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Comparative Seroprevalence and Risk Factors of Toxoplasmosis among Three Subgroups in Nigeria

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Abstract
The study was aimed at ascertaining the seroprevalence and some risk factors of toxoplasmosis among those attending the National Hospital, Abuja, Nigeria. Using the ImmunoComb Toxo IgG Kit for the detection of IgG antibodies to Toxoplasma gondii in human serum/ plasma, 216 persons were examined for toxoplasmosis. This comprised of equal number (72 persons each) of persons from three subgroups, namely, gravid women, immuno-compromised persons consisting of patients with HIV and hepatitis, and the immuno-competent persons who are the controls. The overall seroprevalence of toxoplasmosis was 31.5%. Seroprevalence was significantly higher among pregnant women than among both the immuno-compromised and the immuno-competent persons (χ2-test; $p < 0.05$ for both tests). Seroprevalence was comparable between the immuno-compromised and the immuno-competent (Controls) (χ2-test; $p > 0.05$). Seroprevalence increased with age among gravid women, as well as among the immuno-compromised subgroups but not among the controls. Overall, seroprevalence among those living with cats/dogs (45.61%) was significantly higher than that of those living without cats/dogs (15.69%) (χ2-test; $p < 0.05$); while the risk of infection with toxoplasmosis was four times higher than among those not living with cats (Odds Ratio 4.51). This was the same among the immune-compromised as well as the immune-competent where the risks of getting infected were five times higher among those cohabiting with cats (Odd Ratio 5.45 and Odds Ratio 5.36 respectively). Among the pregnant women, the risk of getting infected with toxoplasmosis was three times higher among those cohabiting with cats (Odds Ratio 3.00). Seroprevalence was independent of the tribal origin (χ2-test; $p < 0.05$ for all the tests).
Keywords: Toxoplasmosis, Toxoplasma gondii, serprevalence, pregnant women, immuno-compromised, immuno-competent, Nigeria

1. Introduction

Toxoplasmosis is an important parasitic infection with global distribution and significance. About a third of the world's human population is estimated to harbor the causative coccidian protozoan, Toxoplasma (Ryan and Ray, 2004). The distribution of this parasite depends on regions and weather condition where the oocysts survive in environment (Dubey and Jones 2008; Dubey 2004; Fayer 1981). It is estimated that between 30% and 65% of all people worldwide are infected with toxoplasmosis (Tenter, 2000). Prevalence of infection varies between countries. In France, for example, about 88% of the population is carriers, probably due to a high consumption of raw and lightly cooked meat (Adam, 2003). High prevalence rates of between 67% and 80% have been reported in Germany, the Netherlands and Brazil (Heckeroth, 2004), while in Britain and South Korea, and about 22% and 4.3% respectively are carriers (Weiss, 2004). Infection is reportedly highest in countries where undercooked meat is traditionally.

Toxoplasmosis could be severe and life-threatening during pregnancy, and to fetuses, and new born babies (Robert-Gangneux et al., 2009). Vertical transmission occurs causing mental retardation, blindness, epilepsy, and death (Petersen, 2007). One of the late sequelae of congenital toxoplasmosis is chorioretinitis (Al-Azawi et al., 2013). Among the immuno-competent people, toxoplasmosis is usually asymptomatic, subclinical or benign, and can be classified as congenital, acquired or ocular (Oyibo et al., 2009). It may precursor spontaneously resolved symptoms such as fever, malaise, and lymphadenopathy, indicating symptomless latent infection (Montoya and Liesenfield, 2004). Toxoplasmosis can be severe and life-threatening to immune-compromised patients (Robert-Gangneux et al., 2009), causing severe encephalitis through acute infection or reactivation of latent infection (Innes, 2010, Hang et al., 2007).

Cats are the definitive hosts since they are the only animals that excrete resistant oocysts into the environment (Silva et al; 2001). Cohabiting with cats increases the chances of getting infected (Sukthana, 2006). However, direct infection through handling cats is generally believed to be rare (Agrappi, 2006). Some animals including humans serve as intermediate hosts in which the parasite may cause systemic infection that result in the formation of tissue cysts. Transmission may occur through ingestion of raw or partly cooked meat, especially pork, lamb, or venison containing Toxoplasma cysts. Oocysts may also be ingested through knives, utensils, or cutting boards contaminated by raw meat (Joss, 2004) or through ingestion of oocysts shed by cats in the environment, transplacentally, and through organ trans¬plantation ((Nissapatorn et al., 2011).

Toxoplasma gondii is a major cause of economic losses in endemic communities as they are responsible for

abortions, still birth and neonatal losses among various classes of livestock (Raeghi et al., 2011, Buxton et al., 2007, Masala et al., 2003). It is associated with congenital defects in humans, and the risk of the infection being passed on to the fetus increases to between 60% and 90% in the third trimester (Tenter, 2007). The severity of congenital infections depends on the stage of pregnancy when the acute infection occurred, and spontaneous abortions or neurological disorders (Black and Boothroyd, 2000).

Toxoplasmosis is a neglected parasitic infection although it is extremely important economically, medically and epidemiologically (Uttah et al., 2013). Compared with other parasitic infections such as malaria and filariasis, it is grossly underreported. The paucity of research data on various aspects of toxoplasmosis in Nigeria is palpable. This study is an attempt to bridge this gap, and is aimed at ascertaining the seroprevalence and some risk factors of toxoplasmosis among those attending the National Hospital, Abuja, Federal Capital Territory, Nigeria.

2. Materials and Methods

2.1 Description of study area

The National Hospital, Abuja is located in central District phase 11 Garki, City of Abuja. It is located within latitude 7° 25' N and 9° 20° North of the Equator and longitude 5° 45' and 7° 39'. The hospital is owned by the Government, and therefore being visited by people of diverse backgrounds from different sections of the country, including the both the poor and rich. Abuja is replete with hills, highlands and undulating plains.

2.2 The study design

Equal number of three subgroups was enlisted into the study, namely the pregnant women, the Immuno-compromised patients, and the Immuno-competent persons (Controls). The immuno-compromised persons enlisted consisted of patients with such medical conditions such as HIV and hepatitis. The Immuno-competent persons enlisted were healthy persons who volunteered to participate in the study.

2.3 Administration of structured questionnaire

A well-structured questionnaire capturing information regarding age, sex, tribe, possession of cats or other domestic animals in the house were administered on the individuals enlisted into the study.

2.4 Collection of samples and serological testing

From each of the 216 patients, 2ml of blood sample was collected between February 2011 and July 2011, and processed using The ImmunoComb Toxo IgG Kit following standard methods. Blood samples were centrifuged for 5 minutes; serum was collected and stored at 2oC. The developing plates, cards, reagents and specimens were all brought to room temperature of between (22°C and 26°C.

2.5 Ethical considerations

The work was approved by the Ethics Committee of Cross River University of Technology, Calabar, and the authorities of the National Hospital, Abuja. Safety protocols were strictly followed all through the study. The work table was covered with absorbent tissues that were discarded as bio-hazardous waste at the end of tests. Reagents were mixed by shaking the Developing Plate.

3. Results

3.1 Seroprevalence of toxoplasmosis among the three study groups

The overall seroprevalence of toxoplasmosis was 31.48% (see Table 1). Seroprevalence was significantly higher among pregnant women than among both the immuno-compromised and the immuno-competent persons (χ2-test; $p < 0.05$). Seroprevalence was comparable in both the immuno-compromised and the immuno-competent (Controls) (χ2-test; $p > 0.05$).

3.2 Seroprevalence in relation to age and sex

Seroprevalence increased with age among pregnant women (See Table 2), and the immunocompromised groups (see Table 3). Among the immunocompromised group, seroprevalence was independent of sex (χ2-test: 0.3136; $p < 0.05$).

Seroprevalence was comparable among males and females and there was no definite age-related pattern among the immunocompetent (control) group (see Table 4).

3.3 Seroprevalence among gravid females

The overall prevalence among gravid females was 44.4% (see Table 2). Prevalence increased significantly with age to 66.7% in the last age group (x2-test; $p < 0.05$).

3.4 Seroprevalence among the Immuno-compromised patients

The overall prevalence among the immune-compromised patients was 27.8% (see Table 3). Prevalence was significantly higher among females than males (x2-test; $p < 0.05$); and significantly increased with age in both sexes (x2-test; p ,0.05 for all tests).

3.5 Seroprevalence among the immunocompetent persons (the controls)
The overall prevalence among the immunocompetent persons was 22.2% (see Table 4). Prevalence decreased significantly with age, especially among females (x2-test; p ¸0.05 for all tests).
3.6 Comparison of seroprevalence among the three subgroups
In all the three subgroups, there was no positive case observed among those 20 years old or younger. Prevalence among females were significantly higher than that among males in both the immuno-compromised and the immune-competent subgroups (x2-test; $p < 0.05$ in both tests).
3.7 Seroprevalence of toxoplasmosis among those living with cats
Prevalence among those who have cats living with them in their residence (see Table 5) was significantly higher than among those not living with cats (x2-test; $p < 0,05$ for all tests). The risk of getting infected among the various subgroups is presented in Table 6. Among those living with cats overall, the risk of infection with toxoplasmosis was four times higher than among those not living with cats (OR 4.51). This was the same among the immune-compromised as well as the immune-competent where the risks of getting infected were five times higher among those cohabiting with cats (OR 5.45 and OR 5.36 respectively). Among the pregnant women, the risk of getting infected with toxoplasmosis was three times higher among those cohabiting with cats (OR 3.00).
3.8 Seroprevalence of toxoplasmosis in relation to the tribe of origin of participants in the study
The seroprevalence of toxoplasmosis in relation to the tribe of origin of participants in the study is presented in Table 7. Prevalence was comparable among the tribes (χ2-test; $p < 0.05$ for all the tests).

4. Discussion
The results from this study indicate that toxoplasmosis is highly prevalent among those attending the National Hospital Abuja especially among pregnant women. This agrees with the findings of Torda (2001). An even higher seroprevalence rates for pregnant women in a Nigerian population ranged from 72.5% to 88.8% with an overall rate of 75.4% (Onadeko et al., 1996). In Columbia, increase in seroprevalence to Toxoplasma antibodies for the past 25years among pregnant women has been reported (Rosso et al., 2008).
Toxoplasmosis seroprevalence increased with age and was not sex-related. Similar findings were made in Malaysia (Nissapatorn et al., 2011), and in a northern Mexican city of Durango among elderly people (Alvarado-Esquive et al., 2012). However, living with cats was an important risk factor in the epidemiology of toxoplasmosis. Perhaps it was a major determinant of toxoplasmosis infection in the study area, as those living with cats constituted a highly significant proportion of positive case in all the three study groups. This is in agreement with findings elsewhere (Joss, 2004; Sukthana, 2006).
Toxoplasmosis is the most frequent protozoal opportunistic infection in immunocompromised individuals. Its association with immunosuppression has been known for several decades. ((Nissapatorn et al., 2011).).
T. gondii antibody prevalence rates vary greatly by geographic distribution and population among healthy persons (Pordeus et al, 2008), pregnant women (Nissapatorn et al, 2003), immunocompromised patients, in¬cluding those with HIV/AIDS (Lindström et al, 2006), cancer (Rai et al, 2003). The seroprevalence of toxoplasmosis obtained in this study among the immunocompromised was lower than (54%) reported for the same group in a study in Uganda (Lindstrom et al., 2006). Similarly seroprevalence obtained in this study among pregnant women was lower than that (70%) reported in Cameroon and 53% in Brazil for the same subgroup (Vaz et al., 2010, Njunda et al., 2011).
In a comparative study, the seroprevalence of toxoplasmosis in pregnant women from the inner area of Ibadan (78%) was significantly higher than that among pregnant women from the Swansea area of the UK (22%); and it was concluded that reinfection or recrudescence was responsible for maintaining high antibody levels in African women, which is also worrisome considering its implications for the immune-compromised subset (Onadeko et al., 1992).
There was no significant difference in prevalence between the various ethnic/ tribal groups in this study. This is not in agreement with findings in Asia where Toxoplasma infec¬tion was reported to be more common among Malays than other ethnic groups, especially in those with a lower education level (Nissapatorn et al., 2011).
Close contact with cats as domestic pets is com¬mon among these people, and this is a well-known risk factor of toxoplasmosis transmission (Alvarado-Esquive et al., 2012). In another study in neighbouring Cameroon, age, cat ownership, consumption of raw vegetables, source of potable water, meat consumption, and gestational age were identified as risk factors for toxoplasmosis in pregnancy (Njunda et al., 2011). In endemic areas wells located in farms could be contaminated with Toxoplasma (Sroka et al., 2006). Health education regarding toxoplasmo¬sis and its consequences need to be given to prevent primary infection among the general population irrespective of their race or socioeconomic status. ((Nissapatorn et al., 2011).).

5. Conclusion
Toxoplasmosis is highly prevalent among those attending the National Hospital, Abuja. These findings buttress

the need for a nation-wide Toxoplasma screening program for a reliable data for proper planning by Health authorities, to be preceded by a comprehensive health education. There should be a definite policy of ensuring that toxoplasmosis screening and monitoring is included in the tests protocols in the first trimester of pregnancy in the Nigeria, considering the high prevalence recorded in this study. This is highly essential as early diagnosis during pregnancy allows for prompt intervention through treatment in order to reduce the probability of foetal infection and consequent substantial damage to the foetus (Njunda et al., 2011). Furthermore, campaign for general improvement in personal hygiene standards among inhabitants should be intensified and sustained. Evolving a strategy for sustainable inspection of meats meant for human consumption for Toxoplasma infection is a challenge that must be surmounted to check the rising profiles of toxoplasmosis in Nigeria.

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Table 1. Seroprevalence of toxoplasmosis among pregnant women, immunocompromised and immunocompetent patients (control) attending national hospital, Abuja.

Group	No Examined	No. Positive	Prevalence (%)
Pregnant	72	32	44.4
Immunocompromised patients	72	20	27.8
Control	72	16	22.2
Total	216	68	31.5

Table 2: Seroprevalence of toxoplasmosis among the age related group in pregnant women.

Age Group (years)	No Examined	No. Positive	Prevalence (%)
≤ 20	6	0	0
21-40	54	24	44.4
41+	12	8	66.7
Total	72	32	44.4

Table 3: Seroprevalence of toxoplasmosis among immunocompromised patients in relation to age and sex

age group (yrs)	Males			Females			Total		
	No. exam[a]	No. +ve	Prev (%)	No. exam	No. +ve	Prev (%)	No. exam	No. +ve	Prev (%)
≤ 20	2	0	0	4	0	0	6	0	0
21-40	14	2	14.3	14	4	28.6	28	6	21.4
41+	20	6	30.0	18	8	44.4	38	14	36.8
Total	36	8	22.2	36	12	33.3	72	20	27.8

[a] Note: No. exam means number examined, while No. +ve means number of positive cases; Prev (%) stands for prevalence of infection.

Table 4: Seroprevalence of toxoplasmosis among immunocompetent patients in relation to sex and age

Age group (yrs)	Males			Females			Total		
	[a]No exam	No +ve	Prevalence (%)	No exam	No +ve	Prevalence (%)	No exam	No +ve	Prevalence (%)
≤ 20	4	0	0	6	0	0	10	0	0
21-40	18	4	22.2	22	8	36.4	40	12	30,0
41 +	10	`2	20.0	12	2	16.7	22	4	18.2
Total	32	6	18.8	40	10	25.0	72	16	22.2

[a] Note: No. exam means number examined, while No. +ve means number of positive cases

Table 5. Seroprevalence of toxoplasmosis among those living with cats/dogs

Group	Response	No. examined	No. positive cases	Prevalence (%)
Pregnant women	YES	44	24	54.6
	NO	28	8	28.6
Immuno-compromised patients	YES	38	16	42.1
	NO	34	4	11.8
Immuno-competent (control) patients	YES	32	12	37.5
	NO	40	4	10.0
Total	YES	114	52	45.6
	NO	102	16	15.7
	Total	216	68	31.5

Table 6. Assessment of the risk of getting infected with toxoplasmosis between those cohabiting with cats and those who are not.

Subgroups	**Infection status**	**Not living with cat**	**Living with cat**	**Odds ratio**
Pregnant women	Positive for toxoplasmosis	8	24	3.00
	Negative for toxoplasmosis	20	20	
Immuno-compromised	Positive for toxoplasmosis	4	16	5.46
	Negative for toxoplasmosis	30	22	
Immuno-competent	Positive for toxoplasmosis	4	12	5.36
	Negative for toxoplasmosis	36	20	
Overall	Positive for toxoplasmosis	16	52	4.51
	Negative for toxoplasmosis	86	62	

Table 7. Prevalence of toxoplasmosis in relation to tribe among the pregnant women, immunocompromised patients and immunocompetent (control) patients

Tribe of origin	Number examined	Number of positive cases	Prevalence (%)
Hausa	68	24	35.3
Igbo	46	14	30.4
Yoruba	46	16	34.8
Others	14	4	28.6
Total	216	68	31.5

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