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Sero-Prevalence of Anti-Toxoplasma Antibodies IgM and IgG among Blood Donor in Benghazi, Libya: A Prospective and Cross-Sectional Study

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Abstract

Introduction: In our study asymptomatic *Toxoplasma gondii* parasitemia has been documented in donor blood in the national blood transfusion center, Benghazi. However, donated blood is not routinely screened for a protozoan parasite *Toxoplasma gondii*.

Objective: To evaluate seroprevalence of *T. gondii* infection among blood donors of Benghazi, Libya and identify characteristics of blood donors associated with seropositivity.

Methods: A prospective-cross-sectional study involved 600 healthy blood donor samples randomly collected from volunteer testing to demonstrate the presence of *T. gondii* antibodies, Elisa test was used to determine the presence of anti *T. gondii* IgG and IgM antibodies parasitemia, during the period from March 2013 to May 2013 The mean age of the blood donors was 32.85 years and the age range was between 18 and 62 years in the national blood transfusion center blood bank, Benghazi city.

Results: The result revealed that the overall infected donor was 280 (46.7%) and the non-infected donor 320 (53.3%), only 98 (16.3%) of the 600 samples tested positive for acute toxoplasmosis, which is indicated by the presence of IgM antibodies. While 253 (42.2%) of the samples had chronic toxoplasmosis, which is only present when IgG antibodies are positive, with highly significant differences between them ($p<0.01$). In relation to the age group, the results showed high positive percentage samples, 30 (50%) in ELISA-IgG test at the age group of (40-51) years, whereas the lowest one was 7(31.2%) as noticed at the age group of (18-28) years. There was a significant difference between them (P=0.00). While ELISA-IgM showed variable results characterized by the presence of high percentage 3 (17.7%) at the age group of (18-28) years and the lowest 1 (10.5%) at the age group of (52-62) years, with a significant difference between them (P=0.00). With a high significant between them (P=0.00). There was no significant difference between them (P=0.485) Seroprevalence rate of *T. gondii* IgM level among 560 tested males donors was 95 (16.96%) and among 40 tested females donors was 3 (7.55%) with no significant difference between them IgG p=0.107 IgM p=.118. The frequencies of ABO blood group phenotypes, with respect to results of the serological test (positive IgG and/or IgM and negative) for anti-*T. gondii* antibodies do not demonstrate statistically significant differences IgG=P=0.243I; gM=p=P=0.112.

Conclusions: It is concluded that a high seroprevalence of *T. gondii* in healthy voluntary donors in Libya. As well as, it may be suitable to include screening investigation (ELISA) for *T. gondii* also in the pre-transfusion blood testing schedule.

Keywords: Blood donors; Serology; ELISA; Blood transfusion; *Toxoplasma gondii;* Immunoglobulin M; Immunoglobulin G

Introduction

The majority of attention has been focused on infections of the blood supply. Although it is extremely safe, the risk of transfusion transmitted disease is not zero. Blood transfusions are a common medical procedure in which blood is injected into a patient's body *via* a narrow tube connected to a vein in their arm or hand. *Toxoplasma gondii* is a parasitic protozoan that can be carried by most warm blooded animal species and infects nearly one-third of the world's human population [1]. Although toxoplasmosis is found worldwide, the seroprevalence of *T. gondii* infection varies greatly between countries (10%-80%) and even within a single country [2]. *T. gondii* infections are usually mild and self-limiting in immunocompetent people. However, severe disease and complications can occur in immunocompromised people and newborns [3]. Food borne transmission (consuming undercooked, contaminated meat), animal to human transmission (ingesting oocysts shed in the feces of infected cats) and vertical transmission from mother to fetus through the placenta during pregnancy are the three main routes of infection. *T. gondii* can also be transmitted through blood transfusion [4]. Toxoplasmosis appears to be transmitted through blood or leukocyte transfusions, especially if parasitized leukocytes are transfused in high concentrations

[5,6]. Since *T. gondii* may be alive in the citrated blood at 5°C for up to 50 days and the buffy coat, multiple units of blood from different donors are regularly used in children with thalassemia, sickle cell anemia and a plastic anemia who need regular, frequent and multiple transfusions for survival. Many studies have found a high prevalence of *T. gondii* antibodies in healthy voluntary blood donors and while screening for *T. gondii* antibodies before transfusion blood is not currently being considered, the information about the epidemiology of *T. gondii* infection in blood donors is low. The epidemiology of T. *gondii* infection has been poorly studied in Libya. In Libya, a few previous research on the seroprevalence of *T. gondii* antibodies has concentrated on specific populations, such as pregnant women 9.1 [7]. Seroprevalence rates among pregnant women in Libya were documented as 27.5% to 34.1% [8,9]. The seroprevalence of toxoplasmosis in Benghazi, however, was found to be as high as 41.7%.

This study aims to investigate the seroprevalence of Toxoplasma antibodies (IgM, IgG) in blood donor sera from a blood transfusion center by the Enzyme Linked Immunosorbent Assay (ELISA) in Benghazi, Libya; and investigate the relationship between this disease (acute, chronic) and associated risk factors among healthy blood donors.

Materials and Methods

Data collection

A questionnaire was filled for each subject and the data were collected after convenient interview. The questions included: Personal information, demography data, social and economic data, nutritional behavior and health data (Index).

Design and setting: A prospective and cross-sectional study six hundred blood samples were collected from healthy blood donors (males and females) in the national blood transfusion central blood bank, Benghazi city, during the period from March 2013 to May 2013. The mean age of the blood donors was 32.85 years and the age range was between 18 and 62 years.

Sample preparation and preservation

Latex agglutination test: Totally, 600 randomly selected samples were collected from healthy blood donors. About five ml of venous blood was collected from each five mL of blood samples from 600 healthy blood donors were randomly selected for serological testing in sterile containers and tested for blood groups detection

Anti-A, B blend test

- According to the manufacturer's procedure.
- Anti-D blend.
- A slide test based on the agglutination method for Rhesus (Rh) typing in serum using.
- A monoclonal/polyclonal blend reagent.

Serological testing: One of the few methods frequently used in the detection of *T. gondii* infection in humans and animals is Enzyme-Linked Immunosorbent Assay (ELISA). The presence of antibodies to *T. gondii* was determined by the conventional ELISA technique, according to the manufacturer,s instructions (Biokit Diagnostics Company, Spain). The optical density of IgG antibody titers were read at 450 nm using automatic ELISA reader (BioTek Plate Reader, Spain); Divide the sample absorbance by the cut-off value. Positive ≥ 1.0 , Negative <0.9 ,E quivocal ≥ 0.9 <1.0

Data nalysis Statistical Package for Social Sciences (SPSS) Version 17 and MedCalc (statistical software) were used for the analysis. A *chi-square* test was used to analyze the distribution of ABO and Rh blood groups.

Results

The current study was to estimate the actual percentage of toxoplasmosis in blood donors in national blood transfusion center 'blood bank center in Benghazi. Libya, by using more specific tests ELISA IgM and IgG antibodies. The results revealed that overall infected donor 280 (46.7%) and non infected donor 320 (53.3%). Out of 600 samples only 98 (16.3%) had acute toxoplasmosis characterized by the presence of positive IgM antibodies. While 253 (42.2%) of samples had chronic toxoplasmosis characterized by the presence of positive IgG antibodies only. with high significant differences between them (p<0.01) (Table 1).

Table 1: Seroprevalence of Toxoplasma gondi specific antibodies of blood donors from blood bank center according to ELISA test.

Toxoplasma-Ab/ Examined no	Non-infected	Infected	Total	Statistical analysis	
				OR	(P value)
	320 (53.3%)	280 (46.%)	600	-	p<0.01.
Chronic toxoplasmosis IgG antibodies	347 (57.8%)	253 (42.2%)	600	OR=0.83	p<0.01.
Acute toxoplasmosis IgM antibodies	502 (83.7%)	98 (16.3%)	600	OR=0.22	p<0.01.

Note: IgG: Immunoglobulin G; IgM: Immunoglobulin M; Ab: Antibodies; OR: Odd Ratio

Seroprevalence of toxoplasma antibodies according to age groups and gender

The results showed that Seroprevalence of *T. gondii* IgG level among blood donor at age groups 18-28, 29-39, 40-51, 52-62 was 31.2%, 49.1%, 50% and 47% respectively. While seroprevalence rate of *T. gondii* IgM at age groups 18-28, 29-39, 40-51 and 52-62 were 17.7%, 17.4%, 12.0% and 10.5% respectively. In relation to age group the results showed high positive percentage samples, 30 (50%) in ELISA IgG test at age group of (40-51) years, whereas the lowest one was 7 (31.2%) as noticed at the age group of (18-28) years. There was a significant difference between them (P=0.00). While, ELISA-IgM showed variable results characterized by the presence of high percentage 3 (17.7%) at the age group of (18-28) years and the lowest 1 (10.5%) at the age group of (52-62) years. There was no significant difference between them (P=.485) (Table 2). The results revealed that Seroprevalence of *T. gondii* IgG level among 560 tested blood donors males was 241 (43.03%) and among 40 tested females donors was 12 (30%). On the other the Seroprevalence rate of *T. gondii* IgM level among 560 tested males donors was 95 (16.96%) and among 40 tested females donors was 3 (7.55%).

Table 2: Seroprevalence of IgG and IgM *Toxoplasma gondi* specific antibodies by age and gender among blood donors from blood bank centre according to ELISA test.

Age/Mean ± SD 32.85 (29 ± 16)	Examined No.	IgG infected	IgM infected	CI (95%)
18-28	237	74 (31.2%)	42 (17.7%)	9.540%-11.523%
29-39	236	116 (49.1%)	41 (17.4%)	5.043%-5.747%
40-51	108	54 (50%)	13 (12.0%)	5.010%-4.947%
52-62	19	9 (47.4%)	2 (10.5%)	2.304%-2.217%
Gender				
Males	560	241 (43.03%)	95 (16.96%)	IgG=X^2=2.601, df=1, p=0.107
Females	40	12 (30%)	3 (7.55)	IgM=X^2=2.447, df=1, p=0.118
Total examined	600	253	98	-

Seroprevalence of *T. gondii* infection according to blood groups

Seroprevalence of *T. gondii* infection according to blood groups: In this study the relationship between Seroprevalence of anti *T. gondii* IgG and IgM antibodies and blood groups revealed that, the Seroprevalence rate of IgG to: A negative tested 33 was 15 (45.45%), A positive tested 190 was 79 (41.6%), AB positive tested 30 was 18 (60%), B negative tested 17 was 6 (35.3%), B positive tested 115 was 51 (44.3%), O negative tested 31 was 8 (25.8%) and O positive tested 177 was 27 (40.7%); and the Seroprevalence rate of IgM to: A negative tested 33 was 3 (9.1%), A positive tested 190 was 28 (14.7%), AB negative tested 7 was 0 (0.0%), AB positive tested 30 was 7 (23.3%), B negative tested 17 was 1 (5.9%), B positive tested 115 was 28 (24.3%), O negative tested 31 was 5 (16.1%) and O positive tested 177 was 26 (14.6%). The frequencies of ABO blood group phenotypes, in respect to results of the serological test (positive IgG and/or IgM and negative) for anti-*T. gondii* antibodies do not demonstrate statistically significant differences. Seroprevalence of *T. gondii* infection according to blood groups: In this study the relationship between Seroprevalence of anti *T. gondii* IgG and IgM antibodies and blood groups revealed that, the Seroprevalence rate of IgG to: A negative tested 33 was 15 (45.45%), A positive tested 190 was 79 (41.6%), AB positive tested 30 was 18 (60%), B negative tested 17 was 6 (35.3%), B positive tested 115 was 51 (44.3%), O negative tested 31 was 8 (25.8%) and O positive tested 177 was 27 (40.7%) and the Seroprevalence rate of IgM to: A negative tested 33 was 3 (9.1%), A positive tested 190 was 28 (14.7%), AB negative tested 7 was 0 (0.0%), AB positive tested 30 was 7 (23.3%), B negative tested 17 was 1 (5.9%), B positive tested 115 was 28 (24.3%), O negative tested 31 was 5 (16.1%) and O positive tested 177 was 26 (14.6%) (Table 3). The frequencies of ABO blood group phenotypes, in respect to results of the serological test (positive IgG and/or IgM and negative) for anti-*T. gondii* antibodies do not demonstrate statistically significant differences.

Table 3: Seroprevalence of IgG and IgM *Toxoplasma gondi* specific antibodies of blood donors from blood bank centre according to ABO phenotypes by ELISA test.

ABO phenotypes	Examined No.	IgG infected	IgM infected
A negative	33	15 (45.45%)	3 (9.1%)
A positive	190	79 (41.6%)	28 (14.7%)
AB negative	7	4 (57.1%)	0 (0.0%)
AB positive	30	18 (60%)	7 (23.3%)
B negative	17	6 (35.3%)	1(5.9%)
B positive	115	51 (44.3%)	28 (24.3%)
O negative	31	8 (25.8%)	5 (16.1%)
O positive	177	72 (40.7%)	26 (14.6%)
Total	600	253	98
		X^2=15.596, df=10, P=0.0112	X^2=12.662, df=10, P=0.243

Seroprevalence of *T. gondii* infection according to occupation

The relationship between Seroprevalence of *T. gondii* IgG and IgM antibodies and occupation of blood donors revealed that the presence of anti-toxoplasma IgG antibodies in priva te workers was 42.1% (53/126), no job was48.6% (51/105), student was 27.4% (17/62) and governmental workers was 43.0%(132/307) and seroprevalence rate of *T. gondii* IgM level in private workers was 18.25% (23/126), No job was 18.09%(19/105), student was 20.96% (13/62) and those having governmental workers was 14.0% (43/307). Toxoplasmosis in those without job which showed included in this study, higher percentage 51 (48.6%) than those having governmental workers 132 (43.0%), private workers was 53 (42.1%) and student 17 (27.4%) in the presence of anti-toxoplasma IgG antibodies. While the presence of anti-toxoplasma IgM antibodies, this result revealed higher percentage 13 (20.96%) in student and 23 (18.25%) in private workers, without job 19 (18.09) and 43 (14.0%) hose having governmental workers. There was significant differences between them (P<0.01) (Table 4).

Table 4: Seroprevalenceof IgG *Toxoplasma gondi* specific antibodies their occupation of blood donors from blood bank center according to ELISA test.

Occupation	Examined no.	IgG infected	IgM infected
Private	126	53 (42.1%)	23 (18.25%)
No Job	105	51 (48.6%)	19 (18.09%)
Student	62	17 (27.4%)	13 (20.96%)
Governmental workers	307	132 (43.0%)	43 (14%)
Total	600	352	98
		(P<0.02)	(P<0.01)

Seroprevalence of *T. gondii* IgG and IgM antibodies in relation to nationality: The results reveald that Seroprevalence of *T. gondii* IgG in Libyan tested 544 was 233 (42.8%) and non-Libyan tested 56 was 20 (35.7%) and Seroprevalence of *T. gondii* IgM in Libyan tested 544 was 91 (16.7%) and non-Libyan tested 56 was 7 (12.5%). The seroprevalence rate of infection IGg and IgM antibodies were highest in Libyan tnan non Libyan (Table 5). IgG=X^2=13.705, df=13, P=0.395, IgM=X^2=12.759, df=13, P=0.467.

Table 5: Seroprevalence of IgG and IgM *Toxoplasma gondi* specific antibodies of blood donors from blood bank centre according their nationality.

Nationality	No. exam	IgG infected	IgM infected
Libyan	544	233 (42.8%)	91 (16.7%)
Non libyan	56	20 (35.7%)	7 (12.5)
Total	600	253	98

Seroprevalence of *T. gondii* IgG and IgM antibodies in relation to regions: In this study the incidence of *T. gondii* IgG and IgM antibodies in correlation to region are showed that incidence of *T. gondii* IgG in Benghazi tested 453 was 195 (43.1%) and out Benghazi tested 147 was 58 (39.45%); and incidence of *T. gondii* IgM in Benghazi tested 453 was 79 (17.4%) and out Benghazi tested 147 was 19 (12.9%) (Table 6).

Table 6: Seroprevalence of IgG and IgM *Toxoplasma gondi* specific antibodies of Blood donors from blood transfusion center according to region.

Regions	No. examined	IgG infected	IgM infected
In Benghazi	453	195 (43.1%)	79 (17.4%)
Out of Benghazi	147	58 (39.45%)	19 (12.9%)
Total	600	253	98

Discussion

Toxoplasmosis is a very common parasitic disease caused by an obligate intracellular protozoon parasite spread among young adults in different parts of the world. An acute infection of toxoplasmosis can be transmitted transplacentally during pregnancy from mother to fetus [8]. In various regions of the world, the percentage of toxoplasma antibodies among young adults varies from 5% to 95% [9]. Due to the *T. gondii* parasites' ability to resist at 4°C and for a period of fifty days, there is a high risk of infection spreading to recipients during blood transfusion. To our knowledge, this is the first study to be carried out on the seroprevalence of *Toxoplasma gondii* among healthy blood donors. Six hundred random healthy blood donors from the blood bank center were tested by ELISA to determine the *T. gondii* infection (IgG and IgM antibodies for *T. gondii*). The results revealed that the overall seroprevalence of toxoplasma antibodies among apparently healthy blood donors was 46.7% by ELISA test. This rate is comparable to previous reports at 41.7% and 43.6% [10]. The present finding was higher than previous reports, 3.4%, 3.7% [11]. On the other hand, the present results are lower than other results by 52.1% [12]. The reason for similarities and differences refers to the regional variations in the seroprevalence of *T. gondii* rates from one to another country or even within the same country. This variation has been attributed to climate, cultural differences pertaining to hygiene and feeding habits [13]. The seroprevalence of *Toxoplasma gondii* IgG and IgM antibodies was 42.2% and 16.3%, respectively, compared to previous reports of 7.4% and 1.9% 20.3 and 3.6 for IgG and IgM antibodies, respectively [14]. Different researchers' explanations for previous percentage differences may be related to *T. gondii*. Seropositivity in the human population. It varies greatly across geographical areas within a single country and even within a single city. These differences may be related to several other factors, including cultural level, nutritional habits, age and rural or urban area, even to the use of different kit origins. The current study showed that the infection increases with age. The results showed a high percentage of positive IgG samples (30, 50%) by ELISA test at the age group of 40-51 years, whereas the lowest one was (31.2%) at the age group of 18-28 years. While IgM showed variable results distinguished by the presence of a high percentage (17.7%) in the age group 18-28 years and the lowest.(10.5%) at age group 52-62 years. This finding is in agreement with previous results, for IgG was 52.9% in age group 41-50 years and the lowest percentage(15%) at age group <20, the highest infection rate occurred in age group (31-35) years. Similar findings have been reported by some studies, that incidence of toxoplasma infection is well known to increase with age [15,16]. On the other hand, the present results disagree with some previous results from different regions [17]. These differences between several previous results and our results may be due to the specificity and sensitivity of the immunodiagnostics method and the immune response of each host to the parasitic strain [18]. Furthermore, the IgM antibody was located near the middle age group, meaning the donors in this group had a recent infection by *T. gondii*, this infection may have come from drinking contaminated water, vegetables or by eating raw infected meat. Whereas the previous infection IgG antibody was found in donors aged 41-50 years, this indicates that the donors in this age group had previously been infected by the infective agent toxoplasma parasite, which causes an immune response and the formation of memory cells for the parasite [19]. The IgM antibody was in the middle age group, meaning the donors in this group had a recent infection by *T. gondii*. This infection may have come from drinking

contaminated water or vegetables or from eating raw infected meat. Whereas the previous infection IgG antibody was found in donors aged 41-50 years, this indicates that the donors in this age group had previously been infected by the infective agent toxoplasma parasite, which causes an immune response and the formation of memory cells for the parasite. The results revealed that th IgM antibody was in the middle age group, indicating that the donors in this group had recently been infected with *T. gondii*. This infection could have been contracted by drinking contaminated water or vegetables or by eating raw infected meat. Previous infection IgG antibodies were found in donors aged 41-50 years, indicating that these donors had previously been infected by the infective agent toxoplasma parasite, which causes an immune response and the formation of memory cells for the parasite [20]. The results revealed that the prevalence of *T. gondii* IgG level among 560 tested blood donors males was (43.03%) and among 40 tested females donors was (30%). On the other the incidence rate of *T. gondii* IgM level among 560 tested males' donors was 95 (16.96%) and among 40 tested female's donors was (7.55%). Different previous studies showed that males are more susceptible than females to many parasites. The current study disagree with in Iran, Davarpanah, et al., who showed that the seroprevalence of toxoplasmosis was higher in males than in female [21]. This variability may be due to different sample size, geographical location, type of kit used and the resistance of different strains of *T. gondii* that plays an important role in differences of infection rates. Also animal petting and exposure to contaminated soil is another reseons for infection. In Iran, Davarpanah, et al., revealed seroprevalence of toxoplasmosis was (48.8%) in males and (55.2%) in females. Toxoplasmosis in those without job which showed included in this study, higher percentage 51 (48.6%) than those having governmental workers 132 (43.0%), private workers was 53 (42.1%) and student 17 (27.4%) in the presence of anti-toxoplasma IgG antibodies. While the presence of anti-toxoplasma IgM antibodies, this result revealed higher percentage 13 (20.96%) in student and 23 (18.25%) in private workers, without job19 (18.09) and 43 (14.0%) in those having governmental workers. In Iraq, found that all seropositive rate was (33.42%), barbers had the highest prevalence rate (72.73%), followed by food handlers (41.18 %), housewives (38.9 %), donated blood (24.30 %) and medical staff (21.43%). Davarpanah, et al. [21]. Farmers had the highest anti-Toxoplasma antibody rate (47.4%), according to Davarpanah, et al., compared to other occupations (clerks, 31%; teachers, 42.1%; students, 21.2% and workers, 37.5%) [22]. These findings could be explained by the fact that farmers were more likely to be uneducated or that their exposure to soil and other risk factors was greater than that of others. Cook, et al., found that contact with soil, contaminated vegetables and fruit were identified as a risk factor for Toxoplasma infection which was confirmed by Buffolano, et al. indicated that seroprevalence Toxoplasma antibodies was significantly higher amongst individuals who keep livestock (52.2%) and abattoir workers (46.3%) and he suggested exposure to *T. gondii* infection is present among residents of Tanga district in Tanzania whom consume raw meat or under cooked meat and petting especially cats that presents more risk factors than other occupational groups .He also emphasized on the necessity to create awareness of this disease and advocate protection of risky In Iran Davarpanah, et al. revealed the demographic and base line characteristics of occupation were clerks (20%) merchant (58.6%) students (33.3%) unemployed (50%) other jobs (48.91%). Zhou, et al. in China showed that some occupations was from required people to have contact with animals and meats and these frequently posses higher risk of infection with the parasite. Such as dairy workers (45.0%) slaughter house workers (25.6%) veterinarians (12.5%), meat processing workers (13.7%) meat sellers and cooks (29.7%). Another investigators demonstrated that out of the 200 fruit and vegetable workers, 15 (7.5%) of them were positive for anti-Toxoplasma IgG antibodies while, anti-T*oxoplasma I*gM, antibodies were found in 2 (1%) of the fruit workers [23]. It is important to note that the current study discovered an association between the blood group system and T*oxoplasma* infection, with the highest prevalence among samples tested by ELISA IgG with blood group AB^{+}(60%) and the lowest prevalence among samples tested by group O-19 (25.8%). On the other hand, ELISA IgM antibodies test showed highly toxoplasmosis percentage 28 (24.3%) with blood group B^{+} and lowest percentage 0 (0.0%) in AB^{-} blood group. A study among blood donors in Russia has reported similar findings, with toxoplasmosis seroprevalence being twice as high among subjects with blood group AB (54%) than among subjects with blood group O (27%) [24]. Other studies report no significant difference between toxoplasmosis and the ABO factor [25]. The A, B and O blood group system are determined by the presence or absence of A and B carbohydrate antigens on the surface of red blood cells. This determines natural resistance in human to many infection disease agents that have cell surface antigens similar to the antigens of different blood group types. This mechanism may, in part, explain the higher susceptibility of individual with blood type AB to several infections diseases, since the blood of those individuals does not contain the corresponding natural antibodies. Previous studies have interpreted and reported the possible relationship between the ABO group system and the presence of anti-*T. gondii* antibodies. Such as an association between this parasite infection and the B and AB blood groups, these studies suggest that the B antigen could be a *T. gondii* receptor. However, other similar investment organizations on the other hand, found no evidence of this association [26]. It has been proposed that B antigen represents a *T. gondii* receptor, which did not appear to be valid in different populations [27]. The results reveald that seroprevalence of *T. gondii* IgG in Libyan tested 544 was 233 (42.8%) and non-Libyan tested 56 were 20 (35.7%) and the seroprevalence of *T. gondii* IgM in Libyan tested 544 was 91 (16.7%) and non-Libyan tested 56 was 7 (12.5%). The seroprevalence rate of infection IgG and IgM antibodies were highest in Libyan than non-Libyan. In this study, the seroprevalence of *T. gondii* IgG and IgM antibodies in correlation to the region are shown that the seroprevalence of *T. gondii* IgG in Benghazi (urban) was (43.1%) and Benghazi (rural) was (39.45%) and the seroprevalence of *T. gondii* IgM in Benghazi was (17.4%) and out of Benghazi was 19 (12.9%). This result was consistent with the study conduct by Munoz, et al. which was about the positive cases of toxoplasmosis in the rural and urban women was (63.4%) and (54.5%) respectively. Munoz, et al. mentioned that, the ratio of infection between rural women is greater than urban

women, Salibay, et al. in Philippines, where they showed that the rate of toxoplasmosis was higher in suburban patients than urban residents. Another study by Zoe, et al. in Romania found that higher seropositivity of toxoplasmosis was in rural environments (63.68%) compared to urban one (55.12%) Sroka, et al. [28]. In Poland, they showed that people living on farms had a significantly higher percentage of anti-*Toxoplasma* antibodies (59% compared to urban dwellers 41.0%). Al-Mayahi in his study has noticed the same results in the presence of higher anti-*toxoplasma* antibodies in women lived in rural area in comparison to those lived in urban area. Therefore the difference in seropositivity between rural and urban area may be due to the hygienic and socio economic status that relates to oocyst shedding by cats and peoples contact with the soil, specifically, the pavement widely seen in the urban area is considered to contribute to the reduced surviving period of oocysts shed by cats, interpreted that, the people in the rural regions had a history of contact with cats as well as the ingestion of the oocysts with the inadequate washing of vegetables, in addition to the increase of domestic animals which are regarded as good carriers of the disease [29].

Conclusion

In Libya, healthy voluntary donors had a high seroprevalence of *T. gondii*, according to our findings. Regular blood testing for *T. gondii* antibodies may be regarded as a necessary component of the battery of serological screening tests used to identify endemic infectious diseases in our nation. Additionally, it may be appropriate to incorporate screening tests (ELISA) for *T. gondii* into the routine blood testing performed prior to transfusion, especially since many pregnant women are exposed to a lack of blood, which necessitates a blood transfusion, which negatively affects both the mother and fetus, so it is necessary to take these tests into consideration.

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