yes	178/190[93.6]	0.466[0.237,1.919]	0.028	9.59[1.544,59.27]	0. 015
ART utilization	Yes	42/54[78]	–	–	–	–
	No	128/136[94]	2.6[0.085,0.987]	0.049	1.541[3.33–6.86]	0.66
Pregnancy status	No	126/135[93.3]	–	–	–	–
	Yes	256/293[87.3]	2.3[0.901,0.991]	0.045	0.13[0.128,4.341]	0.001
Stage of pregnancy	First trimester	49/57[85.9]	–	–	–	–
	Second trimester	134/154[87]	1.08[0.618,1.92]	0.009	0.071[3.28,11.86]	0.225
	Third trimester	76/82[92]	1.233[0.764,1.958]	0.003	0.746[5.198,12.8]	0.78
History of abortion	No	274/309[88.6]	–	–	–	–
	Yes	108/119[90.7]	0.356[0.195,0.652]	0.001	0.4[2.182,11.245]	0.45
Number of abortion	One	23/30[76.6]	–	–	–	–
	Two	7/9[77.7]	0.225[0.065,0.776]	0.031	15.8[1.024,24.6]	0.048
	Three and above	4/4[100]	0.122[0.027,0.51]	0.006	0.5[0.834–0.986]	0.033
Cats at home	No	275/309[88.9]	–	–	–	–
	Yes	159/174[91.4]	1.205[0.481–0.90]	0.034	2.02[6.127–10.6]	0.88
Number of Cats	One	113/132[85.6]	–	–	–	–
	More than one	53/57 [92.9]	0.5[0.834–0.986]	0.005	4.09[1.1–2.631]	0.77
Contact with cat	No	69/78[88.4]	–	–	–	–
	Yes	92/96[95.8]	2.02[0.127–0.631]	0.045	0.5[1.37–8.89]	0.99
Precautions	Precaution	5/6[83.3]	–	–	–	–
	No Precaution	160/168[95.2]	0.12[0.127–4.648]	0.108	4.9[0.19,12.8]	0.33
Raw meat consumption	No	279/313[89.1]	–	–	–	–
	Yes	155/170[91.1]	1.190.602,2.37]	0.012	0.47[0.248,0.928	0.029
Raw Vegetables consumption	No	321/359[89]	–	–	–	–
	Yes	113/124[91.1]	0.325 [0.046–0.84]	0.011	0.21[0.104,0.446]	0.000
Wash Vegetables before consumption	yes	290/326[88.9]	–	–	–	–
	No	31/34[91.1]	0.245[0.046–0.675]	0.02	4.2[1.209,3.531]	0.88
Raw milk consumption	No	194/219[88.5]	–	–	–	–
	Yes	240/264[90.9]	0.541[0.337–0.869]	0.002	3.95[2.154,7.245	0.000
Source of water	Tap	350/398[87.9]	–	–	–	–
	Well + river	76/85[98.8]	2.4[0.630,9.204]	0.002	3.05[4.5 – 8.8]	0.56
Exposure with soil	No	259/292[88.6]	–	–	–	–
	Yes	175/191[91.6]	1.05[0.59 – 1.85]	0.001	0.7[5.18,12.7]	0.46

Lack of knowledge about disease was predictor of *T. gondii* seropositivity [P≤0.05]. Relation seropositivity to *T. gondii* was positively associated with abortion, exposure to cat faces and HIV /AIDS status and negatively associated with study areas, residential place, Pregnancy status, unwashed vegetable consumption, raw meat consumption, raw milk consumption, abortion, and HIV infection.

3.3 Socio Demographic Characteristics of Health Professionals

A total of one hundred physicians, nurses and gynecologist attending pregnant women in selected health institution of different parts of Ethiopia were surveyed. Male to female ratio is

0.53. The health professionals consisted mostly of women (65%). The mean age of respondents was 27.2 years ranging from 21 to 47 years old and half of respondents were belongs to 25–40 years age group.

Among health professionals, 40% of them had diploma, 30% of them had bachelor degree, 20% of them had medical degree and 6% of them specialize in their profession.

Most of health professionals (60%) had 4–6 years of work experiences in their professions (Table 3).

Socio–demographic characteristics of health professionals in selected health institution of different parts of Ethiopia

Professions	Nurses (N=74)	Physicians (N=20)	Gynaecologists (N=6)	Total
Sex				
M	20(27)	13(65)	2(33.3)	35(35)
F	54(73)	7(35)	4(66.7)	65(65)
Age group (years)				
<25	20 (27)	2(10)	0(0)	22(22)
25–40	54 (73)	14(70)	4(66.7)	72(72)
>40	0 (0)	4(20)	2(33.3)	6(6)
Educational status				
Diploma	40(54)	0(0)	0(0)	40(40)
BSc	34(46)	0(0)	0(0)	34(34)
MD	0(0)	20(100)	0(0)	20(20)
MSc	0(0)	0(0)	6(100)	6(6)
Service years(Years)				
2–4 years	19(25.7)	4(20)	2(33.3)	25(25)
4–6 years	34(46)	8(40)	3(50)	45(45)
>6 years	21(28.3)	8(40)	1(17.7)	30(30)

*Number in parentheses is percentage of respondents   *– Shows that significance difference occur*

Of them, 74 were Nurses, 20 general practitioners, and 6 gynecologists. They were asked about [i] general aspects about toxoplasmosis including clinical manifestations, diagnosis and, treatment, [ii] their practices and experiences on toxoplasmosis.

3.4 General Knowledge And Perception Of Health Professionals About Toxoplasmosis

From health professionals, 65 % and 63% of them had knowledge of health risk of cat and toxoplasmosis respectively.

Consumption of raw or undercooked meat and vegetables were recognized as common source of *T. gondii* infection by 71.2% health professionals, but consumption of raw milk (18.4%), contact with cat faces (14.3%), and drinking unboiled water (6.1%) were also mentioned as important modes of transmission. Of health professionals, 42.5% respondents considered as avoid contact with cat faces is most commonly used method for preventing spread and transmission of toxoplasmosis. More over 35% respondents mentioned that transmission of toxoplasmosis could be prevented by keeping personnel hygiene, avoid undercooked food substances (meat, vegetables and milk) (15%) and avoid unboiled water for drinking purpose (7.5%). In current study, 56.7% and 47.3% of health professionals not knew importance of testing toxoplasmosis during pregnancy and symptoms of toxoplasmosis respectively.

The four commonly recognized symptoms of toxoplasmosis mentioned by health professionals were hydrocephalus [33.3%], mental/brain retardation (26.9%), microcephaly (25.4%) and hearing loss (14.3%). Majority of health professionals (93%) do not screen pregnant women but 78% of them had case or exposure of toxoplasmosis in HIV patient and pregnant women. All health professionals didn't give health education for pregnant women regarding modes of transmission and prevention of toxoplasmosis.

Most commonly used method of diagnosis known by health professionals for toxoplasmosis were clinical examination (66.7%) but serology (17.5%), ultra sound (11.1%) and CT scan (4.7%) were also mentioned by respondents as method of diagnosis for toxoplasmosis. 70% (11/63) of health

professionals only requested laboratory tests for detecting toxoplasmosis (Table 4).

Table 4.

Health professional's knowledge about general aspects of Toxoplasmosis in different parts of Ethiopia

Profession	Nurse (N=74)	Physician(N=20)	Gynaecologist (N=6)	Total	P=value
Know disease human could get from cats					
No	35(47.3)	0(0)	0(0)	35(35)	0.000*
Yes	39(52.7)	20(100)	6(100)	65(65)	
Know Toxoplasmosis					
No	35(47.3)	2(10)	0(0)	37(37)	0.009*
Yes	39(52.7)	18(90)	6(100)	63(63)	
Do you know that women could get toxoplasmosis from cats					
No	44(59.4)	2(10)	0(0)	46(46)	0.009*
Yes	30(40.6)	18(90)	6(100)	54(54)	
Methods of transmission from animals to human beings					
No	12(30.7)	1(5)	0(0)	13(20)	0.003*
Yes	27(69.3)	17(95)	6(100)	50(80)	
Methods of transmission					
Contact with cat faces	2(7.4)	5(29.4)	1(16.7)	7(14.3)	
Raw meat consumption	8(29.6)	6(35.3)	1(16.7)	15(30.6)	0.078*
Raw milk consumption	7(26)	1(5.8)	1(16.7)	9(18.4)	0.006*
Raw vegetables consumption	9(33.3)	4(23.5)	2(33.2)	15(30.6)	
Unboiled water	1(3.7)	1(5.8)	1(16.7)	3(6.1)	
Know Prevention Method					
No	10(25.6)	12(66,7)	0(0)	22(35)	0.003*
Yes	29(74.4)	6(33.3)	6(100)	42(65)	
Method of Prevention					
Avoid cat contact	8(44.5)	8(50)	1(16.7)	17(42.5)	
Avoid consuming raw food	1(5.5)	3(18.7)	2(33.3)	6(15)	
Personal hygiene	9(50)	4(25)	1(16.7)	14(35)	0.000*
Avoid unboiled water for drinking	0(0)	1(6.3)	2(33.3)	3(7.5)	
Importance of testing toxoplasmosis during pregnancy					
No	42(56.7)	0(0)	0(0)	42(42)	0.000*
Yes	32(43.3)	18(100)	6(100)	58(58)	
Know symptoms					
No	35(47.3)	2(10)	0(0)	40(40)	0.009*
Yes	39(52.7)	18(90)	6(100)	60(60)	
Symptoms of Brain /mental retards					
Hearing loss	7(18)	8(44.4)	2(33.3)	17(26.9)	
Hydrocephalus	6(15.4)	2(11.1)	1(16.7)	9(14.3)	0.007*
Microcephaly	17(43.6)	3(16.6)	1(16.7)	21(33.3)	
	9(23)	5(27.7)	2(33.3)	16(25.4)	
Case of toxoplasmosis					
No	15(20.3)	5(25)	2(33.3)	22(22)	0.711
Yes	59(79.7)	15(75)	4(66.7)	78(78)	
Providing health education for pregnant for toxoplasmosis					
No	74(74)	20(20) 0(0)	6(6)	100(0)	
Yes	0(0)		0(0)	0(0)	
Screen pregnant women for toxoplasmosis					
No	73(90)	18(90)	2(33.3)	93(93)	0.000*
Yes	1(10)	2(10)	4(66.7)	7(7)	
Diagnosis of toxoplasmosis					
Clinical	24(61.5)	14(77.7)	4(66.7)	2(66.7)	
CT scan	0(0)	3(16.7)	0(0)	3(4.7)	0.000*
Serology	9(23)	1(15.6)	1(16.7)	11(17.5)	
Ultrasound	6(15.5)	0(0)	1(16.6)	7(11.1)	
Importance of Toxoplasma in pregnant women					
Important	10(25.6)	14(77.7)	6(100)	30(47.6)	
Not Important	5(12.8)	3(16.7)	0(0)	8(12.6)	0.000*
Don't know	24(61.6)	1(15.6)	0(0)	25(39.8)	
Importance in HIV infected patient					
Important	13(33.3)	14(77.7)	6(100)	33(52.4)	
Not Important	6(15.3)	4(32.3)	0(0)	10(15.9)	0.000*
Don't know	20(51.4)	0(0)	0(0)	20(31.7)	
Response for Medication	10(25.6)	12(66.6)	6(100)	28(44.4)	
Refer to specialist	15(38.4)	6(33.4)	0(0)	21(33.3)	0.094
Don't know	14(36)	0(0)	0(0)	14(22.3)	

Number in parentheses is percentage of respondents– *Shows that significance difference occur*

The greatest number of health professionals concentrated on clinical issues. In studying altitudes and practices of respondents, 52.7% and 47.6 % of health professionals thought toxoplasmosis as important pathogen in HIV infected patients and pregnant women respectively but Less than half of professionals, 44.4%, knew medication of toxoplasmosis in pregnant and neonates but 22.3 of respondents they don't knew what they do if pregnant women and neonats became toxoplasmosis positive.

Comparing number of answers according to type of profession, professionals who are gynecologist and physician showed total number of correct answers on issues of clinical manifestation, prevention and diagnosis, higher than those who are nurses however nurses had a better experience (23%) of using laboratory test relative to other professionals. In comparison according to professions, gynecologist had highest number of correct answers in diagnostic and clinical issues.

Regarding prevention, no significant differences were found between two professional categories. Mostly nurses had better knowledge than Physician but in medication physician had more awareness relative to nurses.

Results

Overall, a very high seroprevalence of toxoplasmosis of 89.9% was found in pregnant women and HIV infected patients in different parts of Ethiopia.

This high findings is agree with other seroprevalence figures from general or selected populations in different parts of country that ranged from 60.0–97.7% [XIAO *et al.*, 2010; YIMER *et al.*, 2005].

The high seroprevalence due to cat contact, feeding habits and inadequate hygienenic condition, and the suitable climatic factors for the sporulation and survival of oocysts in environment.

When we compare results of our study with other similar studies, *T. gondii* infection in study population is still on increase in Ethiopia perhaps due to lack of awareness about disease. The *anti–T. gondii* IgG positive and IgM negative

results indicate past exposure to chronic infection, while positive results for IgM are suggestive of acute (recent) exposures.

Though positive IgM results are unique indicators of recent infections. Of course confirmation to exclude reaction of natural IgM antibody with *Toxoplasma* antigen is mandatory. Besides, Pregnant women and HIV infected patients negative for IgG and IgM antibodies are at chance of getting primary infection, so monitoring for seroconversion is needed [DIZA et al., 2005]. From pregnant women of study were IgM positive during their pregnancy with potentially high chance of getting congenital toxoplasmosis suggest need to design preventive measures.

From 21 Potent risk factors examined for *T. gondii* seropositivity, study area, residential place, pregnancy status and consumption of raw vegetables, raw meat, raw milk, abortion and HIV/AIDS status were found to be main predictors of *T. gondii* seropositivity.

The study areas association of seropostivity *T. gondii infection* can be a suggestive for way of life of people.

In jinka and Awash high seroprevalence of *T. gondii* infection in pregnant women and HIV infected patients relative to Addis Ababa may be using of *T. gondii* contaminated water for drinking and high interest of feeding raw vegetables. In Awash there is high seroprevalence of toxoplasmosis than mojo may be due to poor sanitation and exposure with cats [83.5%] instead raw vegetables consumption [15.3%].

Furthermore, free movement of people of Awash leading to acquiring of infection from other areas might additionally support this condition.

In Gubre–Xiaber report [GUBRE–XIABER et al. 1994], during pregnancy there is a low risk of *T. gondii* infection, but in our findings recent infections [28.6%] IgM positives is common in pregnancy women.

The high prevalence of *T. gondii* infection in pregnant women is indicates need for launching prevention and control strategies in antenatal program for toxoplasmosis in Ethiopia.

The high prevalence of *T. gondii*

infection in study population shows pathogen is highly circulating in Environment. *Toxoplasma gondii* infection was more common in individuals who are using vegetables than those who didn't. The using of inadequate hygienic method of transport and using of less hygienic water to wash vegetables might have contribution for contamination by *T. gondii* oocysts.

Similar result, Liu [LIU *et al.,* 2009] from China and Kapperud [KAPPERUD *et al.,* 1996] from Norway reported raw vegetable consumption as an important risk factor for contracting toxoplasmosis.

Seroprevalence of anti−*T. gondii* antibodies was higher in study population who used un−boiled river and well water for drinking purpose [98.8%] than those who used un−boiled tap water [87.9%], indicating contamination of river and well waters by oocysts from felids' feces and inadequate water management as reported by Petersen [PETERSEN *et al.,* 2010]. HIV infected patients [93.6%] are mostly acquires *T. gondii* relative to HIV negative women [87.3%]. This may be due to high chance of reactivation of latent infection and development of toxoplasmic encephalitis [MONTOYA and LIESENFELD, 2004; JONES *et al.,* 2009].

The high seroprevalence of toxoplasmosis in HIV infected patients might partly be due to early child hood and teenage infection. In contrast, Biedermann [BIEDERMANN *et al.,* 1995] and Woldemichael [WOLDEMICHAEL *et al.,* 1998] reported similar seroprevalence rates between HIV infected individuals and normal controls.

As age increased, it was observed that there was a relative increase in seroprevalence due to exposure to infective stages of parasite. Around 91.3% of women seroconvert by time they reach 25 – 48 of age may be due to acquiring of oocyst from environment and consumption of raw meat for this age group is more common.

According to Gubre−Xiaber [GUBRE−XIABER *et al.,* 1993] report, 75% of children in Ethiopia were seroconvert before puberty. Due to deep rooted tradition of raw and undercooked meat consumption in Ethiopia and high seroprevalence of toxoplasmosis in sheep and goats there was association between seroprevalence and raw/undercooked meat consumption of pregnant women and 35.5% of all studied pregnant and HIV infected patients consume raw / undercooked meat.

Similarly, earlier studies elsewhere [DIAZ−SUAREZ and ESTEVEZ 2009; JONES *et al.,* 2009] demonstrated significant association between seropositivity and behavior of raw meat consumption.

The seroprevalence of toxoplasmosis was significantly associated with presence of domestic cats in household than in their absence.

The high seroprevalence observed in households where cats are absent suggest a high environmental contamination. In our finding like that of Negash [NEGASH *et al.,* 2008] who reported strong association of seroprevalence and presence of cats. However, Sroka [SROKA *et al.,* 2010] and Guebre−xabier [GUEBRE−XABIER *et al.,* 1993] reported absence of association between seropositivity and presence of cats at home.

Failure to include species of food animals used for meat to correlate seropositivity with food producing animals and failure to do IgG avidity test to exclude reaction of natural IgM antibodies and to know exactly current status of patient are recognized as limitations of study.

In present study we detected 89.9% anti−*T. gondii* IgG and 28.3% anti−*T. gondii* IgM seroprevalence rates, indicators of latent and recent *T. gondii* infections, respectively.

Our study illustrated a reasonably high IgM positive pregnant women indicating vulnerability to congenital transmission. A questionnaire based survey was conducted among health professionals for assessment of knowledge and perception towards toxoplasmosis on selected health facilities of different parts of Ethiopia.

This study demonstrated that majority of health professionals [63%] recognized human get disease from cat and knew toxoplasmosis respectively.

This finding was in agreement with others studies [LAURA BERRIEL da SILVA *et al.,* 2011; JONES *et al.,* 2001]. Since knowledge and awareness of health professionals is not adequate, there is a need for improvement among health professionals in both patient education and self–education.

As numerous studies have shown, eating undercooked meat during pregnancy is most important risk factor for toxoplasmosis sero–conversion [KRAVETZ and DANIEL, 2009; ALVARADO–ESQUIVEL *et al.,* 2011; LAURA BERRIEL da SILVA *et al.,* 2011]. Similarly, in current study majority of health professionals recognize consumption of raw or undercooked meat and vegetables as common source of *T. gondii* infection.

With regard to direct advice given to pregnant women, all health professionals didn't give health education for pregnant women regarding modes of transmission and prevention of toxoplasmosis however studies in USA [KRAVETZ and DANIEL, 2009] showed almost all health professionals (98%) advised them to avoid raw meat and vegetables.

Since consumption of raw vegetables in current study was primary risk factor for toxoplasmosis transmission, all pregnant women should be counseled to thoroughly cook all vegetables during pregnancy. About prevention, although 42.5% of professionals recognize avoid contact with cat faces is most commonly used method for preventing spread and transmission of toxoplasmosis, which is similar to other studies [AKYAR, 2011; KRAVETZ and FEDERMAN, 2005]. Regarding to diagnosis, more than 83% of professionals never request lab test for diagnosis of toxoplasmosis which is very high (25%) relative to studies in Mexico [ALVARADO–ESQUIVEL *et al.,* 2011]. The fact that overall median number of correct answers and diagnosis from professionals working in hospitals were higher than those of health center may in part be explained by fact that professionals working in hospitals have more training in high–risk prenatal care. However, a higher number of correct questions of prevention among professionals health center were expected, since health center has as one of its main missions educational activities aimed at preventing health problems [DIAZ–SUAREZ and ESTEVEZ, 2009]. Likewise, median number of correct answers among physicians higher than that of nurses is expected in diagnosis and clinical issues, as these issues are object of focus in medical schools than in schools of nursing. However, basic knowledge of nurses in issues related to prevention is inconsistent with role of nurses as health educators [ALVARADO–ESQUIVEL *et al.,* 2011].

The greatest number of correct answers among professionals with less training time is consistent with literature that indicates an inverse correlation between knowledge and years of professional practice, justifying need for recertification exams in some countries [KRAVETZ and DANIEL, 2005; LAURA BERRIEL da SILVA *et al.,* 2011]. Continued education seems especially useful when targeted to specific groups and disciplines [ALVARADO–ESQUIVEL *et al.,* 2011] like our target population. However, in this study only 100 data of health professionals are analyzed to assess their knowledge and perception but it is preferable to analyze all data of health professionals for better findings.

Conclusions

In conclusion, high sero–prevalence of toxoplasmosis in present seroepidemological study indicate need of preventive measures, mainly education about identified risk factors, in order to reduce associated morbidities and mortalities. The results of present study help to alert public health delivery system to undertake large scale studies and uncover economic and health impacts and formulate guidelines and policies leading to mitigation of potentially devastating outcomes of this zoonosis.

Health education should be given with special consideration to pregnant women and immunosuppresed individuals regarding minimizing contact with cats, avoidance of consumption of raw meat, vegetables and milk and un–boiled river water, proper hygienic practices should be exercised with aim of reducing contamination of drinking waters and food

by cat feaces, team work between veterinarian and human health physician should be encouraged to increase public awareness about toxoplasmosis and its associated risk factors and transmission pathways via health extension service in rural and urban communities and it is recommended that if screening test for prenatal follow considers toxoplasmosis.

As to knowledge of health professionals especially nurses is not adequate as their main role is providing health education for their pregnant women to maintain safe delivery.

Only half of respondents were aware of treatment and more than 83% never request laboratory test for detecting toxoplasmosis.

The health professionals surveyed showed an incomplete knowledge about diagnosis and treatment of toxoplasmosis.

All health professionals didn't give health education for pregnant women regarding disease. Such findings prove toxoplasmosis is consider as neglected disease even though it had various complication during pregnancy and on newborn health. Therefore, urgent providing of medical education and self learning is needed. Because such findings are useful for optimal design of strategies in medical education about toxoplasmosis. At last authors would like to recommend, Public health awareness through public media, assessment of health professional's knowledge, attitude and practice in large scale towards toxoplasmosis is also recom mended.

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