Comparative Seroprevalence and Risk Factors of Toxoplasmosis among Four Subgroups in Port Harcourt, Nigeria

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

ABSTRACT

Aims: This study was carried out to investigate the comparative seroprevalence and associated risk factors of toxoplasmosis among four subgroups in Port Harcourt viz: immunocompromised persons (HIV), pregnant women (PTW) and schizophrenics (SZN), using immunocompetent persons (IP) as controls.

Study Design: A descriptive cross-sectional study was adopted.

Place and Duration of Study: The study was carried out in the University of Port Harcourt Teaching Hospital (UPTH), Braithwaite Memorial Specialist Hospital (BMSH) and Neuro Psychiatric Hospital (NPH) between March 2016 and February 2017.

Methodology: A total of 800 (200 from each of the group) samples were collected from subjects from the three hospitals. Study participants of ≥20 years were used in this study. The detection of T. gondii antibodies in examined sera was carried out using ELISA –IgG and IgM assay using standard procedures. Structured questionnaires were used to collect data on social demographic risk factors associated with toxoplasmosis.

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Results: Out of the 800 (200 per group) examined, SZN recorded the highest seroprevalence of IgG 50%(100)(P = .05) and IgM 4%(8) followed closely by HIV subjects with seroprevalence of IgG 32%(72) (P=.05) and IgM 2%(3). However, the seroprevalence were not significantly different from that of the immunocompetent control group which had the least seroprevalence. Schizophrenia subjects in age group 20-24 years recorded the highest seroprevalence with (P=.05) The unemployed recorded the highest seroprevalence for SZN with rates of 43% for IgG. More males were infected with the disease than females. Male Schizophrenics recorded a seroprevalence of 20.9%. There was no significant relationship between seroprevalence and demographic factors among subjects.

Conclusion: Our findings indicated that toxoplasmosis was relatively prevalent (P=.05) among the studied population, with schizophrenics having the highest seroprevalence. Therefore, incorporating detection of anti-Toxoplasma antibodies in routine testing in our health care centers is recommended for monitoring and control of the disease.

Keywords: Toxoplasma gondii; seroprevalence antibodies; schizophrenics; toxoplasmosis.

1. INTRODUCTION

Toxoplasmosis is an important but neglected tropical parasitic infection with global distribution and significance [1,2]. It is caused by the protozoa called Toxoplasma gondii [2]. About a third of the world's human population is estimated to harbor a Toxoplasma Spp., infection [3]. The Centre for Disease Control and Prevention (CDC) classifies toxoplasmosis as one of the neglected tropical diseases [2,3].

Several studies have shown that cats and other feline species are the definitive host as they are the only animals that excrete the oocysts into the environment [1,3]. This concedes to the fact that cohabiting with cats increase the chances of getting infected. However, direct infection through handling cats is believed to be very rare [2,3,4]. Some animals including humans may also serve as intermediate hosts in which the parasite may cause systemic infection that results in the formation of tissue cysts [2]. Transmission can also 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 [2,4] and through ingestion of oocysts shed by cats in the environment. Toxoplasma Spp., could also be transmitted by transplacental means or through organ transplantation [3,4].

In humans with a normal immune competence, Toxoplasma Spp., infections tend to be asymptomatic in most cases. This is not the case in individuals who are immunocompromised or pregnant as toxoplasmosis can lead to serious pathological and congenital adverse effects [4,5,6]. Toxoplasmosis could be severe and life-threatening during pregnancy, especially to fetus and new born babies [4,6]. One of the late indicators of congenital toxoplasmosis is Chorioretinitis [6]. Vertical transmission occurs, causing mental retardation, blindness, epilepsy and death [7]. Recent research has also linked Toxoplasmosis with attention deficit hyperactivity disorder, obsessive compulsive disorder and schizophrenia [7,8,9]. Numerous studies found a positive correlation between latent toxoplasmosis and suicidal behavior in [7,8].

Toxoplasmosis can be severe and life threatening to immunocompromised patients causing severe encephalitis through acute infections or reactivation of latent infection [3,10,11].

The geographical distribution of this disease depends on regions and weather conditions where the parasite survives in the environment [3,10]. It is estimated that between 30% and 65% of all countries harbor the parasite [3,4]. Human toxoplasmosis is reported to be widespread in Sub-Saharan Africa with a seroprevalence of 3.6–84% in different countries [12,13,14,15,16]. The variation in the prevalence rates is attributed to the environmental and socio-cultural factors. High prevalence rates of 74.7% was reported in Ethiopia [15], 66.6% in central African republic and 59.4% in republic of congo [16] while in sudan and South Africa about 29.4% and 21.5% respectively are carriers [4,17]. In Nigeria seroprevalence of 32%, 23.9% and 22.2% have reported in Zaria, Maidu, and Abuja respectively [12,13,18]. However in the Niger-delta region especially Port Harcourt, there is no research on toxoplasmosis in schizophrenics which is currently an emerging global health concern. Currently, Toxoplasma
testing is not carried out in government owned health institutions in Nigeria. The aim of this study is to determine the seroprevalence of toxoplasmosis among four physiologically distinct groups viz: Immunocompetent subjects, immunocompromised subjects (HIV patients), pregnant women and individuals with schizophrenia.

2. MATERIALS AND METHODS

2.1 Study Population

This prospective comparative study was carried out on a study population comprised of 800 people attending the tertiary medical facilities; University of Port Harcourt Teaching Hospital (UPTH), Braithwaite Memorial Specialist Hospital (BMSH) and Neuro Psychiatric Hospital (NPH) from March 2016 to February 2017. Four subgroups of physiologically distinct individuals were sampled for the study. These include immunocompetent subjects (controls), Immunocompromised subjects, Pregnant women and Schizophrenia individuals. A total of 200 samples were collected from each of the groups from both hospitals. The technique adopted for sampling was random sampling. Study participants of ≥20 years were used in this study.

2.1.1 Inclusion criteria

All pregnant women must test positive to pregnancy test and negative to HIV I and II tests.

All healthy controls must test negative to HIV and pregnancy tests.

All HIV female patients must test negative to pregnancy test.

All schizophrenics must test negative to HIV and pregnancy test.

2.1.2 Exclusion criteria

All those who refuse to give oral/written consent.

All those who gave oral/written consent but were not eligible based on preliminary test results.

2.2 Detection of Anti-Toxoplasma IgG and IgM Antibodies

Five millimeters of venous blood was collected from each of the 800 participants. 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. 800 participants were subjected to Pregnancy and HIV tests to determine inclusion criteria using Lab Acon pregnancy kit and Alere kit for HIV Tests, before Toxoplasma Immunoglobulins IgG and IgM antibody assays were carried using BioCheck for Toxoplasma Immunoglobulins IgG and IgM enzyme immunoassay test kit (ELISA) following standard methods recommended by the producer.

2.3 Statistical Analysis

Data generated from the work was analyzed using descriptive statistics (frequencies, percentages and means), two-way analysis of variance (two-way ANOVA) and mean separation. Software packages (SAS) version 9 and Microsoft Excel were used for the statistical analysis.

3. RESULTS AND DISCUSSION

3.1 Results

In this study, 276(34.4%) - IgG and 30(3.8%) - IgM of the 800 study participants examined showed the presence of T. gondii antibodies in the blood with schizophrenics being most infected with a seroprevalence of 100 (50%) and 8(4.0%) for IgG ELISA and IgM ELISA test respectively. This was followed closely by HIV subjects' with seroprevalence of 72(36%) test and 3(2.0%) for IgG ELISA and IgM assay test respectively. The immunocompetent subjects recorded the least 43(22%) for IgG T. gondii antibody tests. The two-way ANOVA showed that the seroprevalence for each of the groups were significant, (P=.05) for IgG ELISA tests while it was insignificant for IgM ELISA tests [Table 1].

Schizophrenics recorded the highest seroprevalence for IgG Toxoplasma antibodies for 20-24 yrs 21(18.8%). The ANOVA statistical results showed that the various seroprevalence rates for IgG based on age were insignificant at (P=.01). However, the seroprevalence for IgM ELISA based on age was significant.

Schizophrenics also had the highest seroprevalence of toxoplasmosis among the unemployed with a seroprevalence of IgG 34(43%) and IgM 2(2.5%). HIV patients recorded the highest seroprevalence for traders’ 38 (17.2%) for IgG ELISA Toxoplasma Spp., tests.
There was no significant difference in the seroprevalence between individuals in the various occupation groups [Table 1].

Schizophrenics showed the highest seroprevalence among males recording 57 (20.9%) for Toxoplasma Spp., IgG ELISA assay tests. This was statistically significant compared to the other subgroup’s HIV subpopulation recorded a lower seropositivity to T. gondii infection 44(8.2%) [Table 1].

The highest seroprevalence was recorded for subjects that do not wash fruits and vegetables properly or do not wash fruits and vegetables at all before consumption. Subjects who had a history of owning pets recorded the least seroprevalence all the sub groups. There was no significant difference between the various risk factors as relates to the tests and subgroups of subjects [Table 2].

3.2 Discussion

The study showed that the schizophrenics had the highest seroprevalence IgG 100(50%), IgM 5(2.5%) followed closely by immunocompromised HIV persons IgG 72 (36%), IgM 3(1.5%). Immunocompetent persons (IP) and pregnant women recorded slightly lower prevalence of 61(30.5%) and 43(21.5%) for IgG respectively. Recent studies revealed 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 [8,9,19,20]. Many reports revealed that Toxoplasma Spp. might represent a major pathogen in some cases of psychosis. It has been proven that the parasite infection could increase the dopamine level in mice brains [8,19]. Dopamine plays a key role in psychosis is cases such as schizophrenia [8,20]. The seroprevalence of T. gondii in this study in relation to (IgG 50%, is similar to reports from a study carried out by [13,20], in which the seroprevalence of the toxoplasmosis was reported to be 34%. Varying seroprevalence values of 12.4% [7]; 72.5% [14]; 85.7% [9,20], have also been reported for IgG Toxoplasma Spp., antibodies in schizophrenics. These varying seroprevalence rates may be due to environmental conditions, level of individual hygiene, social custom and habits.

In 2014, Smith Gary in attempting to prove the link of the sampled individuals between T. gondii with schizophrenia was able to determine the proportion of schizophrenia cases attributable to T. gondii infection, by calculating the population attributable fraction (PAF); a measure used by epidemiologists to understand the importance of a risk factor. The PAF was 21.4 for an average life time. This means that a fifth of all schizophrenia cases over a lifetime could be prevented by stopping T. gondii infections from occurring. Invariably, the higher the prevalence of T. gondii in a city, the higher the prevalence of schizophrenia [19].

The seroprevalence of toxoplasmosis in HIV patients in this study 36% IgG is similar to reports of other studies of seroprevalence rates of 38.1% in Meshhad and 32.4% in Zaria Nigeria [10,11,13]. Other similar studies reported varying seroprevalence including 22.2% in Abuja, Nigeria, 96.3% in Mazamddaran, Iran [13,18,21]. The IgM antibody response to Toxoplasma Spp infection is short-lived and it is frequently suppressed to undetectable levels in settings of immunosuppression. In agreement, our study revealed lower levels of IgM seropositivity 2% (3) compared to IgG 36% (72) similar observation of low levels of IgM compared to IgG seropositivity in HIV patients have been reported by Imam et al. in similar studies from South Africa [17] Northern Nigeria [11,18], Mexico [7] These low values of IgM antibodies in HIV positive subjects lends support to the view that the screening for this antibody in routine diagnosis of toxoplasmosis in non-pregnant HIV infected persons may be of limited value [11,13,18,21].

The seroprevalence of T. gondii for pregnant women in this study was reported to be 61(30%) IgG and (5) 2% IgM. This agrees with the findings of some other similar studies where overall prevalence was, found to be 25.5% in Sudan, 29.4% in Mekkah, 21.3% in Almadina, 34.1% in Burkina Faso [14,17,22,23]. Different seroprevalence rates were reported in pregnant women from other studies as well. A study carried out in Abuja, Nigeria reported a seroprevalence of 44.7% and another study carried out in Ethiopia reported a higher seroprevalence of 64% [23]. The causes of the variation in seroprevalence are attributed to environmental distinctiveness, prevailing risk factors and mother hygiene levels [2,3].
Table 1. Seroprevalence based on socio-dermographic factors among the study population

<table>
<thead>
<tr>
<th>Factors /Parameters</th>
<th>Number examined</th>
<th>Ip</th>
<th>HIV</th>
<th>PTW</th>
<th>SZN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>IgG</td>
<td>IgM</td>
<td>IgG</td>
<td>IgM</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-24</td>
<td>112</td>
<td>4(3.6)</td>
<td>3(2.7)</td>
<td>8(7.1)</td>
<td>1(0.9)</td>
</tr>
<tr>
<td>25-29</td>
<td>150</td>
<td>15(10.0)</td>
<td>2(1.3)</td>
<td>13(8.7)</td>
<td>1(0.6)</td>
</tr>
<tr>
<td>30-34</td>
<td>209</td>
<td>11(5.3)</td>
<td>4(1.9)</td>
<td>18(8.6)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>35-39</td>
<td>171</td>
<td>8(4.7)</td>
<td>4(2.3)</td>
<td>13(7.6)</td>
<td>1(0.6)</td>
</tr>
<tr>
<td>&gt;40</td>
<td>158</td>
<td>5(3.2)</td>
<td>1(0.6)</td>
<td>20(12.7)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artisans</td>
<td>110</td>
<td>5(4.5)</td>
<td>3(2.7)</td>
<td>11(10.0)</td>
<td>1(0.9)</td>
</tr>
<tr>
<td>Civil servants</td>
<td>111</td>
<td>5(4.5)</td>
<td>1(0.9)</td>
<td>5(4.9)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>Farmers</td>
<td>25</td>
<td>0(0.0)</td>
<td>1(4.0)</td>
<td>1(4.0)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>Students</td>
<td>185</td>
<td>12(6.5)</td>
<td>3(1.6)</td>
<td>6(3.2)</td>
<td>1(0.5)</td>
</tr>
<tr>
<td>Teachers</td>
<td>69</td>
<td>8(11.6)</td>
<td>1(1.4)</td>
<td>4(5.8)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>Traders</td>
<td>221</td>
<td>13(5.9)</td>
<td>5(2.3)</td>
<td>38(17.2)</td>
<td>1(0.5)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>79</td>
<td>0(0.0)</td>
<td>0(0.0)</td>
<td>7(8.9)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>273</td>
<td>17(6.2)</td>
<td>6(2.2)</td>
<td>8</td>
<td>28(10.2)</td>
</tr>
<tr>
<td>Female</td>
<td>534</td>
<td>26(4.9)</td>
<td>1(5.1)</td>
<td>45(8.4)</td>
<td>1(0.2)</td>
</tr>
<tr>
<td>Overall</td>
<td>800</td>
<td>43(21.5)</td>
<td>14(7.0)</td>
<td>72(36.0)</td>
<td>3(1.5)</td>
</tr>
</tbody>
</table>

IP= Immunocompetent Persons; HIV= HIV Positive Persons; PTW = Pregnant Women; SZN = Schizophrenics; IgG= Immunoglobulin G-toxoplasma ELISA test; IgM= Immunoglobulin M-toxoplasma ELISA test; (P=0.9044) (P<0.05)
Toxoplasmosis among immunocompetent subjects being the control group was found to be 43 (21.5%) IgG and 14 (7%) IgM. This supports the fact that latent toxoplasmosis is asymptomatic [7,17,18,19]. Similar seroprevalence rate of 22.2% and 20% were reported in similar comparative study in Abuja and Eastern Nigeria respectively [17,18].

Schizophrenics within the age group of 20-24 recorded the highest seroprevalence. This age group mainly consists of Youths of school age with several indigent traits, which may promote the initiation of schizophrenia due to the presence of latent toxoplasmosis in their blood. Studies have shown that the peak onset of toxoplasmosis and schizophrenia are similar and occurs between the ages of 20 and 30 years [5,9]. A study in China reported 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 [9].

There is however no trend or pattern as regards occupation and seropositivity to T. gondii. This has been reported by some other authors [4,13,14].

There was no visible relationship established between sex and seroprevalence. This observation was also made in several similar studies which reported no significance between sex and seroprevalence of toxoplasmosis did exist [13,14,23]. However more male schizophrenics and male HIV subjects were seropositive to toxoplasmosis than their female counterpart. However, some scholars in similar studies observed that males are three times more susceptible to toxoplasmosis than females [4,13,23].

From similar studies which border on risk factors which influence toxoplasmosis, it has been observed that poor personal hygiene greatly contributes to toxoplasmosis, provided environmental distinctiveness is not taken into consideration [4,13,23,24]. Observation made in this study concurs with these reports as drinking untreated water and eating improperly or unwashed fruits appear to greatly influence the seroprevalence of Toxoplasma Spp. IgG antibodies. This makes these factors obvious risk factor and great determiner of seroprevalence.
Ethical approval was sought and obtained from the ethical committees of the University of Port Harcourt Teaching Hospital and Rivers State Hospital Management Board.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


[25] strengthened the evidence that Toxoplasma Spp. infection may result from consumption of unwashed raw vegetables and fruits. They indicated that even though the percentage of vegetables and fruits contaminated with Toxoplasma Spp. may be small, the frequency with which these foods are consumed may result in appreciable exposure. Altogether these risk factors are consistent with the majority of infections being food borne [2,13,24].

Other factors which entail a history of owning with pets and eating undercooked suya were observed to have no significance in the present study. This finding is at variance with observations made by some scholars in similar studies where they implicated the possession of pets as one of the risk factors to transmission of toxoplasmosis [3,13,24]. However, statistical analysis shows no significant relationship between risk factors and seropositivity to toxoplasmosis.

4. CONCLUSION

The study showed that toxoplasmosis was significantly prevalent (P=.05) among the studied populations with the schizophrenias having the highest seroprevalence. Drinking untreated water and eating improperly or unwashed fruits and vegetables were the risk factor majorly influencing the transmission of the parasite in this study.

It is recommended that health education; improved hygiene and routine tests should be adopted in the control of the disease.

CONSENT

According to laid down international standards written informed consent was obtained from the patient (or other approved parties) for publication of this study.

Written informed consent was obtained from all study participants and well-structured questionnaires capturing information regarding age, gender, occupation, possession of pets, drinking untreated water, engagement in farming, eating improperly or unwashed fruits and vegetables and eating partially cooked meat (suya) were administered to respondents.

ETHICAL APPROVAL

Ethical approval was sought and obtained from the appropriate ethics committee.

All tests were performed in accordance with laid down standards.

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