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SEROPREVALENCE OF *TOXOPLASMA GONDII* INFECTION AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC IN MAJOR HEALTH CENTERS IN JOS NORTH, NIGERIA

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ABSTRACT

Toxoplasmosis is an infection caused by *Toxoplasma gondii*. It is reported that one third of the world's population is infected with the parasite. *T. gondii* represents the risk of miscarriages and congenital abnormalities in pregnancy. This study was carried out to ascertain the sero-prevalence of *Toxoplasma gondii* among pregnant women attending antenatal clinics in three major Health Centres in Jos North Local Government Area, Plateau State, Nigeria. Three hundred and eight four (384) pregnant women attending antenatal clinics were recruited for the study. Participants were screened for *T. gondii* specific antibodies using the Chromatographic Immuno-Assay (CIA) test method. Information on risk factors were obtained by the administration of a structured questionnaire. An overall seroprevalence of 11.7% was established. IgG antibodies represented 11.7% seroprevalence and 0.0% seroprevalence recorded for IgM antibodies. The highest seroprevalence of *Toxoplasma gondii* infection was established in women in their second trimester. Seropositivity was found to be significantly associated ($p < 0.05$, 95% CI) with type of drinking water, consumption of raw or fresh vegetables, previous history of miscarriage and older child with congenital deformation.

Keywords: antenatal clinics, Jos pregnant women, *T. gondii*, Toxoplasmosis, seroprevalence

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INTRODUCTION

Toxoplasmosis is a cosmopolitan parasitic zoonosis infecting human and other warm-blooded animals, including mammals and birds (Montoya *et al.*, 2004; Tenter *et al.*, 2002; Hills *et al.*, 2002; Dubbey *et al.*, 2009). The disease is distributed worldwide infecting almost one-third of the global population (Tenter, 2000). About 20-75% of the world population has been found to be seropositive without any symptomatic episodes (Corrnea *et al.*, 2007). *Toxoplasma gondii*, a single celled protozoan regarded as the most successful protozoan parasite on earth (Saeij *et al.*, 2005; Riebeiro *et al.*, 2008 and Mawhoob *et al.*, 2010), is the causative agent of Toxoplasmosis with Felids as its definitive host.

The parasite is transmitted to humans via ingestion of raw or undercooked meat (Olusi *et al.*, 1994), water contaminated with sporulated cysts (Amuta *et al.*, 2012), oocyst contaminated environment (Nissapatron *et al.*, 2011), and vertical transmission through the placenta from pregnant mothers to the foetus (Amuta *et al.*, 2012). Acute primary maternal Toxoplasmosis acquired during pregnancy can cause significant morbidity and mortality in developing foetuses (Singh, 2003) and can induce abortions and loss of vision (Montoya and Liesenfeld, 2014) and for this particular reason the World Health Organization (WHO) has recommended, repeatedly, the regular monitoring of Toxoplasmosis in Humans and Animals.

In African region, *Toxoplasma gondii* overall prevalence rate has been reported to be as high as 92.5% (Ayi *et al.*, 2009) and Congenital Toxoplasmosis is reported to be 2.5% per 1000 live births and a Daily Adjusted Life Years (DALY) of 15% per 1000 live births. In Nigeria, the prevalence rate of Toxoplasmosis by serological investigation has been estimated to vary from 7%- 51.3% in immunocompetent pregnant women to 17.5%-52.3% in women with abnormal pregnancy and abortions (Deji-Agboola *et al.*, 2010) and a reported prevalence rate of 29.1% and 0.8% for chronic and acute infections respectively (Ishaku *et al.*, 2009).

Primary infections during pregnancy may result in severe damage or death of foetus and long term sequelae in the child. Congenital Toxoplasmosis is said to occur between 1 and 10 per 10,000 life birth in Europe (Montoya and Liesenfeld, 2004). The risk of congenital infection has been shown to increase with increase in trimesters, from 10 - 25% in the first trimester to 60 - 90% in the third trimester (Jones *et al.*, 2001b; Dubbey and Jones 2008). Infections within the first trimester may result in death of foetus or spontaneous abortion and in the last trimester babies may be born asymptomatic but develop symptoms later in life. These symptoms include hydrocephalus, retirochroiditis and intercranial calcification which occur in approximately 10% of all infected new-borns. There may also be mild infections such as reduced vision or even severe abnormalities like blindness, mental retardation and epilepsy (Tenter, *et al.*, 2000)

Previous studies in major Nigerian cities including, Maiduguri, Abuja and Lagos revealed a prevalence of 22.2% (Oyinloye, 2014), 44.4% (Yusuf *et al.*, 2016) for *Toxoplasma gondii* IgM antibodies and 7.6% and 32.6% for *Toxoplasma* IgM and *Toxoplasma* IgG respectively (Deji-Agboola, 2010) in pregnant women. Despite this, routine antenatal screening of *Toxoplasma gondii* infections and education on associated risk factors, the mainstream for monitoring and reducing the risk of infections with *Toxoplasma gondii* and congenital toxoplasmosis, is still not performed in health facilities in Plateau State. It is on this premise that this study was carried out to ascertain the

prevalence of *Toxoplasma gondii* among pregnant women attending antenatal clinics in major Health Centres in Jos, Plateau State, Nigeria.

MATERIALS AND METHODS

STUDY AREA

The study was carried out in Jos North, Plateau State, Nigeria. Jos North Local Government Area of Plateau State lies on longitude 9° 55'N 8° 54'E and latitude 9.917°N 8.900°E. It houses the capital city of Jos as its headquarters. Jos North Local Government covers a total area of 291km² and has a population of 429,300 (2006 Census).

ETHICAL CONSIDERATION

Ethical approval was obtained from the health and ethical committees of the Plateau State Ministry of Health through Plateau State Specialist Hospital and from the ethical committees of Bingham University Teaching Hospital and Faith Alive Foundation.

STUDY DESIGN

The study was a cross-sectional study carried out among pregnant women attending antenatal care and included 384 women from three (3) selected health centres including, Bingham University Teaching Hospital, Faith Alive Foundation and Plateau State Specialist Hospital. The participants were taken through the informed consent process where the study objectives, risks, benefits and study procedures were explained in details in English Language and also interpreted in Hausa Language, where necessary. Only women who consented were enrolled in the study. After obtaining duly signed informed consent, the pregnant women who volunteered for the study were interviewed by the administration of a standard study questionnaire to obtain their socio-demographic, economic status information, medical histories as well as epidemiological risk factors. No names were used on any data collection forms, instead each pregnant woman examined was assigned a unique identity number.

SAMPLE COLLECTION AND TESTING

2ml of venous blood was collected from each of the volunteers and emptied into well labelled EDTA test tubes. The collected blood samples were centrifuged at 3000rpm for 5 minutes and the plasma was collected into well labelled plain tubes (Murebwayire, 2014). Plasma was screened for the presence of *Toxoplasma gondii* IgM and *Toxoplasma gondii* IgG antibody using Aria IgM and IgG test kits (CTK Biotech, California, USA) according to manufactures instructions.

DATA ANALYSIS

The data collected from the questionnaire and the laboratory test were entered into the Statistical Package for Social Sciences Programme (SPSS, Version 20). The data was subjected to chi square test of association.

RESULTS

The result of the study shows an overall prevalence of 11.7% with prevalence of 8.3%, 10.0% and 15.97% for Bingham University Teaching Hospital, Faith Alive Foundation and Plateau State Specialist Hospital, respectively. The result also showed that chronic infection, as determined by the presence of IgG markers accounted for 100% of the positive cases in the current study while acute infection, identified by presence of IgM was not established in the current study.

Table 1: *T. gondii* sero-prevalence based on facility

Facility	Total Examined (n)	No. Positive	Prevalence (%)
BHUTH	120	10	8.33
FAF	120	12	10
PSSH	144	23	15.97
Total	384	45	11.7

BHUTH: Bingham University Teaching Hospital

FAF: Faith Alive Foundation

PSSH: Plateau State Specialist Hospital

Table 2: The Distribution of the immune response to *T. gondii* among participants.

Infection	Total Examined	No. Positive (n)	Prevalence %
Chronic infection	384	45	11.7
Acute Infection	384	0	0
Total	384	45	11.7

Table 3: Distribution of *T. gondii* in relations to demographic factors

Demographic Characteristics	No. Examined N=384	No Positive	Prevalence %	X^2	df	P-value
Age						
16-25	115	13	11.3	0.13	3	0.716
25-35	204	25	12.3			
36 -45	65	7	10.8			
Above45	0	0	0			
Occupation						
Student	39	3	7.7	0.591	2	0.44
Unemployed	189	23	12.2			
Employed	156	19	12.2			
Level of Education						
Primary	45	7	15.5	0.379	2	0.538
Secondary	179	23	12.8			
Tertiary	160	15	9.3			
Age of Pregnancy						
1 st Trimester	62	5	8.1	0.811	2	0.368
2 nd Trimester	159	24	15.1			
3 rd Trimester	163	16	9.8			

$X^2 =$ chi square

df= degree of freedom

Table 4: Distribution of *T. gondii* seroprevalence in relation to marital status and inhabitation

Characteristics	No. Examined	No. Positive	Prevalence (%)	OR [95%CI]	P-value
Marital status					
Single	5	1	20	1.90 [0.21-17.42]	0.466
Married	379	44	11.7		
Residence					
Urban	251	33	13.1	1.53[0.76-3.07]	0.249
Rural	133	12	9.0		
Communities					
Hausa/Fulani	157	19	12.1	1.06[0.567-1.998]	0.873
Non-Hausa	227	26	9.4		

Table 5: Association of *Toxoplasma. gondii* seroprevalence with food and Water consumption

Characteristics	No positive	Prevalence (%)	OR [95%CI]	P-value
Eat Vegetables				
Yes	42	11.2	0.51[0.11-2.46]	0.39
No	2	20		
Preferred state				
Fresh/Raw	22	16.8	2.64[1.34-5.17]	0.007
Steamed	17	7.1		
Water type				
Treated	19	8.1	1.4[0.22-0.77]	0.04
Untreated	26	17.6		
Eating Undercooked Meat				
Yes	23	4.2	0.88[0.33-2.37]	1.00
No	22	11.9		

Table 6: Association of seroprevalence *T. gondii* with type of untreated water consumed by respondents

Untreated Water Source	Examined	No. Positive	Prevalence (%)	OR [95%CI]	P-value
Rain water					
Yes	61	12	19.7	1.59[0.68-3.70]	0.29
No	105	14	13.3		
Well					
Yes	41	15	36.6	5.04[2.07-12.27]	0.0004
No	107	11	10.2		
Boreholes					
Yes	68	9	13.2	0.57[0.23-1.37]	0.28
No	80	17	21.3		

Table 7: Distribution of *T. gondii* seroprevalence in relation to Presence of Pets in respondent's homes

Pets	No Examined	No Positive	Prevalence (%)	OR[95%CI]	P-value
None					
Yes	172	16	9.3	0.647[0.33-1.24]	0.204
No	212	29	13.7		
Cats					
Yes	25	4	16	1.477[0.483-4.517]	0.516
No	359	41	11.1.		
Dogs					
Yes	58	7	12.3	1.040[0.44-2.46]	1.00
No	326	38	11.7		
Other Animals					
Yes	258	27	10.4	0.701[0.370-1.328]	0.311
No	126	18	14.3		

Table 8: Association of *T. gondii* with Types of BOH

BOH Type	No. Examined	No. Positive	Prevalence %	OR [95%]	Pvalue
Miscarriages					
Yes	91	18	19.8	4.92[1.25-4.65]	0.008
No	293	27	9.2		
Stillbirth					
Yes	21	1	4.8	0.363[0.05-2.77]	0.49
No	363	44	12.1		
Birth defect					
Yes	7	4	57.1	10.93[2.36-50.55]	0.004
No	337	41	10.9		

BOH: Bad Obstetric History

DISCUSSION

This study was carried out among pregnant women in three (3) major hospitals in Jos North Local Government Area of Plateau State, Nigeria with the use of the Immuno-Chromatographic Assay method. The overall sero-prevalence among pregnant women in this study area based on this study was 11.7%. This result is comparable with a seroprevalence of 12.1%, a seroprevalence of 13.8% and a seroprevalence of 12.2% as reported in Plateau State (Mariam, 2016), and in Rwanda respectively (Malarvizhi *et al.*, 2012 and Murebwayire, 2014). This result is lower than the one found by Ishaku *et al.*, (2009), Alayande *et al.*, (2013) and Deji-Agboola *et al.*, (2011), all who reported a sero-prevalence of 29.9% in Zaria, Kaduna State, 27.7% in Sokoto State and 32.8% in Lagos State respectively. This difference in results may probably be attributed to variation in geographical and climatic conditions. Zaria in Kaduna State, Sokoto State and Lagos State all has a higher temperature and humidity than Jos, Plateau State, Nigeria. Higher temperature and humidity have been reported to favour oocyst sporulation. Sero-prevalence has been found to vary within the same country or even within locations in a particular region of a country (Ayi *et al.*, 2009). This study result is in agreement with this statement. Plateau Specialist Hospital produced a higher sero-prevalence rate (16%) than other study locations considered in this study.

None of the 384 pregnant women examined in this study was found positive for *Toxoplasma gondii* IgM antibodies indicating that all cases reported in this study were not recent infections. This is in agreement with what was observed in Sudan by Musa *et al.*, (2014), and in Greater Accra region Ghana by Ayeh-kumi *et al.*, (2010) and Kwofie *et al.*, (2012), whom all reported a 0% sero-prevalence rate for *Toxoplasma gondii* IgM specific antibody. This is however lower than the rate of 5.4% observed in Gabon (Mickoto *et al.*, 2010).

In respect to age, although there was no statistical significance with *T. gondii* prevalence, the result of this study suggests an increase in sero-prevalence with increase in age. Sero-prevalence rate increased from pregnant women in the age bracket 16-25 years to those in the age bracket 26- 35 years for *Toxoplasma gondii* IgG antibody. This is consistent to that published by Markovich *et al.*, (2014), who observed an increase in seroprevalence of *T. gondii* with age. There was however a decrease in seropositivity with age from between those in the bracket age of 26-35 years and those in the age bracket of 36 and above as also observed in Nairobi, Sefah-Boakye, (2015). This result might be because most pregnant women examined in this study were within the 26-35 age brackets. Prevalence of *T. gondii* was found to decrease with educational achievements. Pregnant women with just primary school certificate had highest prevalence to *Toxoplasma gondii* than those with higher qualifications. This result is in agreement with the one found in Jigjiga, East Ethiopia (Neguessie *et al.*, 2017). This decreasing result might be due to increasing level of hygiene that comes with increased educational qualification.

Certain studies have previously shown that sero-prevalence of *T. gondii* can be attributed to socioeconomic and occupational status. Employed women were reported more highly susceptible to *T. gondii* than unemployed ones. This might be due to their easy access to meat and outdoor eating lifestyle (Mwambe, *et al.*, 2013). In this present study however, the seropositivity for anti *T. gondii* was found to be quite similar for both employed and unemployed pregnant women as was observed in Rwanda by Murebywaire, (2014). In this study, results show that single pregnant women had a higher seropositivity to anti *T. gondii* antibody than married ones probably because single women had more outdoor lifestyles that made them more exposed to *T. gondii*, yet marital status showed no association with prevalence of *T. gondii*.

A seropositivity of 12.1% was observed in women belonging to the Hausa/Fulani Community, this prevalence was not found to be significant against the 11.5% prevalence found in pregnant women belonging to the Non-Hausa/ Fulani Community. This agrees with the result that was observed in Lagos State, Nigeria by Uttah *et al.*, (2013). Uttah *et al.*, 2013 stated that ethnicity has no effect on transmission of Toxoplasmosis.

Several authors have accounted drinking of untreated water as a risk factor and a significant source for the transmission of *T. gondii* in Nigeria (Mariam, 2016), and other countries (Murebywaire, 2014). Significant association was observed between *T. gondii* prevalence and drinking water type in this study. Pregnant women who drank from well water in this region showed significant association with *Toxoplasma gondii* transmission. This might be due to the reason that most wells constructed in this region are constructed without rings or proper surface covering. This lack of rings or proper covering allows in flow of surface runoffs during rainfalls. Drinking of untreated water was found to be associated with *T. gondii* spread by our results. This result portrays that oocyst can survive for long period in water hence individuals who drink untreated water maybe frequently exposed to *T. gondii* (Ishaku, *et al.*, 2009).

The presence of cats in the home has been attributed with significance with sero-prevalence of *T. gondii* infections (Alvarado, *et al.*, 2006, Ballah *et al.*, 2017). We observed in this study no significant association between cat ownership and sero-prevalence of *T. gondii* antibodies. This study result is in agreement with that published by Bello *et al.*, (2017) who reported that the mere presence of cats in the home is not enough to confirm zoonosis but rather the handling of cat litter is of more importance. Significant association was observed between previous occurrence of bad obstetric history and seropositivity to *T. gondii* antibodies in this study. This study result is in agreement with the study results obtained in Gombe State, Nigeria (Ballah *et al.*, 2017) who observed an association with previous bad obstetric history. In consideration with types of bad obstetric histories and its association with prevalence rate of *T. gondii*, bad obstetric history such as history of previous miscarriages and congenital malformations were found significant.

CONCLUSION

This study was carried out among pregnant women in three (3) major hospitals in Jos North Local Government Area of Plateau State, Nigeria with the use of the Immuno-Chromatographic Assay method. An overall sero-prevalence of 11.7% was established. The highest sero-prevalence of *Toxoplasma gondii* infection was established in women in their second trimester. Seropositivity was found to be significantly associated with type of drinking water, consumption of raw or fresh vegetables, previous history of miscarriage and older child with congenital deformation. The study therefore recommends that more education and sensitization on the risk factors associated with *Toxoplasma gondii* be intensified in the study area.

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