



Comparative Study of Toxoplasmosis amongst Healthy Volunteers and Schizophrenics Attending Two Health Facilities in Port Harcourt, Rivers State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author GNW designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author EO managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Toxoplasmosis is a neglected tropical zoonotic infection caused by an intercellular protozoan parasite called *Toxoplasma gondii*. *T. gondii* infection is gaining prominence as an important public health parasitic infection and possibly the aetiology of some cases of schizophrenia. The comparative seroprevalence and associated risk factors of toxoplasmosis were investigated among two subpopulations - schizophrenics (SZN) drawn from the Neuropsychiatric hospital Port Harcourt and Neuropsychiatric department of University of Port-Harcourt Teaching Hospital, all in Rivers State. Immunocompetent persons (IP) were used as control after ethical clearance was obtained from Rivers State Hospitals Management Board Ethical Committee. Immunodiagnostic techniques involving the detection of *T. gondii* antibodies in examined sera using ELISA IgG and IgM tests were employed. Well structured questionnaire was used to collect data on social demographic risk

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factors associated with toxoplasmosis. Out of the 400 subjects (200 subjects per sub population) examined, SZN recorded a seroprevalence of 54.0% (109) ($P \leq 0.05$), while IP recorded 28.5% (57) ($P \leq 0.05$). SZN recorded a higher seroprevalence compared to IP with 50.0% (100), 4% (8) and 21.5% (43), 7.0% (14) for *Toxoplasma gondii* ELISA IgG and IgM tests respectively. Age groups 35-40 and 40 and above both had the highest seroprevalence 11.0% (22) for SZN while age groups 25-29 had the highest seroprevalence of 7.5% (15) for IP. Students recorded the highest seroprevalence for SZN, 21.5% (43) for IgGE and 2.0% (4) for IgME while traders recorded the highest seroprevalence for IP 6.5% (13) for IgGE and 2.5% (5) for IgME. More males were infected among SZN while more females were infected for IP. Eating improperly washed fruits and vegetables, and drinking untreated water were the risk factors associated with the disease. Public health campaign, improved personal hygiene and routine tests have been advocated for.

Keywords: Rivers State; seroprevalence; schizophrenia; toxoplasmosis; Nigeria.

1. INTRODUCTION

Toxoplasma gondii is an obligate intercellular protozoan, the etiological agent of toxoplasmosis [1,2]. Several studies have shown that cats and other feline species are the definitive hosts for the parasite, as they are the only animals that excrete the oocysts into the environment [3].

Humans can become infected with toxoplasmosis by drinking water or eating food contaminated with oocysts released in cat faeces or by accidental digestion of raw or uncooked meat; such as pork and lamb containing tissue cysts of *Toxoplasma gondii* [1]. Its transmission is also possible through blood transfusion, organ transplant and transplacentally from mother to fetus.

Earlier studies have found a positive correlation between *T. gondii* antibody titres and schizophrenia [4,5]. The existence of an association between schizophrenia and toxoplasmosis has been suspected since the 1950s. This suspicion was based on the fact that many studies have found an increased seroprevalence of toxoplasmosis in charts of mental health institutions in comparison with members of control populations [6]. Investigations have also correlated seropositivity with changes in neurological functions [7]. However, the complex underlying mechanism of the subtle behavioural alterations is still not fully understood. The parasite can induce modifications in the infected cells. *Toxoplasma gondii* infects the brain by forming a cyst within its cells and produces an enzyme called tyrosine hydroxylase, which is essential for the production of dopamine. Dopamine is a neurotransmitter involved in mood, sociability, attention, motivation and sleep patterns. Schizophrenia has long been linked to dopamine dysregulation [4,8,9].

Establishing the link between toxoplasmosis and schizophrenia is vital, as baseline data generated will assist health institutions to make policies as to whether or not toxoplasmosis testing should be included in daily routine laboratory testing. Such data may also determine the most efficient method to adopt for detecting the parasite.

1.1 Objective of Study

This study aimed at investigating the seroprevalence and risk factors of *Toxoplasma gondii* among healthy volunteers and Schizophrenics drawn from the Neuropsychiatric hospital and Neuropsychiatric department of the University of Port-Harcourt Teaching Hospital, Port-Harcourt, Rivers State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

Neuropsychiatric Hospital (NPH), Port Harcourt is a government-owned specialised service hospital in Obio/Akpor Local Government Area, Rivers State, Nigeria. It is located at Rumuigbo, Port Harcourt, Rivers State. The University of Port Harcourt Teaching Hospital, Port Harcourt is located in East-West Road, a few kilometres from the University of Port Harcourt, Port Harcourt. Both hospitals are the only government-owned neuropsychiatric facilities in Port Harcourt and therefore, attract people from all works of life.

2.2 Sample Collection and Serological Testing

Minimum sample size determination in the study was based on Leslie-kish formula [10]. The minimum sample size needed to obtain a

precision of 0.05 at 95% confidence interval was obtained thus.

$$N = z^2(1-P) / D^2$$

N = Minimum sample size required, Z = standard normal deviate corresponding to confidence interval level of 95% (standard value of 1.96), P = 31.5% prevalence of toxoplasmosis in a given Time (Uttah et al., 2013), D = margin of error to be tolerated at 5% (0.05).

Hence, minimum sample size that could be used in precision is 354.5.

Three millilitres of venous blood was collected from each of the 400 participants between February and June 2016. Blood samples were allowed to clot and then centrifuged for 5 minutes at (1500) rpm. Serum was collected and stored at 2°C. The developing plates cards, reagents and specimen were all brought to temperature of 24°C. These were processed using Bio Check for Toxoplasma Immunoglobulins IgG and IgM enzyme immunoassay test kit in which a MAPLAB plus microtiter plate reader was used to read the result of the titre [11].

2.3 Demographic Data Collection

Well-structured questionnaire capturing information regarding age, gender, occupation, possession of pets and other risk factors were administered to respondents.

2.4 Ethical Considerations

Ethical clearance was obtained from the ethical committee of the Rivers State Hospital Management Board. Written informed consent was obtained from the subjects whose age, ranged from twenty years old to forty and above.

2.5 Statistical Data Analysis

A two-way factor ANOVA and mean separation were used to analyse the data generated. A descriptive statistics were generated in simple proportions and results of seroprevalence rates presented in percentages (%); means and two-way analysis of variance were also used. A p-value of ≤ 0.05 was considered statistically significant.

3. RESULTS

Out of the 400 subjects (200 per group) examined, the schizophrenics (SZN) recorded a

higher seroprevalence of 54.0% (109) ($P \leq 0.05$), than the immunocompetent (IP) with 28.5% (57) ($P \leq 0.05$) as seen in Fig.1. The seroprevalence of IgG was found to be statistically significant ($P \leq 0.05$) while that of IgM was not significant ($P \geq 0.05$). SZN had a higher seroprevalence of IgG (50% (100) than IP (21.5% (43); in contrast, it recorded a lower IgM (4.0% (8) than IP (7.0% (14) for *Toxoplasma gondii* ELISA IgG and IgM tests respectively. Age groups 35-40 and 40 and above both had the highest seroprevalence of 11.0% (22) for SZN while age groups 25-29 had the highest seroprevalence of 7.5% (15) for IP as shown in Fig. 2. More males were infected with the disease for SZN while more females were infected for IP as shown in Fig. 3. Students recorded the highest seroprevalence for SZN, 21.5% (43) for IgGE and 2.0% (4) for IgME while traders recorded the highest seroprevalence for IP 6.5% (13) for IgGE and 2.5% (5) for IgME as shown in Fig. 4. The different risk factors associated with toxoplasmosis in Schizophrenics and healthy volunteers are shown in Table 1.

4. DISCUSSION

The study showed that the schizophrenics recorded a higher overall seroprevalence of 54% (109) ($P \leq 0.05$), than the healthy volunteers which recorded 28.5% (57) ($P \leq 0.05$) for *Toxoplasma* Spp. The seroprevalence of IgG was found to be statistically significant ($P \leq 0.05$) while that of IgM was not significant ($P \geq 0.05$). The schizophrenics also recorded a higher seroprevalence compared to IP with 50% (100), 4% (8) and 21.5% (43), 7% (14) for *Toxoplasma gondii* ELISA IgG and IgM tests respectively. This agrees with similar work that showed that levels of antibodies to *T. gondii* have been found to be increased in individuals with schizophrenia as compared to controls with an odd ratio for *Toxoplasma* spp. seropositivity between 2.4-4.4 [12,13]. However, as observed in immunocompetent subjects, an overall seropositivity of 28.5% (57) ($P \leq 0.05$) agrees with the fact that latent toxoplasmosis is asymptomatic. Uttah et al. [14] reported a similar seroprevalence rate of 22.2% in a similar comparative study in Abuja, Nigeria. Uneke et al. [15] reported a seroprevalence of 20% for IgG *Toxoplasma* Spp which is in agreement with this study. Ouologuem, Djimde and Diallo, [16] have also reported a seropositivity of 27% for toxoplasmosis among healthy immunocompetent persons in Mali, Africa.

Schizophrenics within the age groups of 35-40 and 40 and above both had the highest seroprevalence of 11% (22) while the age group 25-29 had a lower seroprevalence of 7.5% (15) for the healthy volunteers. This may point to the fact that there was no significant correlation between age groups and the seroprevalence of *Toxoplasma* Spp. However, the high seroprevalence among the healthy volunteers within the age group 25-29 mainly consists of youths in their prime with several indigent traits, which may promote the initiation of schizophrenia due to the presence of latent toxoplasmosis in

their blood. A study in China predicted that having antibodies to *T. gondii* at the time students enter college made it significantly more likely that the students would be diagnosed with schizophrenia during the next four years [8,17]

Male schizophrenics had higher seroprevalence to toxoplasmosis than their female counterparts. This may be due to the fact that males seemed to be more adventurous than females. However, some scholars in similar studies observed that males are three times more susceptible to toxoplasmosis than females [18,19]

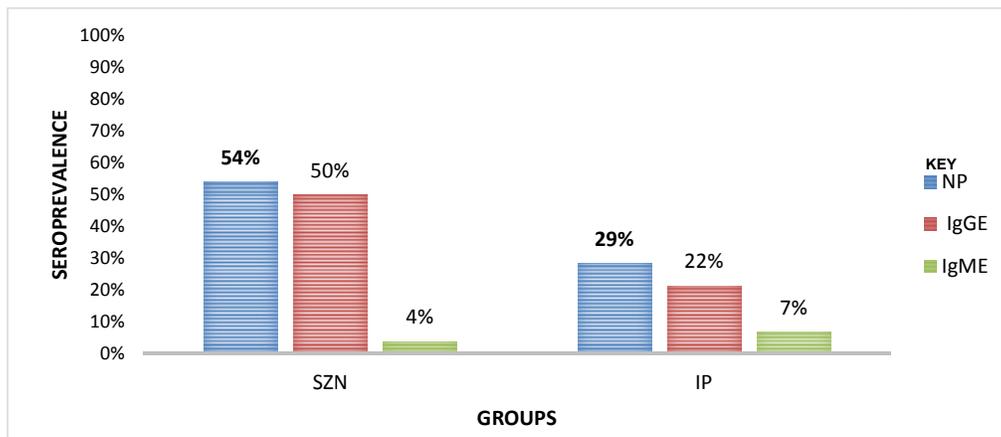


Fig. 1. Overall seroprevalence of toxoplasmosis among schizophrenics and healthy volunteers

Legend:
 NP= Number positive to *Toxoplasma gondii*
 IgGE= Immunoglobulin G-*Toxoplasma* ELISA test
 IgME= Immunoglobulin M-*Toxoplasma* ELISA test
 SZN= Number of positive schizophrenics
 IP=Number of positive healthy controls

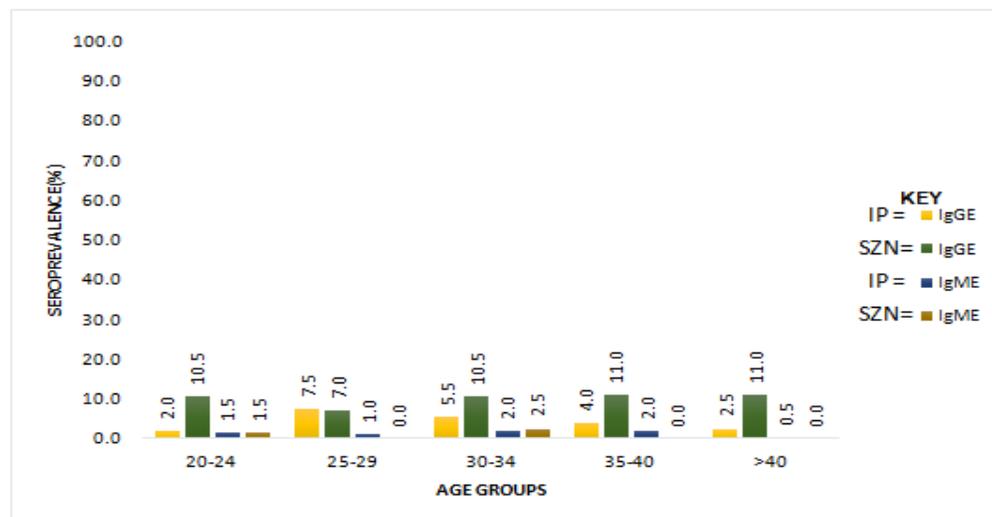


Fig. 2. Age related seroprevalence of toxoplasmosis among schizophrenics and healthy volunteers

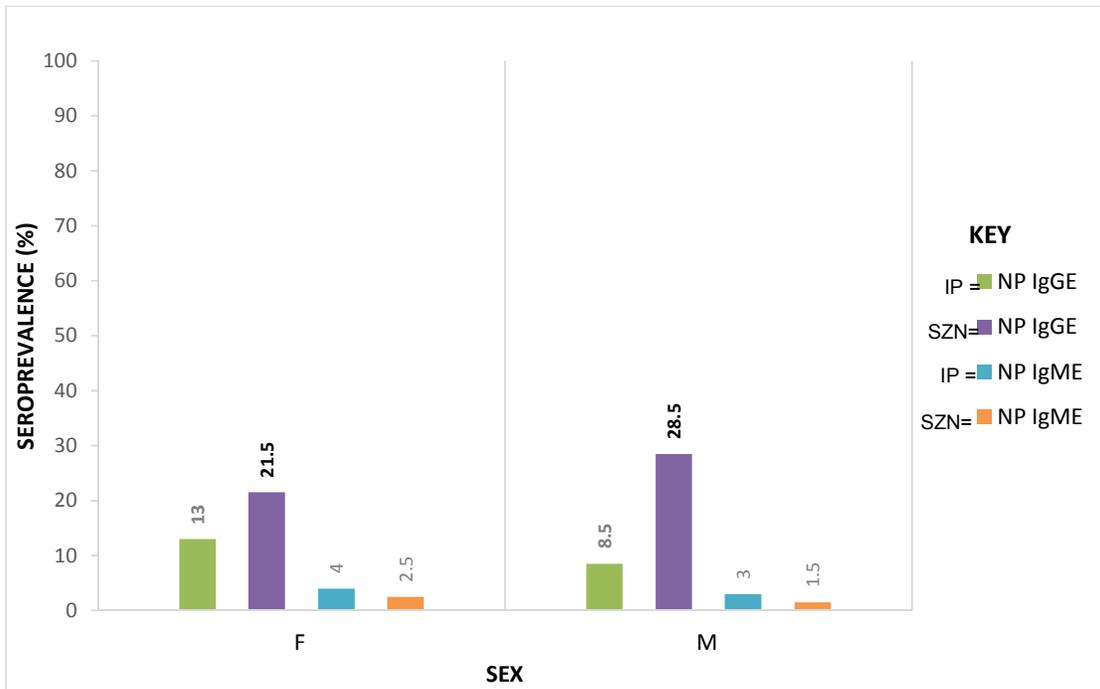


Fig. 3. Sex related seroprevalence of toxoplasmosis among schizophrenics and healthy volunteers

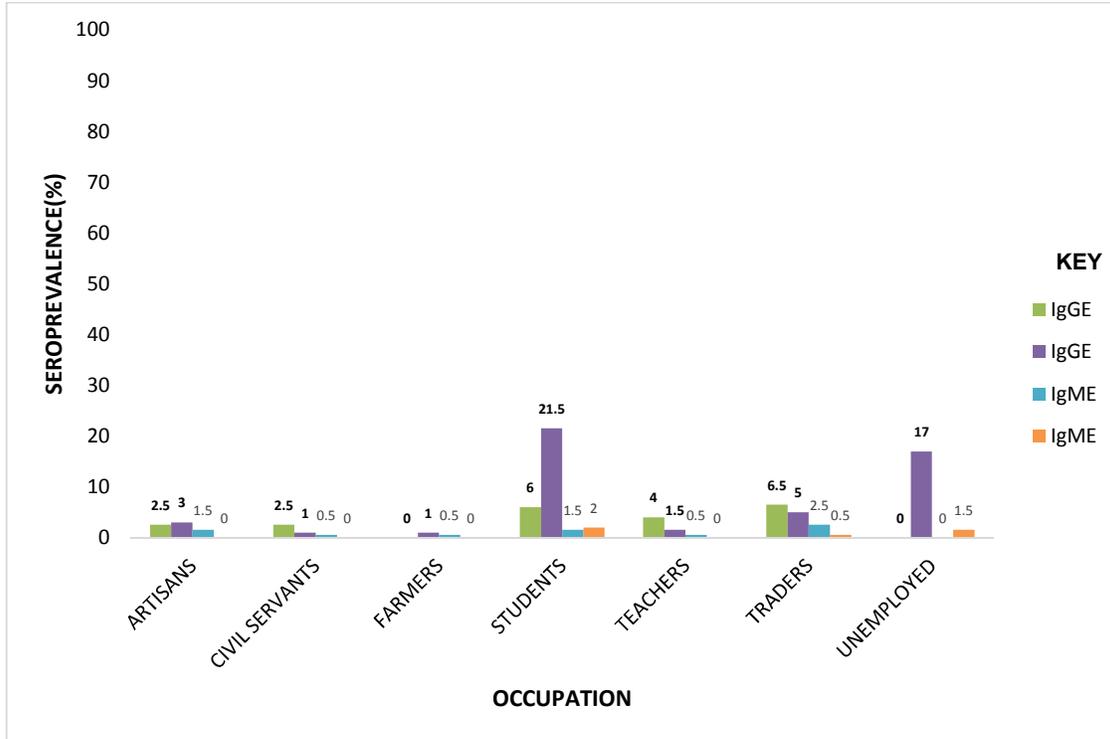


Fig. 4. Occupation related seroprevalence of toxoplasmosis among schizophrenics and healthy volunteers

Table 1. Seroprevalence of toxoplasmosis among schizophrenics and healthy volunteers based on associated risk factors

Risk factors	NE IP	NE SZN	NP IgGE		NP IgME		Mean separation
			IP	SZN	IP	SZN	
Engage in farming							
Yes	86 (43.00)	157 (78.50)	19 (9.50)	21 (10.50)	4 (2.00)	1 (0.50)	1.68a
No	114 (57.00)	43 (21.50)	24 (12.00)	32 (16.00)	10 (5.00)	1 (0.50)	1.38a
Wash fruits							
Yes	75 (37.50)	41 (20.50)	12 (6.00)	10 (5.00)	3 (1.50)	2 (1.00)	0.42b
No	125 (62.50)	159 (79.50)	31 (15.50)	43 (21.50)	11 (5.50)	0 (0.00)	0.89a
Drink treated water							
Yes	72 (36.0)	1 (0.5)	14 (7.0)	0 (0.0)	3 (1.5)	0 (0.0)	1.13b
No	9 (4.5)	199 (99.5)	29 (14.5)	53 (26.5)	11 (5.5)	2 (1.0)	1.88a
History of owning pets							
Yes	44 (21.8)	81 (40.3)	8 (4.0)	8 (3.8)	2 (1.0)	2 (0.8)	0.80a
No	100 (50.0)	100 (50.0)	22 (10.8)	27 (13.3)	7 (3.5)	1 (0.5)	0.75a
Consume suya							
Yes	36 (18.00)	15 (7.50)	7 (3.50)	4 (2.00)	5 (2.50)	2 (1.00)	0.67a
No	164 (82.00)	185 (92.50)	36 (18.00)	49 (24.50)	9 (4.50)	0 (0.00)	1.05a

Means that do not share a letter are significantly different $P \leq 0.05$ ($P \leq 0.05$)

Legend: IP= Immunocompetent Persons, SZN= Schizophrenics

NE= Number Examined, NP = Total number positive to *Toxoplasma gondii*

IgGE= Immunoglobulin G-*Toxoplasma* ELISA test, IgME= Immunoglobulin M-*Toxoplasma* ELISA test

NP IgGE = Total number positive to *Toxoplasma gondii* diagnosed with Immunoglobulin G-*Toxoplasma* ELISA test

NP IgME = Total number positive to *Toxoplasma gondii* diagnosed with Immunoglobulin M-*Toxoplasma* ELISA test

a and b = are mean separation codes to group means that are related. All figures bearing a are similar while those with b are different

The occupation related seroprevalence of the infection among schizophrenics for IgGE and IgME showed students as highest risk bearers while traders had the highest among the healthy volunteers, for IgGE and IgME respectively. Seroprevalence for IgGE was also high among unemployed; this may be attributed to high-stress levels and weak financial strength. Factors such as high stress levels and low standards of living may trigger behavioural changes that may lead to schizophrenia for which toxoplasmosis has been implicated [13,20,21]. Although some researchers, however, have argued that there is no trend or pattern as regards occupation and seropositivity to *T. gondii* [14,22].

Factors such as eating improperly washed fruits and vegetables, drinking untreated water and having a history of living with pets were associated with the disease. From similar studies which focused on risk factors that influence toxoplasmosis, it has been observed that poor personal hygiene greatly contributes to toxoplasmosis, provided environmental distinctiveness is not taken into consideration [13,23,24,25]. It is, therefore, recommended that health education, improved hygiene and routine tests should be adapted in the control of the disease.

5. CONCLUSION

T. gondii (IgG) infection is common among SZN (tests) and significantly higher statistically among them than in IP (controls). More male SZN seemed to be infected than their female counterparts. Poor personal hygiene and the history of living with pets were closely associated with toxoplasmosis.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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