Original Research Article

Prevalence of *Toxoplasma gondii* and associated risk factors among pregnant women attending hospital centers in Penka-Michel, Cameroon.

Abstract

Aims: The study was carried out to investigate the epidemiology of toxoplasmosis and associated predisposing risk factors in a rural setting of Cameroon.
Study design: The survey took place from April to July 2014 at the District Medical Center of Balessing, the District Medical Center of Bansoa chefferie, the District Medical Center of Eglise Evangelique du Cameroun and the District Hopital of Penka-Michel, 4 reference hospitals in Penka-Michel, a sub-division in the west region of Cameroon.
Methodology: Serum samples were collected from 643 pregnant women attending the ante natal clinic after obtaining informed consent. *Toxoplasma gondii*-specific IgG antibodies were detected by indirect solid-phase enzyme immunoassay (EIA), immunoComb® Toxo lgG. A structured questionnaire was used to collect information on sociodemographic parameters and predisposing risk factors for toxoplamosis from each patient. The data were analyzed using GraphPad prism version 5.03.
Results: The age range of the women was 15-50 years with a mean of 27.1 ± 2.51 years. The mean gestational age was 6.22 ±1.93 months with, 9.8%, 39.5% and 50.7% of the women in the first, second and third trimester respectively. The overall IgG seroprevalence was 35.77% (230/643) of our sample population. There was a statistically significant association between Toxo IgG seropositivity status, educational level, professional status, had knowledge on toxoplamosis and frequency of raw meat consumption with a significantly higher risk of being seropositive amongst farmers and housewives (X^2 =13.28; P = .0100), among women with university level of education (X^2 =11.77; P = .0082), among women with knowledge on toxoplamosis (P = .0001) and those who frequently consume raw meat (P = .0426).
Conclusion: Our data found out a high risk of toxoplasmosis in pregnant women. Thus, a general screening program for toxoplasmosis in pregnancy in Cameroon should be done.

Keywords: Seroprevalence, toxoplasmosis, risk factors, Penka-Michel, Cameroon.

1. Introduction

Toxoplasmosis is one of the most common parasitic zoonoses world-wide caused by *Toxoplasma gondii*, which establishes long-lasting infections in humans and animals [1]. *Toxoplasma gondii* is an intracellular Apicomplexan protozoan capable of infecting almost any cell type, making it one of the most 'successful' protozoan parasites on earth. Felids are the definitive hosts for *T. gondii* and warm blooded species, including humans, serve as intermediate hosts [2]. Infection in humans usually occurs via the oral or transplacental route from a mother infected during pregnancy. Consumption of raw or undercooked meat containing viable cysts, water contaminated with oocysts from cat feces, and unwashed vegetables are the primary routes of oral transmission; improper handling of undercooked meat or contaminated soil also may lead to hand-to-mouth infection [3]. Latent toxoplasmosis, i.e., the lifelong presence of cysts and anamnestic concentrations of anti-*T.gondii* antibodies in immunocompetent subjects, is considered asymptomatic and harmless, although 10% of patients may present a self-limiting, mild, febrile illness characterized by

lymphadenopathy, fever, fatigue, arthralgia, dermatosis, malaise, he… 5]. However, infection in immunocompromised patients and… acquire acute infection during pregnancy can lead to ver… Opportunistic toxoplasmosis infection or reactivation of a… immunocompromised patients may cause encephalitis, pneumo… with lethal outcome [7]. The rate of congenital infection in women with acute infection ranges from 20% to 100% depending on which trimester the acute infection occurs in: 15% to 25% in the first trimester, 30% to 54% in the second trimester, and 60% to 65% in the third trimester; by the last week of gestation, the incidence approaches 100% [8]. The outcome is more severe if the infection occurs early in the pregnancy. In the congenitally infected fetus, the infection may spread to the central nervous system. The consequences include spontaneous abortions, stillbirth or serious birth defects when infection takes place during the first trimester of pregnancy, and chorioretinitis, visual impairment, hydrocephalus, intracranial calcifications, irreversible cognitive and other neurologic impairment in case of infection during the second or third trimester [9]. Quantitative screening for IgG antibodies to *T. gondii* is a pragmatic diagnostic approach for determination of the immune status in pregnant women and newborns. IgG antibodies appear within one to t… with *T. gondii*, peak in six to eight weeks and then decline over t… antibodies remain detectable for life. Consequently, the presen… exposure because asymptomatic humans can develop very hig… remain elevated for several years or even whole life if repeated … [10]. In patients with known baseline antitoxoplasma IgG level… may indicate reactivation of Toxoplasma infection [11] or … acute infection. IgM antitoxoplasma antibody usually disappears within weeks to months after the primary infection but may remain elevated for more than one year. Therefore, elevated IgM levels do not always suggest recent infection [12].

The prevalence of serologic evidence of *T gondii* infection changes according to social and cultural habits, geographic factors, climate, and transmission route, and it typically increases with age [13], with seropositivity seen in 10% of persons aged 10 years, 20% of persons aged 20 years, and 50% of persons aged 70 years in the U.S. and UK [5]. The prevalence of infection varies by country; in french population, toxoplasmosis seroprevalence decreased overtime from 54.3% in 1995 to 43.8% in 2003 and 36.7% in 2010 [14], about 12.5% of the Japanese population and 60% of the Du… positive for *Toxoplasma gondii* antibodies by the fourth decade of l… of the U.S. population [5]. Seroprevalence in women of chi… try; for exa… 1990s, 37% to 58% of women in … Aust… as 51% to 77% of women in S… ub-S… seropositive, whereas only 4% to … least As… seropositive [2]. The birth prev… toplasmosis ranges … cases per 100,000 live births [5]. Diagnosis of acute *T. gondii* infection … particularly important because of the risks of transmission to the newborn secondary to congenital infection. Pregnant women with newly acquired infection should receive treatment to help avoid transmission to the fetus and congenital infection. If the child is infected at birth or in early infancy, treatment should be initiated to prevent symptomatic infection or limit sequelae. Recent reports show increasing number of evidences linking *T. gondii* infection with schizophrenia [15], epilepsy [16] and traffic accidents [17]. If toxo… etiological role or attributed to the aforementioned problems then th… toxoplasmosis is likely to be much higher together with the life-long … congenitally infected babies [18]. However, toxoplasmosis is still a n… unreported disease despite causing a considerable global burden of ill health in humans.

congenital infection does not occur in women

Not clear what role IgG and IgM play in response to an infection and how this affects diagnosis, needs to be accurate here

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reference

The serological screening of pregnant women for toxoplasmosis and the follow-up until delivery are not routine procedures in Cameroon. In a few studies performed in our country, seroprevalence of *T. gondii* infection among pregnant women was found to be 77.1% in 1992 [19] and 65.5% in 2011 [5]. However those previous study on the [illegible] toxoplasmosis among pregnant women has been done only in urban [illegible] information is very scarce on the prevalence of toxoplasmosis [illegible] rural setting where some predisposal factors are more frequent [illegible] present study was therefore initiated to determine the seroprevalence [illegible] specify IgG antibodies among pregnant women and to identify the [illegible] for toxoplasmosis in Penka-Michel, a rural area in West Cameroon.

There are lots of review papers on the situation in Africa and West Africa and these deserve a mention in this introduction

2. Methodology

sub-divisions

2.1. Study Area

The research was carried out in Penka-Michel, one of the five sub-division of Menoua division in the west region of Cameroon. Penka-Michel is located between latitude 21.52, 5^{o} and 31.41, 5^{o} north of the equator and longitude 7.39, 10^{o} and 20, 10^{o} east of the GreenWich Meridian. It has an altitude of about 1500 m above sea level. It enjoys two distinct seasons, a short dry and a long rainy season. The highest rainfall registered in a year could reach 345.1 mm and the thermal amplitude between the hottest month of the year (March: 21.5^{o} C) and the coldest (August: 18.9^{o} C) is 2.6^{o}*C*. It is a rural area near the University of Dschang, with most of the inhabitants being farmers. The population is about 124 880 people with a growth rate of 6.8% per year of which 'Bamilikes' constitute more than 90 % of inhabitants [20]. Most of the inhabitants do not have access to potable water and have resorted to wells or streams as their only source of drinking water which is not often treated. In addition, poor housing and poor hygienic conditions help in the spread of most parasitic infections. Penka-Michel has many secondary hospitals including 4 of reference with high capacity of reception and wide variety of patients; the District Medical Center of Balessing (CMA-B), the District Medical Center of Bansoa chefferie (CMA-BC), the District Medical Center of Eglise Evangelique du Cameroun (CAA-EEC) and the District Hopital of Penka-Michel. This work was carried out in the four reference hospitals listed above. By selecting this four reference hospital, we believe our sampling was largely representative of all categories of patients in this rural setting.

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2.2. Study population

Pregnant women of ages 15-50 years attending the [illegible] pril to July 2014 participated in the study. The study protocol h[illegible] National Ethical Committee on human health research in Cameroon before carry out experiment. Informed consent was obtained from all volunteers pregnant women who fulfilled the eligibility criteria for the study. Each pregnant woman was interviewed using a standard questionnaire. The questionnaire contained socio-demographic data on age of the women, age of the pregnancy, educational level, occupation, gravidity and related risk factors including obstetrical history (total number of pregnancy and abortions*),* frequency of meat consumption (a few meals in a week as more frequent, a few meals in a month as frequent and seldom/never) and type of meat (beef, lamb, chicken, pork, delicatessen)*,* vegetables and fruits (raw or not), cooking preferences (raw or undercooking-if the center is still raw or if the center is still pink, well-done-if no pink meat is seen), owning cat (outdoor or indoor)*,* soil exposure (occupation or hobby) and knowledge on toxoplasmosis*.*

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2.3. Specimen collection and laboratory a

Venous blood was collected by venepuncture respecting all aseptic techniques. A blood sample of about 3-4ml was collected and rapidly transferred into a labeled dry tube. The samples were transferred to the laboratory and centrifuged at 3000 rpm for 5 min and serum separated from red cells, labeled and stored between - 2 to - 8 ^{o} C for samples that were to be processed 2-7 days from the collection date. Serum samples were analyzed using an indirect solid-phase enzyme immunoassay (EIA) using immunoComb® Toxo lgG set (Orgenics, France) in order to identify the presence of immunoglobulin IgG. Antibody levels were evaluated following the instructions of the set manufacturers. The level of anti-Toxo IgG in each specimen was assessed by comparing the color intensity obtains, with the color scale on the CombScale provided with the kit and were expressed in titers (<10, > 10, >50 and >100 IU/L). A titer more than 10 IU/ml was taken as positive results in the current study as recommended by the manufacturers.

2.4. Statistical assessment

The data collection forms were first checked for completeness, obvious errors and inconsistencies which were corrected before they were entered into a computer and double checked. The descriptive data was given as mean ± standard deviation (SD). Using GraphPad prism version 5.03, the data were analyzed with chi-square and presented as appropriate. The differences were considered to be statistically significant when the p-value obtained was less than 0.05. The analysis was focused on determining the prevalence of *Toxoplasma gondii* lgG antibodies among pregnant women in our study population and their association with socio-demographic and predisposing risk factors for maternal infection.

3. Results

3.1. Sociodemographic characteristics

A total of 643 participants were enrolled in the study. The age range of the women was 15-50 years with a mean of 27.1 ± 2.51 years. Over 92 % of the women possessed primary and secondary levels of formal education. Forty seven percent (47.43 %) of the total study participants were housewives followed by farmers (24.72 %). More than half (50.7%) of study participants was in their third trimester of pregnancy. In relation to gravidity, most of the subjects were multiparous (76.04%), whereas few of them had more than 6 children (18.20%) (Table 1).

3.2. Seroprevalence of toxoplasmosis

The prevalence of toxoplasmosis was found to be 35.77% (230/643) in the study population. This prevalence of *T. gondii* was subsequently used to test their association with socio-demographic parameters and known risk factors for toxoplasmosis infection.

The strength of the association between women's occupation and Toxo IgG seropositivity status was statistically significant (P = .0100), with a significantly higher risk of being seropositive amongst farmers and housewives, relative to those in other occupation groups. Our findings showed that 41.66 % and 39.01 % of farmers and housewives were respectively seropositive for Toxo IgG (Table 2). Moreover, we observed a significant difference between the prevalence of toxoplasmosis and educational level (Table 2). The prevalence of *T. gondii* infection among women with university level of education was higher (70%) than that of the others educational groups (P = .0082).

As regards the age groups, the 21 to 25 years age group constitutes 25% of the total population. Toxo-IgG positivity was higher amongst women of age group 41+ (12/21;

57.14%), following by those of age group 26-30 (65/155; 41.93%) (Figure 1), however, this difference was not statistically significant (P = .0749).

Figure 2 shows the relationship between gravidity and Toxo IgG seropositivity status in the study population. The mean gravidity was 3.7 ±1.1. The prevalence of Toxo-IgG were 34.41% (53/154) and 36.19 % (177/489) among primigravidae and multigravidae females respectively. One hundred and seventy seven (77 %) of the 230 pregnant women that were seropositive to Toxo-IgG were multiparous. There was a positive relationship between gravidity and Toxo IgG seropositivity status, which was not statistically significant (P = .6878).

In terms of gestational age, 63 (9.8%) of the women were in the first trimester of gestation while 254 (39.5%) and 326 (50.7%) were at secondary and tertiary trimester respectively. The mean gestational age was 6.22 ±1.93 months. Table 3 shows the Toxo IgG seropositivity status of the women in accordance of the gestational age. Among the 230 Toxo-IgG positive women 31.74, 37.79 and 34.96% were respectively in the first, second and third trimester of gestation. There was no a significant different between gestational age and seropositvity (P = .6640).

Table 4 shows the variation of toxoplasmosis with the predisposing risk factors. In our study, we observed the potential impact of risk factors on the prevalence of toxoplasmosis. Based on our epidemiological data, we observed a high frequency of raw vegetables or fruit consumption (145/374; 38.77%) in serologically positive women in comparison with women whom did not used to (85/269; 31.59%), but these difference were not statistically significant (P = .0667). We also observed an increased seropositivity in women that was related to history of abortion (58/148; 39.18%), although this was no statistically significant (P = .3813). No correlation was found between cat owners as risk factor and prevalence of Toxo-IgG (P = .5594). The seroprevalence was almost the same among those who were exposed (92/268; 34.32%) compared to those who were not exposed (138/375; 36.8%) to this risk factor. A similar result was obtained when considering the frequency of meat consumption as predisposing risk factor (P = .4281). There was an inverse relationship between type of meat consumption and toxo IgG seropositivity status with a higher risk of being infected amongst women who consumed one meat type regularly (76/185; 41.08 %), relative to those who consumed more than one meat type (154/458; 33.62%), although the difference was not statistically significant (P = .0842). However, we observed a significant high frequency of raw meat consumption (71/156; 45.51%) in seropositive women in comparison with non exposed women (P = .0426). We also noticed a significant (P = .0001) inverse relationship between had knowledge on toxoplamosis and seroprevalence status, with women who had knowledge on toxoplasmosis showing the highest positivity (43/63; 68.25 %) than those without knowledge (187/580; 32.24%).

4. Discussion

The overall prevalence of toxoplasmosis was found to b tudy population. Previous studies done in Yaoundé, an urban se umbe *et al.* in 1992 [19] and by Njunda *et al.* in 2011 [5] shown the seroprevalence of 77.1% and 65.5% respectively, indicating that the prevalence of *T. gondii* appears to be more concentrated in high density areas especially cities and towns, like Yaoundé. The prevalence of toxoplasmosis can vary among different groups and these differences have also been seen between rural and urban regions. Some studies determined a higher prevalence in rural

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regions [21], while others did not show any difference between urban and rural inhabitants [22]. The seroprevalence we found correlates with the [illegible] done in others countries. In Bobo Dioulasso-Burkina Faso, a sero[illegible]osis during pregnancy showed Toxo-IgG seropositivity of 31% [illegible]24], 30.1% in Aydin province-Turkey [25], 38.01% in Iran [26] [illegible] [27] all among pregnant women. However, our results are less compare to those found in others study; a hemagglutination test found antibodies in 54% of blood donors in Kenya [4], in Gabon 56% at Franceville [28] and 60% at Libreville [29], in Dakar-Senegal 50% [30] all among pregnant women, and in Yopougon (Abidjan) 60% among the women in child-bearing age using indirect immunofluorescent test [31]. Moreover, an increased prevalence of toxoplasmosis was demonstrated in studies conducted in many others regions; in Brazil an EIA method found a prevalence of 79.9% in men and of 6[illegible] [32], in the Democratic Republic of Sao Tome 75.2% [33]. The di[illegible]served between the pr[illegible]tioned studies c[illegible] setting and study po[illegible] correlates with dietary habits, as well as with improvements[illegible]ity or [illegible]ever, this difference may also due to the availability of differ[illegible]mperature and humidity that favor the sporulation, longe[illegible]s, since it has been reported that infection is more com[illegible]wer altitudes than in cold climates and mountainous regions [9]. The prevalence of toxoplasmosis in the human population is also associated with exposure to risk factors. An increased prevalence of toxoplasmosis is detected in people who are often in contact with soil, who eat raw or insufficiently heat treated meat or raw vegetables, or who lack basic personal hygiene or have unhygienic food preparation [34].

In accordance with other studies showing that prevalence increases with age [13, 35], our results showed that the highest number of seropositive women was within the age group 41+ (12/21; 57.14%), followed by those within the age group 26-30 (65/155; 41.93%), however, this difference was not statistically significant ($P = .0749$) (Figure 1). This age group is made of the oldest pregnant women of our sample and thus indicates the possibility that the risk of exposure increases with age through continuously exposition. This result is in agreement with those obtained in France by Berger *et al.* 2007 [35], in Senegal by Coulibaly 2012 [30] and in Gabon by Mpiga *et al.* 2010 [28] where the highest number of seropositive women was within the age group 40-54 (58.2%), 40+ (66.6%) and 35-44 (62%) respectively.

We also found a positive relationship between gravidity and Toxo IgG seropositivity status, which was not statistically significant ($P = .6878$) (Figure 2). Seventy seven percent (177/230) of the 230 pregnant women that were seropositive to Toxo-IgG were multiparous. A similar relationship were obtained by Berger *et al.* 2007 [35] who found a seroprevalence of 46.1 % among multigravidae vs 39,4 % among primigravidae females in his study population. This once more highlights the fact that risk of exposure increase with age with is correlates with gravidity.

In the previous studies, lower educational level, soil-related occupations [13], eating raw or unwashed vegetables or fruits, cleaning the cat litter box [36], having poor hand hygiene [34], were all found as risk factors for toxoplasmosis. These factors were assessed in the current study; however, no relation was found among much of them. The assessment of risk factors was done according to information given by the participants. Some issues such as hygienic behaviour might be misrepresented (hidden) because of shaming or other factors. However, an improvement in the quality of data was attempted by using district midwifes who were familiar and trusted by the women during data collection.

In the current study, statistical meaningful difference was observed between professional groups for toxoplasmosis seroprevalence ($P = .01$) with the highest risk of being seropositive

amongst housewives (39.01 %) and farmers (41.66 %), relative to th groups (Table 2). This may be interpreted by the fact that housewives being in direct contact with infection through handling and preparing of food (contamin meat and vegetables) in addition to cleaning of house garden contaminated wit fection with toxoplasmosis. Similarly, the highest risk of being 41.66 %) may be explained by continuous exposure of wom nfection through their routine works like gardening, conta nwashed vegetables and fruits and drinking water from con tion to the widespread of stray cats which play an essential ro ection [9].

One would have expected a positive relationship between educational status and Toxo-IgG seropositivity with less educated women showing the highest positivity because of lack of knowledge concerning contraction routes or risk factors of toxopla fection. However, the reverse was the case as the prevalence was signifi with university level of education (14/20; 70%) than that o P = .0082) (Table 2). This distribution of prevalence who found the highest prevalence of Toxo-IgG (46 of education. Such variations may imply that posses as a risk factor for toxoplasmosis infection, sinc ome knowledge on toxoplasmosis had university level ght the fact that after finishing with schooling, women do not apply their back ground knowledge in their daily lives, probably due to unemployment since the majority of them were housewives (47.33%) (Table 1). Moreover, we also observed a controversial significant increase in the frequency of Toxo-IgG antibodies with respect to knowledge on toxoplasmosis implying that those women might have known of toxoplasmosis ever before they became informed of it. This distribution of prevalence was similar to the findings of Njunda *et al*. 2011[5] who found the highest prevalence of Toxo-IgG (87.5%) among women with knowledge on toxoplasmosis. This emphasizes once more on the need of sensitization and education activities of the Cameroonian population regarding the risks involved in toxoplasmosis transmission and the importance of preventive strategies by our health authorities.

Our findings show that women in the second (37 trimester (34.96%) of gestation were slightly more infected than th and the mean gestational age was 6.22 ± 1.93 months. *T. gondii* infection increases with gestational age and last week of gestation [8]. In addition, the severity of f gestational age at which maternal infection occurs [8]. Th of seropositive women were in the second and third tri of gestation suggest that there could be a possibility of transmission to neonates within this community. This emphasizes the need to equip mothers with knowledge to prevent toxoplasmosis infection and to establish a program which allow all pregnant women to be screened during their first trimester in order to allow timely treatment, where necessary. It further indi highlights the present inadequacy of community sensitization activities by our health autho ian population about toxoplasmosis infection, and the import

Frequent consumption and type of meat (pig, sh as the principle risk factor in several recent studies of *T.* No relation was observed between seroprevalence and type ent study although, in Penka-Michel, beef, chicken and pork are commonly consumed. The cooking temperature of meat is an important issue in the infection of *T. gondii*. Consumption of raw or undercooked meat containing viable cysts, water contaminated with oocysts from cat feces, and unwashed vegetables are the primary routes of oral transmission; improper handling of undercooked meat or contaminated soil also may lead to hand-to-mouth infection

needs to check sentence construction

Are you sure it should be a positive relationship?? need to check

very speculative and should not be a conclusion at all needs to be taken out. where is the proof of this assertion??

no i do not agree….reasoning is not sound

do you know the cost benefit analysis of the screening being proposed?? are you sure your paper has enough proof to

[3]. In the current study, we observed a significant high frequency of raw meat consumption (71/156; 45.51%) in seropositive women in comparison with not exposed seropositive women (P = .0426). Thorough cooking as well as habit to eating at home is always preferred in Penka-Michel. However, 'Bamilikes' who constitute more than 90% of inhabitants of Penka-Michel usually consumed undercooked chicken meat in their traditional practice as 'bab si' which is a mixture of roasted chicken meat and palm oil.

In the current study, no relation was detected between cat owners as risk factors and prevalence of Toxo-IgG (P = .5594). The association of cat owners and human toxoplasmosis is difficult to assess by epidemiological surveys because soil, not the cats, is the main culprit. Oocysts are not found on cat fur and are of[illegible] with cat feces, and soil contact is universal and difficult to avoi[illegible]

This paper does not provide enough evidence for such a conclusion it merely adds onto the literature on the subject. Revise the conclusion

Conclusion

Seventy three percent of seropositive[illegible]erm of pregnancy, indicating a possibility of congenital t[illegible]hin our community. Health authorities, especially primary[illegible]ensitive to the importance of the issue. All pregnant women should be screened for toxoplasmosis and educated on predisposing risk factors during antenatal visits.

Consent statement

Informed consent was obtained from all individual participants included in the study.

Ethical statement

The studies have been approved by the National Ethical Committee on human health research in Cameroon (Ethical clearance N^0 2014/03/425/L/CNESRH/SP) and have been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments.

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Table 1: Demographic characteristics of the study participants (n = 643)

Demographic characteristics	Number (%)
Age (years) (Mean = 27.1; SD = 2.51)	
15-20	111 (17.3)
21 – 25	161(25)
26 – 30	155(24.1)
31 – 35	125(19.4)
36-40	70(10.9)
41+	21(3.3)
Educational status	
No formal education	29 (4.5)
Primary	232 (36.1)
Secondary	362 (56.3)
University or beyond	20 (3.1)
Occupation	
Housewives	305 (47.4)
Traders	31 (4.8)
civil servants	77 (11.97)
Students	74 (11.5)
Farmers	156 (24.7)
Gravid status	
Primigravidae	154 (23.95)
Multigravidae	489 (76.05)
Gestational age	
1st trimester	63 (9.8)
2nd trimester	254 (39.5)
3rd trimester	326 (50.7)

Table 2: Variation of *Toxoplasma gondii* seropositivity with educational and professional status in pregnant women (n = 643).

Socio demographic characters	Total tested No (%)	Positive No (%)	Negative No (%)	χ2 ; df	P-value
Educational status					
No formal education	29	13(44.82)	16(55.17)	11.77 ;	0.0082
Primary	232	77(33.18)	155(68.81)	3	
Secondary	362	126(34.80)	236(65.19)		
University or beyond	20	14(70)	6 (30)		
Occupation					
Housewives	305	119 (39.01)	186 (60.98)	13.28 ;	0.0100
Traders	31	8 (25.80)	23(74.19)	4	
civil servants	77	22 (28.57)	55 (71.42)		
Students	74	16 (21.62)	58(78.37)		
Farmers	156	65 (41.66)	91(58.33)		

Table 3: Seropositivity status of the women in accordance of the gestational age.

Gestational age	Total tested No (%)	Total Toxo-IgG+ No (%)	X^2	P value
1st trimester	63 (9.8)	20 (31.74)		
2nd trimester	254 (39.5)	96 (37.79)		
3rd trimester	326 (50.7)	114(34.96)	0.8182	0.6640
Total	643	230 (35.76)		

Table 4: Variation of *Toxoplasma gondii* seropositivity with predisposing risk factors in pregnant women (n = 643).

Toxoplasmosis risk factors	Total tested No (%)	Positive No (%)	Negative No (%)	OR (95% CI)	P value
History of abortion					
Abortion	148	58 (39.18)	90 (60.82)	1.189	0.3813
No abortion	495	172 (34.74)	323 (65.26)	(0.815-1.736)	
Knowledge on toxoplasmosis					
Had knowledge on toxoplasmosis	63	43 (68.25)	20 (31.75)	4.518 (2.585-7.898)	0.0001
Had no knowledge on toxoplasmosis	580	187 (32.24)	393 (67.76)		
Eating raw vegetable and fruits					
Yes	374	145 (38.77)	229 (61.23)	1.371	0.0667
No	269	85 (31.59)	184 (68.41)	(0.9847-1.908)	
Proximity to cats					

Contact with cats	268	92 (34.32)	176 (65.68)	0.8977	0.5594
No contact with cats	375	138 (36.8)	237 (63.2)	(0.6466-1.246)	
Eating raw or undercooked meat					
Yes	156	71 (45.51)	85 (54.48)	0.6170	0.0426
No	487	159 (32.64)	328(67.37)	(0.3900-0.9760)	
Meat consumption					
One meat type	185	76 (41.08)	109 (58.92)	1.376	0.0842
More than one meat type	458	154 (33.62)	304 (66.38)	(0.9686-1.958)	
Frequency of meat consumption					
more frequent	150	50 (33.33)	100 (66.66)	X^2 1.697	0.4281
Frequent	258	100 (38.75)	158 (61.24)		
Rare	235	80 (34.04)	155 (65.95)		

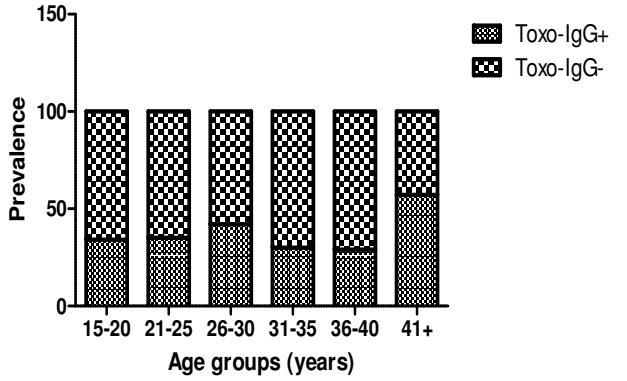

Figure 1: Relationship between age group and *Toxoplasma gondii* seropositivity status in the study population.

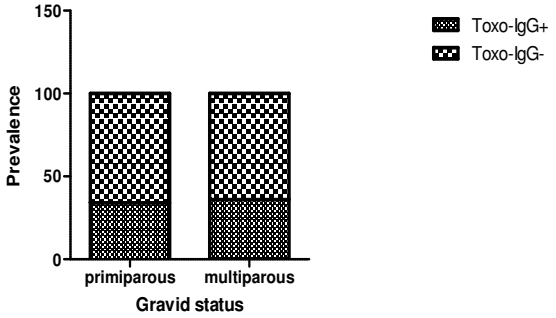

Figure 2: Relationship between gravidity and *Toxoplasma gondii* seropositivity status in the study population.