Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908

Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Original article

Prevalence of Toxoplasma Gondii Infection and Knowledge of Risk Factors among Female Medical Students in Tripoli, Libya

Fatma Alaribi[1]*, Mohamed Lashal[1], Safa Sharfuldeen[1], Ahlam Ellafi[2], Walid Saadawi[3], Hanan Aqeelah[3], Akram Aliwan[3], Noura Gresh[3]

[1]*Parasitology Department, Faculty of Medicine, University of Tripoli, Libya*
[2]*Histology and Medical Genetics Department, Faculty of Medicine, University of Tripoli, Libya*
[3]*National centers for Disease Control, Libya*
Email. *fatmamahamed1234567@gmail.com*

Keywords.
Seroprevalence, *Toxoplasma Gondii*, Toxoplasmosis, Behaviour Risk Factor, Abortion.

ABSTRACT

Toxoplasmosis is a widespread infection caused by the intracellular protozoan *Toxoplasma gondii* (*T. gondii*). Transmission occurs through the fecal-oral route, blood transfusion, and vertical transmission from mother to fetus. Although typically asymptomatic in immunocompetent individuals, *T. gondii* infection can lead to severe complications in immunocompromised patients and congenital abnormalities if acquired during pregnancy. This study aimed to determine the prevalence of *T. gondii* infection, knowledge about toxoplasmosis, behavioral and lifestyle risk factors, and medical history, including a history of abortion, and to find the association between the variables of the study among female students at the Faculty of Medicine, University of Tripoli, Libya. A cross-sectional study was conducted over five months, from August 2025 to January 2026. Two data collection instruments were employed: blood sample analysis to evaluate the seroprevalence of *T. gondii* and *an* adapted questionnaire to assess the sociodemographic characteristics of the participants, knowledge about toxoplasmosis, behavioral and lifestyle risk factors, and medical history and history of abortion among the participants. A total of 223 female students were screened for *T. gondii* antibodies using a standard enzyme-linked immunosorbent assay (ELISA). Demographic, socioeconomic, knowledge and behavioral, and risk factor data were collected using a pre-tested, adapted questionnaire administered through face-to-face interviews. The seropositivity rate for *T. gondii* was 78 (35%) positive for IgG and none for IgM. The majority of participants were aged 23-27 (84.8%); 184 (82.5%) of them had heard about toxoplasmosis, 197 (88.3%) knew the route of transmission, 75 (33.6%) do own a cat, and almost all of them, 73 (32.7%), handled a cat and changed a cat's litter box, 9 (4%) participants were married, five of them (2.2%) had history of abortion. This study observed a significant association between the prevalence of the infection and wearing gloves when dealing with meat (p=0.032) and whether participants had heard about Toxoplasma before (p=0.019). This study documented that *T. gondii* was positive among female students at Tripoli University, Libya, identified the prevalence of the infection, and gave insight into risk behaviors among the participants. Enhanced sanitation practices, rigorous personal hygiene protocols, and targeted educational initiatives on responsible pet ownership may mitigate this pathogen transmission.

Introduction

Toxoplasma gondii (T. gondii), an obligate intracellular protozoan, causes toxoplasmosis. It is regarded as one of the most critical blood and tissue zoonotic protozoa. Research indicates that *T. gondii* infects nearly one-third of the global population. It was discovered in 1908 by Nicolle and Manceaux in Tunisia in the rodent known as the Gundi (Ctenodactylus gundi) [1,2].

The parasite can infect humans through three primary routes: (a) consuming tissue cysts in undercooked meat from intermediate hosts; (b) ingesting sporulated oocysts from soil, water, or food contaminated with the feces of infected cats and other felines, which are the definitive hosts; and (c) transplacental transmission, leading to congenital toxoplasmosis [3]. Additionally, *T. gondii* can be transmitted through blood transfusions involving whole blood or white blood cells from healthy seropositive donors, especially those in the acute phase of infection, to seronegative recipients. It can also be spread through organ transplantation [4]. In humans, the clinical manifestations of *T. gondii* infections are influenced by parasite genotype and host immunity status. The spectrum of infection ranges from asymptomatic to acute toxoplasmosis [5].

Pregnant women are particularly at risk, with potential adverse outcomes including miscarriage, stillbirth, and congenital disabilities. Toxoplasmosis can lead to significant ocular and neurological manifestations ranging from slightly impaired vision to severe conditions like retinochoroiditis, hydrocephalus, and intracerebral calcifications in newborns [3,6]. In addition, in immunocompromised individuals, *T. gondii* infection frequently manifests as severe toxoplasmic encephalitis,

Received: *09-07-2026 -* ***Accepted:*** *08-09-2026 -* ***Published:*** *14-09-2026*

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

a potentially life-threatening condition. Although pneumonia can occur, it is less prevalent than encephalitis. Notably, toxoplasmic encephalitis is a leading cause of mortality among patients with acquired immunodeficiency syndrome (AIDS) [3,6]. The global seroprevalence of toxoplasmosis varies significantly, ranging from 8% to 77% [7] . Moreover, there are remarkable differences within a country and among various regional communities. These variations are influenced by numerous factors such as environmental conditions, socioeconomic status, dietary and drinking habits, availability of healthcare services, hygiene and sanitation practices, population susceptibility, geographical location, and soil moisture levels [7,8].

A high prevalence of toxoplasmosis antibodies has been observed among pregnant women and women of childbearing age across various regions worldwide [9]. The prevalence of toxoplasmosis in Libya showed wide variations, as revealed by a previous study. The highest seropositivity rates were reported in Zawia (74%), Surman (68.8%), and Sabrata (58.1%) [10]. Studies showed lower prevalence in: Tripoli (45%) [11]., El-Beida (26.86%), [12], Benghazi (47.7%) [13], and in Al-Ajailat (34.9%) [14].

Once the infection is preventable, raising awareness about toxoplasmosis and its transmission is crucial for reducing its prevalence. Furthermore, educating young women about toxoplasmosis not only helps in lowering its prevalence but also in minimizing the adverse effects of congenital toxoplasmosis. The purpose of this study was to assess the toxoplasmosis prevalence, level of knowledge, and behavioural risk factors associated with toxoplasmosis seroprevalence among female medical students at the University of Tripoli.

Methods

Study Design and Location

This cross-sectional, observational study was conducted over five months from August 2025 to January 2026 to estimate the prevalence of toxoplasmosis, knowledge, behavioural risk factors, and the association between the variable of the study within 5% true prevalence, 95% confidence intervale and a power of the study chosen at 80%. The study location was the Faculty of Medicine, University of Tripoli, Libya, which was chosen as the study site due to its diverse student population, representing various regions of Libya and a broad spectrum of academic levels.

Sampling Population, Sampling Strategy

The study population included all healthy female students enrolled at the Faculty of Medicine during the study period, regardless of their age, academic year, or nationality. Participants were recruited through convenience sampling, a non-probability sampling technique based on willingness to participate voluntarily and availability at the time of recruitment. Moreover, the participants were selected according to inclusion and exclusion criteria.

Inclusion criteria

Female students currently enrolled at the Faculty of Medicine who are healthy and not known to have acute or chronic illness. In addition, participation was based on willingness to participate, as indicated by signing a written informed consent form.

Exclusion criteria

- Students who have a history of immunosuppressive conditions or treatments.
- Those who are known to have had toxoplasmosis in the past.
- Those who refused to participate, refuse a blood test, or are unable to provide informed consent.

Sample Size Determination

The minimum required sample size was calculated using the single proportion formula:
$n=Z^2 \cdot \pi(1-\pi)/d^2$ [15], where: n = required sample size, Z = Z-score for 95% confidence level (1.96), π = assumed prevalence of *T. gondii* infection (0.5), d= margin of error (0.075). Using this formula, the minimum required sample size was 171 participants. To increase statistical power and account for possible non-responses or data losses, 223 participants were ultimately recruited.

Ethical Considerations

Ethical approval was obtained from the University of Tripoli Committee of Research Ethics. All participants were informed about the study's objectives, procedures, benefits, and potential risks. Written informed consent was obtained from each participant before enrollment. Participant confidentiality was maintained throughout the study, and all data were anonymized before analysis.

Data Collection Instruments and Procedure

Data were collected through a two-part approach involving an adapted questionnaire and venous blood sampling.

Received: *09-07-2026 -* ***Accepted:*** *08-09-2026 -* ***Published:*** *14-09-2026*

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

Questionnaire

The questionnaire was adapted from previous studies [8,16,17], according to the current study objectives, and was pretested in a pilot involving 10% of the sample size of students to ensure clarity and reliability. It consists of four main sections:

- Sociodemographic Information: date of birth, nationality, current level of education, marital status, area of residence (urban vs. rural), and average family income.
- Behavioral and Lifestyle Risk Factors: cat ownership and handling practices, washing fruits and vegetables before consumption, ingestion of raw or undercooked meat, using gloves when dealing with meat, drinking unpasteurized milk, source of drinking water, and contact with garden soil at home.
- Knowledge about *Toxoplasma gondii* (if the participants have heard about toxoplasmosis or not, if they know about the transmission mechanism or not, and whether they have been tested for *Toxoplasma* before or not)
- Medical History: History of spontaneous abortion, chronic diseases, prior blood transfusions, intravenous drug use, surgical operations/Admissions and previous testing or diagnosis of toxoplasmosis.

All questionnaires were administered through in-person interviews conducted by trained medical staff to reduce response bias and ensure completeness of data.

Blood Sample Collection, Transport and Processing

Approximately 5 mL of venous blood was drawn aseptically from each participant using sterile vacutainers. The collected samples were immediately placed in cold boxes and transported to the National Center for Disease Control (NCDC) in Tripoli for processing. At the laboratory, blood samples were centrifuged at 3000 rpm for 10 minutes at room temperature to separate the serum. The serum samples were then aliquoted and stored at −20 °C until further analysis.

Laboratory Analysis

Serological testing for anti-*Toxoplasma* IgG and IgM antibodies was performed using a commercial Enzyme-Linked Immunosorbent Assay (ELISA) kit (DIALAB, Austria), following the manufacturer's instructions. Each sample was tested in duplicate to ensure accuracy and reproducibility. The presence of IgG antibodies was interpreted as past exposure or infection, while the presence of IgM antibodies indicated recent or acute illness. Positive and negative controls were included in each run to validate test performance.

Data Management and Statistical Analysis

All collected data, including questionnaire responses and serological test results, were coded and entered into IBM SPSS Statistics version 25 for statistical analysis. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize participants' characteristics. Inferential analyses, such as the Chi-square test, were used to identify associations between variables of the study. A p-value < 0.05 was considered statistically significant.

Results

Distribution of Sociodemographic Information, Behavioral and Lifestyle Risk Factors, Knowledge about *Toxoplasma Gondii*, Medical History and History of Spontaneous Abortion, and Overall Seropositivity of Toxoplasmosis.

General Characteristics of the Participants

The study includes 223 healthy female students participate in this study. The age range was 23-32 years, with a median age of 26. The majority of the participants were in the age group 23-27, 189 (84.8%). The majority of them were single, 214 (96%), and only 9 (4%) were married. The vast majority of students were Libyan, 217 (97.3%), and 6 (2.7%); were the minority of them from other nationalities (Syria, Palestine, and Sudan).

Overall Seropositivity of Toxoplasmosis

In the current study, out of 223 samples, only 78 (35%) were positive for IgG antibodies, indicating the presence of prior exposure or past infection, and none of the participants tested positive for IgM antibodies. The absence of anti-*Toxoplasma* IgM antibodies in all serum samples suggests that none of the participants had a recent or acute illness at the time of the study. Among the positive participants, only one (1.28%) is married, while 77 (98.72%) of the unmarried participants were positive for IgG.

Distribution of Behavioral and Lifestyle Risk Factors of Toxoplasmosis Among the Participants

When the participants were asked about their exposure to the potential risk factors for toxoplasmosis, 75 students (33.6%) reported owning a cat, and among them, 73 (32.7%) were responsible for caring for their cats and cleaning the litter boxes. Additionally, 63 (28.3%) of students reported occasionally consuming raw or undercooked meat. A majority, 180 (80.7%),

Received: 09-07-2026 - **Accepted**: 08-09-2026 - **Published**: 14-09-2026

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

did not use gloves when handling meat. On the other hand, 207 (92.8%) stated that they wash fruits and vegetables before consumption, while 16 (7.2%) admitted to occasionally eating them without washing. Furthermore, 51 (22.9%) of students reported drinking unpasteurized milk. In terms of water sources, 126 (56.5%) relied on bottled water, while 97 (43.5%) of them used untreated water. Regarding soil contact, 125 (56.5%) of participants had no contact with garden soil at home, whereas 97 (43.5%) reported occasional contact (Table 1).

Table 1. Distribution of Behavioral and Lifestyle Risk Factors of Toxoplasmosis Among the Participants

Variable	Response	Study group N= 223	
		n	%
Ownership of cats	Yes	75	33.6
	No	148	66.4
Handling cats and changing a cat's litter box	Yes	73	32.7
	No	150	67.3
Washing fruits and vegetables before consumption	Yes	207	92.8
	No	16	7.2
Ingestion of raw or undercooked meat	Yes	63	28.3
	No	160	71.7
Using gloves when dealing with meat	Yes	43	19.3
	No	180	80.7
Drinking unpasteurized milk	Yes	51	22.9
	No	172	77.1
Source of drinking water (Treated & Bottled water)	Yes	126	56.5
	No	97	43.5
Contact with garden soil at house	Yes	98	43.9
	No	125	56.1

Distribution of Knowledge About Toxoplasmosis Among the Participants

Among the 223 participants surveyed in this study, 184 (82.5%) reported being familiar with toxoplasmosis. In addition, the majority of them, 197 (88.3%), knew the mechanism of transmission of the parasite. But most of them, 214 (96%), did not test for it before.

Distribution of Past Medical History and History of Abortion Among the Participants

In this study, five participants (55.5% of married women and 2.2% of total participants) had a history of abortion out of a total of nine married participants. In addition, this percentage was among the age group 23-27 years old, and all of them were Libyan participants. Looking for previous medical and surgical risk factors, the study showed that the majority of the participants, 212 (95.1%) did not receive blood transfusions or have surgery, 183 (82.1%), and none of them were found to had a history of intravenous drug use (Table 2).

Table 2. Distribution of Past Medical History and History of Abortion Among the Participants

Variable	Response	Study group N= 223	
		n	%
History of spontaneous abortion	Yes	5	2.2
	No	218	97.8
Chronic diseases	Yes	12	5.4
	No	211	94.6
Prior blood transfusions	Yes	11	4.9
	No	212	95.1
Intravenous users	Yes	0	0
	No	223	100
Surgical operation /Admissions	Yes	40	17.9
	No	183	82.1

Relationship Between Sociodemographic Profiles, Behavioral and Lifestyle Risk Factors, Knowledge About Toxoplasmosis, Past Medical History and History of Abortion with Seroprevalence of *Toxoplasma* IgG Among the Participants.

Association Between Sociodemographic Profiles of the Participants with Seroprevalence of Toxoplasma IgG

Received: 09-07-2026 - **Accepted**: 08-09-2026 - **Published**: 14-09-2026

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

The Majority of infected participants were in the age group 23-27 (37%), single (36%), and Libyan (35%); however, this study found no significant association between participants' age, marital status, and nationality and seropositivity of *Toxoplasma gondii* IgG (Table 3).

Table 3. Association between sociodemographic profiles of the participants and seroprevalence of Toxoplasma IgG

Sociodemographic profiles	Toxoplasma IgG		*P*	Prevalence ratio	95% CI	
	Positive n (%)	Negative n (%)			Lower	Upper
Age group 23-27 28-32	 70 (37) 8 (23.5)	 119 (63) 26 (76.5)	0.128	1.57	0.821	4.453
Marital status Single Married	 77 (36) 1 (11.1)	 137 (64) 8(88.9)	0.240**	3.243	0.552	36.627
Nationality Libyan Other nationality	 76 (35) 2(33.3)	 141 (65) 4(66.7)	1**	1.05	193	6.021

*P<0.05=statistically significant, (p=Chi square). ** Continuity correction for cells <5*

Association Between Behavioral and Lifestyle Risk Factors and Seroprevalence of Toxoplasma IgG Among the Participants

This study reported that the participants who had positive IgG for *Toxoplasma gondii* were found among cat owners (38.7%); handling cats and changing a cat litter box (42.5%); not washing fruits and vegetables before eating (37.5%); not eating raw or undercooked meat (35.6%), not wearing gloves when dealing with meat (37.5%); drinking unpasteurized milk (37.8%); and contact with garden soil (30.4%).

This study indicated a significant association between wearing gloves when dealing with meat and seroprevalence of *Toxoplasma* IgG (95% CI = 0.193 and 0.942, p = 0.032). But the current study reported no significant association between the other behavioural and lifestyle risk factors with seroprevalence of *Toxoplasma* IgG (Table 4).

Table 4. Association Between Behavioral and Lifestyle Risk Factors with Seroprevalence of Toxoplasma IgG Among the Participants

Variables	Toxoplasma IgG		*P*	Prevalence ratio	95% CI	
	Positive n (%)	Negative n (%)			Lower	Upper
Ownership of cats Yes No	 29 (38.7) 49 (33.1)	 46 (61.3) 99 (66.9)	0.411	1.169	0.715	2.269
Handling cats and changing a cat's litter box Yes No	 31(42.5) 47(31.3)	 42 (57.5) 103 (68.7)	0.102	1.357	0.907	2.884
Washing fruits and vegetables before eating Yes No	 72 (34.8) 6(37.5)	 135 (65.2) 10 (62.5)	0.826	0.928	0.311	2.545
Eating raw or semi-cooked meat Yes No	 21(33.3) 57 (35.6)	 42 (66.7) 103 (64.4)	0.747	68.9	0.488	1.672
Wearing gloves when dealing with meat Yes No	 9 (20.9) 69 (38.3)	 34 (79.1) 111(61.7)	0.032***	0.545	0.193	0.942
Drinking unpasteurized milk Yes No	 13(25.5) 65 (37.8)	 38 (74.5) 107(62.2)	0.106	0.674	0.279	1.135
Drinking treated water (tap water)			0.407	1.165	0.724	2.215

Received: 09-07-2026 - **Accepted**: 08-09-2026 - **Published**: 14-09-2026

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

Yes No	47(37.3) 31(32)	79 (62.7) 66 (68)				
Contact with garden soil Yes No	 40 (40.8) 38 (30.4)	 58 (59.2) 87 (69.6)	0.105	1.342	0.907	2.749

****P<0.05=statistically significant, (p=Chi square).*

Association Between Knowledge of Toxoplasmosis and Seroprevalence of Toxoplasma IgG Among the Participants

The study showed that among 78 positive participants, about 58 (31.5%) had heard about *toxoplasmosis* before, and about 20 (51.3%) of seropositive participants had not heard about toxoplasmosis before; about 66 (33.5%) out of 78 seropositive participants knew the transmission mechanism of toxoplasmosis. However, the majority of IgG-positive participants 75 (35%), had no serology test for toxoplasmosis before.

This study demonstrated a significant association between previous knowledge of toxoplasmosis (95% CI=0.217 and 0.881, p=0.019) and seroprevalence of *Toxoplasma* IgG; however, this study failed to establish any association between knowledge of mode of transmission and previous serology testing of toxoplasmosis and seroprevalence of *Toxoplasma* IgG (Table 5).

Table 5. Association Between Knowledge and Seroprevalence of Toxoplasma IgG Among the Participants

Variable	Toxoplasma IgG		*P*	Prevalence ratio	95% CI	
	Positive n (%)	Negative n (%)			Lower	Upper
Have you heard about toxoplasmosis before? Yes No	 58 (31.5) 20 (51.3)	 126 (68.5) 19 (48.7)	0.019***	0.614	0.217	0.881
Do you know the transmission mechanism of Toxoplasma Yes No	 66 (33.5) 12 (46.2)	 131(66.5) 14 (53.8)	0.204	0.725	0.257	1.342
Did you test for Toxoplasma before (serology)? Yes No	 3 (33.3) 75 (35)	 6 (66.7) 139 (65)	1**	0.951	0.225	3.811

**** $p < 0.05$= statistically significant, ($^a p$) = Chi square, ** Continuity correction cells <5*

Association Between Past Medical History and History of Abortion with Seroprevalence of Toxoplasma IgG Among the Participants

The study showed that one participant (20%) who had a previous history of abortion tested positive for IgG, however, the majority of positive participants had no history of abortion77 (35.3%), no history of chronic diseases 74 (35.1%), no history of blood transfusion 72 (34%), and no history of a surgical operation 64 (35%). Notably, this study showed no significant association between the above-mentioned variables and the prevalence of the infection (Table 6).

Table 6. Association Between Past Medical History and History of Abortion with Seroprevalence of Toxoplasma Ig G Among the Participants

Variable	Toxoplasma IgG		*P*	Prevalence ratio	95% CI	
	Positive n (%)	Negative n (%)			Lower	Upper
History of spontaneous abortion Yes No	 1 (20) 77(35.3)	 4(80) 141 (64.7)	0.66*	0.566	0.050	4.168
Chronic diseases Yes No	 4 (33.3) 74 (35.1)	 8 (66.7) 137 (64.9)	1.000**	0.948	.270	3.177
Prior blood transfusions Yes No	 6 (54.5) 72 (34)	 5 (45.5) 140 (66)	0.284**	1.60	.689	7.906

Received: 09-07-2026 - **Accepted**: 08-09-2026 - **Published**: 14-09-2026

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908

Libyan Medical Journal

https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Surgical operation and admission						
Yes	14 (35)	26 (65)	0.997	1	0.489	2.051
No	64 (35)	119 (65)				

**Fisher exact test (cells <2), **Continuity correction (cell <5)*

Discussion

The findings of this study provide important insights into the knowledge, behavioral risk factors, and the prevalence of *T. gondii* infection among female medical students at the University of Tripoli. The seropositivity of 35% for IgG indicates the infection is endemic in the area of the study. However, this prevalence among the participants was considered somehow not very high. The current study showed that none of the participants tested positive for IgM, which is similar to the study done among university female students in Yemen, where participants showed positive results for IgG, and none of them tested positive for IgM [24].

Many studies were conducted in different municipalities in Libya and among different types of participants, which showed a wide range of toxoplasmosis prevalence. Here are presented some results from the previous studies: in a study conducted in Alkhoms, Libya, among pregnant women, IgG seropositivity was 39.3% [18]; 38.5% of women with spontaneous abortion were positive for IgG in a study done in Alzawia, Libya [10], and both of them had a result of prevalence approximated to the result from the current study. However, a higher incidence was detected in a study conducted in Sirt, Libya, where blood samples were taken from patients who visited Ibn Sena Hospital; the seroprevalence of *Toxoplasma* was 45.50% [19]. Another high incidence was detected among pregnant women in Aljalla Maternity Hospital, Tripoli, Libya (50.8%), in a study done by Mahmoud and others [11]. The major difference between the current study and the other above-mentioned previous studies in Libya was the type of participants and the study design, whereas they were mainly hospital-based studies, which were conducted among various sick people or among pregnant women, who could be at a higher probability of having *Toxoplasma* seropositivity as a high-risk group for the infection.

Notably, this incidence among university students in medical school was noticed to be less than the other results obtained from participants in various other communities. However, among university students in other countries, the results showed less prevalence. For example, in a study done in Iraq among university students in an education school, the prevalence of IgG was only 9.05% and 3.33% for IgM [20].

Comparing toxoplasmosis with other parasitic infections that are transmitted through contaminated food and drinks and share the same risk factors of infection in the country, the following results are recorded: The intestinal nematodes in the study run in Aljmail municipality had a prevalence of 34.8%, 33.3% prevalence of *Enterobius vermicularis,* only a 1.5% prevalence of *Strongyloides stercoralis,* 3% detected *Entamoeba histolytica,* and 10.6% *Gardia lambalia* in a study done by Ahmed and others [21]. Then helminth infections (7.6%) were detected in Alzawia by Fawzia Shawesh and others [22]. The intestinal helminths are known to share the same need for specific environmental conditions in soil for the development of the egg to be infective, and here is the similarity with *Toxoplasma gondii* oocysts, which need some period of time in soil to become infective sporulated oocysts. Concerning other protozoal infections, a prevalence of *Entamoeba histolytica* (60.70%) and *Giardia lamblia* (31.73%) was reported by Fawzia Shawesh study [22]; 99.3% (141/142) of infected samples were protozoan infections, including intestinal protozoa, such as *Blastocystis hominis*, *Entamoeba histolytica/Entamoeba dispar*, *Giardia lamblia*, and *Entamoeba coli*, in a study done by Hasan M. S. Ibrahim in Sabha city [23]. Here, all previous studies indicate that the infection through the fecal-oral route is still present in the country, including both helminths and intestinal protozoa. But what is noticed is that the prevalence of helminths and intestinal protozoa infections is still less than toxoplasmosis in the current study. Such results indicate a defect in hygiene and educational programs about such preventable infections. In addition, toxoplasmosis can lead to harmful outcomes, unlike other mentioned helminths and protozoa, especially when acute infection occurs while a woman is pregnant or among immunocompromised patients [10,24]. Additionally, a study conducted in Benghazi municipality on the contamination of leafy vegetables with various intestinal parasites revealed that nearly all of the samples (90%) were contaminated with parasite eggs, larvae, or cysts. The study was carried out on a group of vegetables that are typically consumed by Libyans, such as lettuce and parsley. This highlights the importance of taking precautions against faecal- oral- transmitted parasite infections [25, 26].

Regarding the zoonosis, *Toxoplasma gondii's* definitive host is felines, including cats. There is another zoonotic disease that causes a major health problem in Libyan society as well as major economic problems among animals such as goats, cattle, and camels, which is *Echinococcus granulosis*, which is also transmitted by eating infective eggs in contaminated food and drinks [27]. The Presence of infection among this group of participants, even though they are medical students who are supposed to be more educated about such infections than others, could be due to a lack of clear information about such infections or ignorance of important preventive measures, which play a major role in the spread of the infections among the participants.

However, the results showed the need to include the university or other schools' members in the educational programmes about such parasitic infections and zoonotic diseases, especially those that could be transmitted by pet animals, which usually live very close to humans and their sources of food and drink [28]. This study showed the risk factors that participants were exposed to in terms of preventing or acquiring the infection. For example, in the current study, only 33.6%

Received: *09-07-2026 -* ***Accepted:*** *08-09-2026 -* ***Published:*** *14-09-2026*

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

of the participants owned cats, which are a source of the infection with the parasite; however, when studying associations between having a cat pet animal and seropositivity of IgG, the result showed no significant association (p>0.05). The same result was found among university students in China [17]. In contrast to this result, in a study done by Talal Saeed Al-Wajeeh [16], the infection among female students was found to have a significance association with having cats at home (p = 0.045). Also, in a study done among female university students in Iraq, a significant association was found between owning cats and seroprevalence of toxoplasmosis (p = 0.037) [20].

Noticeably, in the Libyan community, owning animals in cities, including cats, was not common, while it could be seen more in rural areas or in areas where animal raising is a main part of the population's economy; however, the recent trend to own cats as a pet animal, especially among young generations who are at a similar age of the current study participants, is on the rise. Routine medical checkups for pet animals and taking advice from a veterinary doctor are not well-known behaviors. In addition, for those who own cats, almost all of them handle their cats themselves. The study showed the need for more details about the knowledge of how they handle their cats, routine medical checkups, and follow-ups with a veterinary doctor; knowledge about handling litter boxes; if they know about the period needed by non-infective, unsporulated oocysts in the soil to be transmitted to infective, sporulated oocysts; and the preventive measures for those owning cats to prevent getting these zoonotic diseases [28, 29].

In this study, the results of other behavioural risk factors, such as washing fruits and vegetables before consumption, showed no significant associations with seroprevalence of IgG, where the majority of the participants (92.8%) said they washed fruits and vegetables before consumption, which reduces the risk of ingesting oocysts from contaminated produce. However, 7.2% admitted to occasionally consuming unwashed fresh produce, which remains a concern, particularly in areas where soil or irrigation water contamination is possible.

In contrast to the current study, Riyadh A. Alzaheb and Osama al-Amer found a significant association between washing fruits and seroprevalence of *Toxoplasma gondii* among undergraduate students in Saudi Arabia (p= 0.007) [30]. The Same for other behavioural risk factors that increase exposure to the infective stage of the parasite, which showed no significant association with the prevalence of the infection when the majority of participants answered No (p>0.05), such as ingestion of raw or undercooked meat (71.7% of the participants answered No), drinking of unpasteurized milk (71.1% of the participants answered No), and contact with garden soil (66.5% of the participants answered No). The majority of the participants were drinking treated or bottled water (56.5% of the participants answered Yes).

However, reviewing the literature showed variation in the detection of an association between the variables of the study, where some of them detected a significant association and some did not; for example, significant associations include consumption of raw, unwashed fruits or vegetables (p=0.007) [30]; drinking water (p=0.015) [8]; drinking unboiled water (p=0.028); gardening, doing agriculture, or contacting the soil (p= 0.000) [17]. On the other hand, research conducted in Yemen, Iraq, Jordan, and China revealed the same result of no significant association between the prevalence of toxoplasmosis and having cats [16,17]; handling cats' litter boxes [16]; washing fruits and vegetables before consumption [16,17]; eating raw or semi-cooked meat [8,16,17]; source of drinking water; drinking unpasteurized milk; or contact with soil or gardening [16].

The behavioral risk factors are connected mainly to routes of infection, so the current study highlights the need for more targeted education regarding safe food handling, such as washing fruits and vegetables and consuming well-cooked meat; drinking clean, treated water or boiling it; and, especially because of inadequate water treatment infrastructure in most areas of the country. Furthermore, proper hygienic practices such as washing hands after contact with soil and before eating, frequent cleaning of the cat litter box, and proper hygienic measures when dealing with animal excreta all minimize exposure to the infective stage of the parasite. As noted in this study's results, one behavioral risk factor, which is using gloves when dealing with meat, showed a significant association with the prevalence of the infection (p=0.032). In this behavioral risk factor, the majority of participants (80.7%) did not use gloves during meat handling, underscoring the importance of gloves as a protective measure against infection transmission.

This research has shown that 82.5% of participants reported knowing about toxoplasmosis, and further analysis showed a significant association between this knowledge and the prevalence of the infection (P=0.019). Moreover, this survey found that the majority of participating students knew the mode of transmission (88.3%), and the majority of them had no previous experience of blood testing for toxoplasmosis (96%), still, no significant association was detected between study variables. The same result was detected among Italian women with p < 0.001 [31]; it also detected no significant association between the knowledge of the methods of transmission variable. However, to assess the degree of toxoplasmosis knowledge among students in disciplines other than medicine, comparative research is strongly advised [32].

Along with this, good knowledge about the transmission method reflected the influence of their medical education and training. This level of awareness is encouraging, as it plays a critical role in their health practices and future capacity as healthcare providers to educate patients about the risks, transmission, and prevention of toxoplasmosis. The evidence from this study reveals that the majority of infected participants have no chronic disease, no prior history of blood transfusion, or spontaneous abortion. Further analysis detected no significant association between clinical manifestation variables and the prevalence of the infection. As is known, blood transfusion is considered an important method of transmission of the infection, but it is neglected and not included in screening programs in blood banks in the country [33].

Received: 09-07-2026 - **Accepted**: 08-09-2026 - **Published**: 14-09-2026

Libyan Med J. 2026;18(9):589-599
https://doi.org/10.69667/lmj.26908

Libyan Medical Journal

https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Many research studies were conducted to evaluate the prevalence of toxoplasmosis among aborted women. In one study carried out in Alzawia Hospital, Libya, toxoplasmosis was detected in 32.7% of the aborted participants; the study detected a significant association with *Toxoplasma* IgM and abortion, indicating that acquired infection during pregnancy carried a major risk for abortion [34]. Another study done by Gashout, A., detected 17.6% IgM-positive women, which could be the cause of abortion [35]. Alongside pregnancy loss, congenital toxoplasmosis causes a major disabling condition in the fetus, which could be manifested in the newborn if the infection occurs at the time of organogenesis or may be later in childhood when the pregnant mother is infected in her late weeks of pregnancy [3, 9, 30]. Add to that, if an infection occurs in immunocompromised individuals, it will perhaps act as an opportunistic infection and could cause fatal conditions, such as in HIV patients; in a study done by Shimelis, T. et al., 93.3% of HIV participants were found positive for *Toxoplasma gondii* [35]. These findings underscore the complexity of *T. gondii* transmission, which is influenced by environmental exposure, dietary habits, and personal hygiene practices. Although the overall awareness level was high, certain behaviors still pose potential infection risks and point to gaps in translating knowledge into preventive action. More study needed to look for some risk factors, such as stored and manufactured or imported meat and vegetables. The role of routine blood screening among the high-risk population may be discussed, and research about its efficacy should be conducted [37].
Given that medical students represent the next generation of healthcare providers, continuous education and training on zoonotic infections, including toxoplasmosis, should be emphasized. Reinforcing knowledge about transmission routes, prevention strategies, and the importance of personal protective behaviors is crucial. Furthermore, integrating comprehensive modules on zoonotic diseases and public health education into the medical curriculum could further enhance students' understanding and promote healthier personal and professional practices.

Further research

The results of this study have shown that the occurrence of toxoplasmosis is still alarming; another study to determine the burden of infection among a large number of participants from different country sites should be linked to some geographical distribution, a study of the nature and source of food, and screening for commonly used frozen products, which could be contaminated with oocysts of the parasite. The need for community work and studies to measure the effect of educational programs in changing the level of knowledge before and after the implementation of the programs should be conducted in combination with community health services. Also, a study of the spread of the infective stage among secretions of stray and domestic cats should be done in a wide area of the country.

Limitations

This study has some limitations in terms of scope and sampling, as it was designed as a cross-sectional study, which could have failed to detect causation; another is the use of convenience sampling rather than randomization, which may not provide a fully representative sample of the student population. Additionally, the study targeted undergraduate medical students, who mostly have a higher degree of knowledge about toxoplasmosis than other university students. Future studies would be better done as a long-term cohort or case-control study for a stronger study design. In addition, including male students and comparing between both genders would provide a more comprehensive understanding of toxoplasmosis awareness and behaviors. However, this study has provided baseline data for establishing many educational and screening programs among college students.

Conclusion and recommendation

Overall, the study highlights a good level of awareness about toxoplasmosis among female medical students at the Faculty of Medicine, University of Tripoli. However, significant gaps were identified in safe practices related to food handling and hygiene. Tackling these problems through targeted educational interventions could minimize the risk of *T. gondii* infection and improve public health outcomes.

Conflicts of interest

Nil

References

1. Elsalem RMA. A review of toxoplasmosis in humans and animals in Libya. JOPAS. 2024;23(1):64–71. doi: 10.51984/jopas.v23i1.2447
2. Zeinali S, Khademvatan S, Jafari R, Vazifekhah S, Yousefi E, Behroozi-Lak T. Prevalence and risk factors of Toxoplasma gondii infection among women with miscarriage and their aborted fetuses in the northwest of Iran. PLoS One. 2023;18(10):e0283493. doi: 10.1371/journal.pone.0283493
3. Bollani L, Auriti C, Achille C, Garofoli F, De Rose DU, Meroni V, et al. Congenital toxoplasmosis: the state of the art. Front Pediatr. 2022;10:894573. doi: 10.3389/fped.2022.894573

Received: *09-07-2026 -* ***Accepted:*** *08-09-2026 -* ***Published:*** *14-09-2026*

4. Mamizadeh M, Maleki F, Mohammadi MR, Shamsi L, Asghari A, Pouryousef A. Seroprevalence and risk factors for Toxoplasma gondii infection in solid organ transplant patients: a global systematic review and meta-analysis. Parasite Epidemiol Control. 2025;29:e00421. doi: 10.1016/j.parepi.2025.e00421
5. Korycinska J. Toxoplasmosis: clinical presentation, diagnosis and prevention. Pol Ann Med. 2025:1–6. doi: 10.29089/paom/203319
6. Paul M, Petersen E, Szczapa J. Prevalence of congenital Toxoplasma gondii infection among newborns from the Poznań region of Poland: validation of a new combined enzyme immunoassay for Toxoplasma gondii-specific immunoglobulin A and immunoglobulin M antibodies. J Clin Microbiol. 2001;39(5):1912–1916. doi: 10.1128/JCM.39.5.1912-1916.2001
7. Uttah E, Ogban E, Okonofua C. Toxoplasmosis: a global infection, so widespread, so neglected. Int J Sci Res Publ. 2013;3(6).
8. Obaidat MM, Al-Sheyab NA, Bani Salman AE, Lafi SQ. Seroepidemiology and risk factors of Toxoplasma gondii infection in undergraduate university female students in Jordan. Epidemiol Infect. 2015;143(9):1898–1903. doi: 10.1017/S0950268814003604
9. Mulu Gelaw Y, Worku Dagnew G, Degu Alene G, Gangneux JP, Robert-Gangneux F. Toxoplasma gondii seroprevalence among pregnant women in Africa: a systematic review and meta-analysis. PLoS Negl Trop Dis. 2024;18(5):e0012198. doi: 10.1371/journal.pntd.0012198
10. Gashout A, Amro A, Erhuma M, Al-Dwibe H, Elmaihub E, Babba H, et al. Molecular diagnosis of Toxoplasma gondii infection in Libya. BMC Infect Dis. 2016;16(1):157. doi: 10.1186/s12879-016-1491-5
11. Mahmoud A, Alarwiy A, Ganghish K, Alhares A, Sabei L, Altaesh M, et al. Seroprevalence and potential risk factors associated with Toxoplasma gondii infection in women from Tripoli, Libya. Asian J Public Health Pharm. 2019;5(3):45. doi: 10.5455/ajpmph.20190625055602
12. Elazirg Elammari N, Sariti SR, Husieen Boba Kr Muftah H, Younus M, Abbar A. Seroprevalence of IgG and IgM of Toxoplasma gondii among pregnant women at El-Beida city-Libya. Int J Med Sci Clin Res Rev. 2019;4(5).
13. Agelah A. Prevalence of toxoplasmosis among pregnant women in Benghazi City / Libya. Tobruk Univ J Med Sci. 2024;8(1).
14. Ai Hireereeq A, Elkhouly NM. Evaluation of the seroprevalence of the coccidian parasite Toxoplasma gondii in AL-Ajailat region, Libya. Int J Adv Res. 2021;12(11):11694–11970.
15. Levy PS, Lemeshow S. Sampling of Populations: Methods and Applications. 4th ed. Hoboken (NJ): John Wiley & Sons; 2008.
16. Saeed Al-Wajeeh T, Ahmed Al-Hadheq A, Hazzaa Nomaan M, Hassan Edrees W, Abdullah Al-Shehari W. Toxoplasma gondii prevalence and risk factors among female students. J Amran Univ. 2024;4.
17. Yang N, Wang D, Xing M, Li C, Li J, Wu A, et al. Seroepidemiology and risk factors of Toxoplasma gondii infection among the newly enrolled undergraduates and postgraduate students in China. Front Microbiol. 2017;8:2092. doi: 10.3389/fmicb.2017.02092
18. Gamal MAB, Jaroud RB. Seroprevalence study of IgG antibodies to Toxoplasma, and risk factors for Toxoplasma infestation among pregnant women in Alkhoms state, Libya. Leb Med J. 2015;1.
19. Abd H, Zaed A, Ali M, Elgobbi M, Faraj M, Faraj S. The incidence of Toxoplasma gondii infection in some patients from Sirte, Libya: methods & materials. Sirte Univ Sci J. 2021;11(1).
20. Barzinji AKRA. Seroprevalence and risk factors of toxoplasmosis among University of Kirkuk female students. Ann Parasitol. 2021;67(2):175–186. doi: 10.17420/ap6702.327
21. Ahmed O, Amar O, Asarat O. Detection of human intestinal helminths in Aljmail City-Libya. Afr J Adv Pure Appl Sci. 2023;134(1).
22. Shawesh F, Elazomi A, Almgherbi M, Almaryami O, Lajnaf H, Eh A, et al. Prevalence of intestinal parasitic infections in the city of Zawia, State of Libya. Saudi J Biomed Res. 2019;4(5):212–217. doi: 10.21276/sjbr.2019.4.5.3
23. Salem AHA, Ibrahim HMS. Prevalence of intestinal parasitic infections among people in Sebha City, Libya. JOPAS. 2020;19(2).
24. Avelar JB, Da Silva MG, Rezende HHA, Storchilo HR, Do Amaral WN, Xavier IR, et al. Epidemiological factors associated with Toxoplasma gondii infection in postpartum women treated in the public healthcare system of Goiânia, state of Goiás, Brazil. Rev Soc Bras Med Trop. 2018;51(1):57–62. doi: 10.1590/0037-8682-0112-2017
25. Ibrahem Alaribi F, Zasmy Unyah N, Misni N, Norbaya Masri S, Osman M. The prevalence of soil-transmitted helminths infection and its association with anaemia among refugee school children in the Klang Valley, Malaysia. Mal J Med Health Sci. 2020;16(4).
26. Salem Elmnefi E, Idrees Alshibli N, Mahmoud Alfurjani N, Amrajaa Salh H, Fadlallah Altom S, Ali Faraj M, et al. Parasite contamination of fresh leafy vegetables in Benghazi, Libya. Sci J Fac Sci Sirte Univ. 2024;4(2):62–72. doi: 10.37375/sjfssu.v4i2.2893
27. Murshid M, Masaoud E, Gamag E, Almabrouk A. Prevalence of hydatidosis in sheep, goats, cattle, and camels slaughtered in selected abattoirs in Sabratha City, Libya. Arab J Med Appl Sci. 2026;5(1). doi: 10.54561/ajmas.269312
28. Lashal M, Masaud Ellafi A, Sharfudeen S, Bashir Elagili M. Toxoplasmosis among the University of Tripoli students: knowledge and risk factors. Acta Sci Microbiol. 2024;7(1371):24–29. doi: 10.31080/asmi.2024.07.1371
29. Shapiro K, Bahia-Oliveira L, Dixon B, Dumètre A, de Wit LA, VanWormer E, et al. Environmental transmission of Toxoplasma gondii: oocysts in water, soil and food. Food Waterborne Parasitol. 2019;15:e00049. doi: 10.1016/j.fawpar.2019.e00049
30. Alzaheb RA, Al-Amer O. The seroprevalence and risk factors of toxoplasmosis among female undergraduate university students in Saudi Arabia. Oman Med J. 2017;32(6):486–491. doi: 10.5001/omj.2017.93
31. Martini A, Pietrafesa E, Rondinone BM, Iavicoli S, D'Amelio S, Cavallero S, et al. Toxoplasmosis and knowledge: what do the Italian women know about? Epidemiol Infect. 2020;148:e239. doi: 10.1017/S0950268820002393
32. Mahfouz M, Elmahdy M, Bahri A, Mobarki Y, Altalhi A, Barkat N, Al-Essa H, et al. Knowledge and attitude regarding toxoplasmosis among Jazan University female students. Saudi J Med Med Sci. 2019;7(1):28. doi: 10.4103/sjmms.sjmms_33_17
33. Singh G, Sehgal R. Transfusion-transmitted parasitic infections. Asian J Transfus Sci. 2010;4(2):73–77. doi: 10.4103/0973-6247.67018

Received*: 09-07-2026 -* ***Accepted****: 08-09-2026 -* ***Published****: 14-09-2026*

34. Khalleefah MA. Prevalence of Toxoplasma gondii and cytomegalovirus in sera of aborted women in Zawia City. Arab J Med Appl Sci. 2024;3:583–589. doi: 10.54361/ajmas.247321
35. Gashout A, Lazrag T, Gashut H, Swedan T. Qualitative assessment of risk for spontaneous abortion associated with toxoplasma and rubella: immunity appraisal. Libyan J Infect Dis. 2008;2(1).
36. Shimelis T, Tebeje M, Tadesse E, Tegbaru B, Terefe A. Sero-prevalence of latent Toxoplasma gondii infection among HIV-infected and HIV-uninfected people in Addis Ababa, Ethiopia: a comparative cross-sectional study. BMC Res Notes. 2009;2:213. doi: 10.1186/1756-0500-2-213
37. Foroutan M, Majidiani H. Toxoplasma gondii: are there any implications for routine blood screening? Int J Infect. 2017;5(1):e62886. doi: 10.5812/iji.62886

Received*: 09-07-2026 -* ***Accepted****: 08-09-2026 -* ***Published****: 14-09-2026*