Seroprevalence and Risk Factors for *Toxoplasma Gondii* Infection among Antenatal Women in Zaria, Nigeria

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**Abstract:** *Toxoplasma gondii* infection during pregnancy represents the risk for congenital infection. Serological screening of pregnant women for *T. gondii* is not a routine antenatal examination in health centers in Zaria Nigeria. This study was therefore conducted to determine the prevalence of anti- *T. gondii* IgG and IgM antibodies among pregnant women in Zaria and the risk factors for infection. A total of 374 serum samples of which 202 and 172 from Sabon Gari and Zaria Local Government Areas respectively were collected from antenatal women. The samples were analyzed using specific Toxo IgG and IgM EIA kits. Information on sociodemographic data and risk factors were obtained using structured questionnaire. The prevalence rates were 29.1% and 0.8% for anti- *T. gondii* IgG and IgM antibodies respectively. Multivariate analysis showed that there was an association between tasting of meat while cooking and *T. gondii* infection among antenatal women in Zaria. (OR=1.9; 95% CI=1.078, 3.358; P= 0.027). Seropositivity was found to increase with age (OR=0.378; 95% CI=0.182, 0.787, P=0.009) and decrease with level of formal education (OR=2.52; 95% CI=1.188, 5.331, P=0.016). Infection was found to vary with different source of drinking water. Seroprevalence was higher in those drinking well water (41.6%) and lowest in the group that drank packaged water (20.8%) (OR=3.32; 95% CI=1.568, 6.660, P=0.001). The study also revealed that 39.0% of the infection in antenatal women was attributed to tasting of meat while cooking. Other characteristics such as owning/housing of cats, history of cleaning of cat feces, type of meat consumed and working in the farm did not show any association with *T. gondii* infection.

**Key words:** *Toxoplasma gondii*, Seroprevalence, antibodies, pregnant women, sociodemographic

**INTRODUCTION**

*Toxoplasma gondii* is an obligate intracellular protozoan parasite found in many species of animals throughout the world and may cause a variety of clinical syndromes in humans and animals. It is the cause of toxoplasmosis, which is considered a major zoonosis. Felidae, both domestic and wild, are the only known definitive hosts for *Toxoplasma gondii* and thus the main reservoir of infection. Cats excrete millions of oocyst within a short period of time (1-2 weeks), and therefore play a major role in the transmission of *T. gondii* through faecal contamination of soil, food or water. The virtual absence of *T. gondii* infection in localities not inhabited by cats emphasizes the epidemiological importance of oocysts in the worldwide distribution of the disease. *Foodborne transmission of *T. gondii* is however increasingly recognized as a potentially more important source of infection to humans than cats in many endemic areas.*

Humans and domestic animals acquire infection by ingestion of viable tissue cysts in meat or oocysts excreted by cat that contaminate the environment. Most infections in humans are asymptomatic, but the parasite can produce a devastating disease. Only about 10% of infected individuals develop signs and symptoms. However, in pregnant women and immunosuppressed individuals the clinical disease can be severe. It is the frequent cause of encephalitis in severely immunosuppressed patients with Acquired Immuno Deficiency Syndrome (AIDS). Infection during pregnancy can cause spontaneous abortion and neurological disorders such as blindness and mental retardation in congenitally infected new borns. The severity of foetal disease varies inversely with the
1. The Health Centre has specific antenatal clinic inclusion criteria for Health Centers in the study were selected by simple random sampling method. A Health Center in each district selected was then taken. Inclusion criteria for Health Centers in the study were that:

1. The Health Centre has specific antenatal clinic days.

2. The Health Centre serves a large proportion of the population or neighboring districts.

Four district (two from each Local Government) were eventually selected namely; Samaru, Sabon Gari, Zaria City and Tudun Wada

Sample Collection:

Ethical Consideration: Permission was obtained from the Kaduna State Ministry of Health Ethical Committee (Ref No: MOH/ADM/744/VOL.II/329) before sample collection from two state hospitals, while permission was obtained from the Medical Directors of a Private owned Hospital and an institutional health center before sample collection. The aim of the study was clearly explained to the patients and informed consent obtained before administering questionnaire. To ensure confidentiality, names of respondents were not recorded on the questionnaire. The questionnaire was interpreted in local language for those who could not understand English.

Questionnaires: Information on the patients’ age, literacy levels (illiteracy, primary, secondary, tertiary), and related risk factors including source of drinking water (packaged water, well, piped water, others), type of meat consumed (beef, chevron, mutton, etc), environmental contacts (owning of cat, cleaning of cat litter), using a structured questionnaire were obtained.

Sample Collection and Handling: Blood samples were collected by venupuncture using vacutainers. Each blood sample was labeled. Samples were then centrifuged at 1000rpm for 3 minutes to separate serum. Serum samples were then transported on ice pack to the Parasitic Zoonoses Laboratory, Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria. Serum samples were kept at – 20°C until used.

Serological Method: Commercial Kits for specific anti-

T. gondii IgG and IgM antibodies were used according to the manufactures instruction (Asia-Lion Biotech, Co. China).

Interpretation of Eia Results: EIA reader at 450nm (using OD value of the blank well to correct all OD reading from all wells) was used.

Cut off: 0.10 + Average OD of Negative Control. OD values greater than or equal to the cut off value was considered positive for IgG/IgM, while OD values less than the cut off was considered negative for IgG/IgM. The Cut Off values determined for IgG was 0.161 and 0.15 for IgM.
**Statistical Analysis:** Statistical Package for Social Sciences (SPSS) version 14 was used. Descriptive statistics were used for categorical (frequency or percentage) variables. To assess the association between the characteristics of the subjects and *T. gondii* seropositivity, data was initially examined with bivariate analysis. For multivariate analysis, Cochran-Mantel-Haenszel summary statistics was calculated for each risk factor examined in the study. Factors that were found by Cochran–Mantel–Haenszel summary statistics to have a significant (P<0.05) association with *T. gondii* seropositivity were entered into backward elimination logistic models at a P<0.1 level. Variables with P<0.05 at the final stage (step 4) were considered statistically significant.

**RESULTS AND DISCUSSION**

**Serology and Prevalence:** Out of the 374 pregnant women studied, 109 were positive for anti-*T. gondii* IgG antibodies and 3 were positive for anti-*T. gondii* IgM antibodies. Therefore, we found a 29.1% and 0.8% prevalence of latent (chronic) and recent (acute) *T. gondii* infection respectively (Table 1).

**Seroprevalence and Questionnaire Analysis:** Fig 1 shows the prevalence of *T. gondii* infection according to age. Seroprevalence among the antenatal women did show that seropositivity increases with age. Seropositivity was found to be associated with age using multivariate analysis. (OR= 0.378, 95% CI= 0.182, 0.787, P= 0.009).

Fig 2 shows the seroprevalence of *T. gondii* infection among ante-natal women according to their literacy level. The results showed that the prevalence was higher in women without formal education (40.3%) and lower among those with higher education (24.5%). *T. gondii* seropositivity was found to decrease with level of education using multivariate analysis; (OR=2.516; 95% CI=1.188, 5.331, P=0.016).

*Toxoplasma gondii* seropositivity was highest (41.6%) among women using well water and lowest in those who used packaged water. Seropositivity was found to be significantly associated with source of drinking water using multivariate analysis at OR =3.232; 95% CI=1.568, 6.660, P= 0.001 (Table 2).

The study showed that infection was higher (33.1%) in women with the habit of tasting meat while cooking than in those without the habit of tasting meat and was 1.9 times more likely to occur in the former. Seropositivity was found to be significantly associated with tasting of meat while cooking using multivariate analysis (OR = 1.90; 95% CI=1.77, 3.358, P= 0.027 (Table 3).

Other risk factors assessed in this study did not show any association. This include; history of working in the farm. ($\chi^2 = 0.017, P = 0.896$), knowledge of the type of meat consumed ($\chi^2 = 8.616, P=0.029$) but did not show significant association with *T. gondii* seropositivity by multivariate analysis, owning of cats ($\chi^2=0.610, P= 0.435$), housing of cats (indoor/outdoor) ($\chi^2 = 0.143, P = 0.931$), history of cleaning of cat faeces ($\chi^2 = 0.35, P = 0.851$).

**Discussion:** The study showed that overall prevalence of *T. gondii* IgG and IgM antibodies in pregnant women in Zaria was 29.1% and 0.8% respectively. Studies conducted by Aganga et al., two decades ago in Zaria showed a prevalence of (39.5%) and (0.4%) of chronic and acute infection respectively. Thus, the result of this study suggests a decline in chronic *T. gondii* infection. Studies in other parts of the world also showed a declined in infection. *T. gondii* infection has continued to declined since 1960 in the United Kingdom[24]. Also a 1.0% yearly declined of *T. gondii* infection among pregnant women in Portland has been reported[25]. Increased literacy level with attendant improved hygienic sanitary practices may contribute to explain the reason for declined in *T. gondii* infection in this study. The result of this study also suggests that 70.9% of ante-natal women in Zaria are susceptible to first primary infection. In this study however, decline in prevalence may not indicate fall in the incidence of toxoplasmosis acquired during pregnancy. Instead, the decline in prevalence in pregnant women probably reflects a decline in incidence during childhood and supported by the fact that prevalence of recent infection in this study did not decline when compared with previous work[19].

Seroprevalence of *T. gondii* infection has been shown to increase with age[26,17]. This study also found age effect on seroprevalence of *T. gondii* infection among antenatal women. The risk of exposure to *T. gondii* infection may increase with age. This may contribute to explain the reason for the high prevalence in age group 36-45 observed in this study. This also highlights the need to continue to educate women of child-bearing age on prevention of toxoplasmosis.

Seroprevalence in this study was significantly higher in those with no education which agrees with the findings of other workers who reported that lower levels of education were associated with increased risk for toxoplasmosis[27]. Transmission of *Toxoplasma gondii* is possible by containers, knives or cutting boards or other preparation surfaces contaminated with raw meat. Persons with less education might be less likely to wash cutting boards, knives e.t.c, with soap after cutting of raw meat[27]. This may explain the high prevalence in those with no education in this study.
Table 1: The seroprevalence of *T. gondii* infection among antenatal women according to presence and type of immunoglobulin.

<table>
<thead>
<tr>
<th>Infection</th>
<th>No of samples</th>
<th>No positive</th>
<th>% prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latent (IgG)</td>
<td>374</td>
<td>109</td>
<td>29.1</td>
</tr>
<tr>
<td>Acute (IgM)</td>
<td>374</td>
<td>3</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Table 2: The seroprevalence of *T. gondii* infection among antenatal women according to source of drinking water.

<table>
<thead>
<tr>
<th>Source of drinking water</th>
<th>No of samples</th>
<th>No positive</th>
<th>% prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well</td>
<td>84</td>
<td>35</td>
<td>41.6</td>
</tr>
<tr>
<td>Piped</td>
<td>177</td>
<td>46</td>
<td>25.9</td>
</tr>
<tr>
<td>Packaged</td>
<td>24</td>
<td>5</td>
<td>20.8</td>
</tr>
<tr>
<td>Others</td>
<td>89</td>
<td>23</td>
<td>25.8</td>
</tr>
</tbody>
</table>

OR = 3.232; 95% CI=1.568, 6.660; P= 0.001

Table 3: The seroprevalence of *T. gondii* infection among antenatal women according to habit of tasting meat while cooking.

<table>
<thead>
<tr>
<th>Tasting of meat while cooking</th>
<th>No of samples</th>
<th>No positive</th>
<th>% prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>260</td>
<td>86</td>
<td>33.1%</td>
</tr>
<tr>
<td>No</td>
<td>114</td>
<td>23</td>
<td>20.2%</td>
</tr>
</tbody>
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OR = 1.90; 95% CI=1.077, 3.358, P= 0.027, PAF = 39.0%

Fig. 1: The seroprevalence of *T. gondii* infection among antenatal women according to age

Fig. 2: The seroprevalence of *T. gondii* infection among antenatal women according to their literacy level
Seroprevalence has been reported to vary according to use of different water sources\textsuperscript{(17)}. The high prevalence of \textit{T. gondii} infection among women using well water in this study agrees with the findings of other workers who reported a high prevalence (51.8\%) of \textit{T. gondii} antibodies in those drinking well water in Guatemala\textsuperscript{(29)}. Contamination of well water with oocysts from soil is likely to occur in floods or run off after rain. Oocysts can survive for long periods in water\textsuperscript{(21)}, hence individuals who use well water may be frequently exposed to \textit{T. gondii} oocyst.

The cooking of meat at temperature of 50\(^\circ\)C or above rapidly destroys \textit{Toxoplasma} cysts (ESR, Newzealand, 2002). In Nigeria thorough cooking is always preferred. This study has shown that seroprevalence was significantly higher in those with habit of tasting meat while cooking than in those without the habit. This result agrees with previous findings\textsuperscript{(22)}. Tasting meat while cooking may mean ingesting tissue cysts that have not been killed or inactivated thus leading to toxoplasmosis.

Other workers reported association between infections and contact with soil\textsuperscript{(22)}, cleaning of cat feces\textsuperscript{(29)} indoor or outdoor housing of cat\textsuperscript{(32)}, consumption of cured meat\textsuperscript{(23)} and working in the farm or garden\textsuperscript{(27)}. These factors were assessed in this study, however no associations were found.

**Population Attributable Fraction:** In this study 39.0\% of the infection was attributed to tasting of meat while cooking whereas 16.6\% of the infection was attributed to cleaning of cat feces.

**Conclusion:** This study suggests that prevalence of latent \textit{T. gondii} infection in pregnant women in Zaria has declined. Seroprevalence of \textit{T. gondii} infection was also found to increase with age and decrease with level of education. \textit{Toxoplasma gondii} infection among antenatal women in Zaria was likely to have been acquired through drinking well water and tasting of meat while cooking. Avoidance of both tasting meat while cooking and cleaning of cat feces could reduce the risk of infection by 39.0\% and 16.6\% respectively.

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**REFERENCES**


