

Knowledge and Practices Regarding Toxoplasmosis Among Pharmacy Students at the University of Benghazi

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Abstract:

Background: Toxoplasmosis is a widespread zoonotic infection caused by *Toxoplasma gondii*, with major consequences in pregnancy and immunocompromised patients. Pharmacy students are key future health professionals who may advise patients on the prevention, screening, and treatment of toxoplasmosis; their base knowledge and practice need to be understood for curricular planning. This study aimed at assessing the knowledge, attitudes, and practices of toxoplasmosis among pharmacy students of Benghazi University.

Methods: A cross-sectional study was conducted over four months in 2024 among undergraduate students at the Faculty of Pharmacy, University of Benghazi. Data were collected using a structured questionnaire. Eligible participants were currently enrolled undergraduate pharmacy students, aged 18 years or older, who could read English and provided informed consent. Individuals not enrolled in the pharmacy program or under the age of 18 were excluded. The data were analyzed using descriptive statistics, with key variables presented as frequencies and percentages in summary tables.

Results: A total of 190 respondents, 76 (40.0%) had heard of toxoplasmosis. Among those, 34 (44.7%) correctly identified *Toxoplasma gondii* as the causative agent. Only a quarter (25.3%) understood the specific risk posed by toxoplasmosis during pregnancy. Recognition of key transmission routes was limited, with many respondents emphasizing direct contact with cats. Diagnostic knowledge (IgG/IgM serology) was reported by 44.2%, and only 36.8% indicated knowledge of appropriate treatment. 44 (23.2%) respondents reported cat ownership; among owners, 33 (75.0%) reported performing medical examinations on their cats.

Conclusion: Pharmacy students demonstrated significant gaps in their knowledge of toxoplasmosis, particularly regarding transmission routes, diagnostic serology, and treatment. These deficiencies pose a direct threat to public health by impairing their future competency in delivering crucial preventive counseling, especially to women of reproductive age. Therefore, implementing targeted educational interventions within the pharmacy curriculum and through campus-wide awareness activities is strongly recommended to mitigate this public health risk.

Keywords: Toxoplasmosis; *Toxoplasma gondii*; pharmacy students; knowledge; congenital infection; University of Benghazi.

Introduction

Toxoplasmosis is a zoonotic protozoan parasitic infection caused by *Toxoplasma gondii*, with worldwide distribution and considerable clinical and public health importance. In immunocompetent individuals, the infection is usually asymptomatic. Still, in immunocompromised patients, it is known to cause serious disease, and congenital infection resulting from primary maternal infection during pregnancy can lead to serious

fetal outcomes [1,2,3]. Major routes of human infection include ingestion of tissue cysts in undercooked or raw meat, ingestion of oocysts in contaminated food or water, and transplacental transmission of tachyzoites during acute maternal infection [4,1,3]. As definitive hosts, cats contribute to environmental contamination by shedding oocysts in feces, while public perceptions frequently overemphasize direct contact with cats and underrecognize the foodborne and waterborne pathways – an important consideration when communicating prevention messages [5,3].

Health professionals, including pharmacists, are in a leading role to provide community education, antenatal counseling, and interpret serologic screening (IgG/IgM) for toxoplasmosis. However, several studies among university students and women of reproductive age throughout the Middle East and North Africa and beyond have documented suboptimal awareness of *T. gondii* transmission, diagnosis, and pregnancy risks [6,7,8,9,10,11,12,13,14]. Local studies in neighboring North African countries, as well as regional cohorts, similarly demonstrate variable knowledge and preventive practices, and thus point to gaps that would be amenable to targeted educational interventions [6,15,12,16,17,5,14]. Although data from Libya remain limited, recent student-focused investigations in Libyan universities suggest comparable patterns of incomplete awareness and inconsistent preventive behaviors – for example, around food handling and pet care, that may heighten the risk of exposure among young adults [12-18]. Nationally representative seroprevalence data remain sparse, complicating efforts to prioritize screening and education; pairing assessments of KAP with serologic surveys would better inform local policy and curricula [12,19,20,17,21,18,2].

Given the pivotal role pharmacists can play in antenatal care and public health outreach, the assessment of knowledge, attitudes, and practices regarding toxoplasmosis among pharmacy students becomes paramount to identify curricular gaps and design appropriate interventions. This study aimed to evaluate these domains among pharmacy students at the University of Benghazi to inform targeted educational strategies and campus health promotion.

Methods

A cross-sectional study was conducted among undergraduate students of the Faculty of Pharmacy at the University of Benghazi over four months in 2024, using a structured questionnaire including demographics data, basic knowledge of toxoplasmosis, perceived transmission routes and information sources, cat ownership and care practices, clinical awareness (symptoms and congenital risks), and diagnostic and treatment knowledge. Eligible participants were current pharmacy undergraduates aged 18 years or older who could read English and provided informed consent; students not enrolled in the program, those under 18, and questionnaires with >20% missing core items were excluded. The questionnaire was administered online. The instrument collected information on age, sex, year of study and residence, whether participants had heard of toxoplasmosis, knowledge of the causative agent (parasite, bacteria, virus, fungus or don't know), perceived transmission routes and information sources, pet ownership and care behaviours (including cleaning frequency and veterinary care), recognition of diagnostic tests (IgG/IgM), and awareness of treatment. The study protocol received approval from the institutional review board. Participation was voluntary, and all participants provided informed consent before enrollment. Data were anonymized before analysis to ensure confidentiality. Statistical analysis was performed using IBM SPSS Statistics, Version 28. The data are presented descriptively as frequencies and percentages, which are summarized in the accompanying tables.

Results

Participant characteristics:

A total of 190 pharmacy students participated; the sample was predominantly female (n = 163; 85.8%) and the mean their ages is (21.7± 2 years). Most participants were Libyan nationals (n = 187; 98.4%) and reported urban residence (n = 180; 94.7%). Other socio demographic distributions are summarized in Table 1.

Table 1. Socio-demographic characteristics of the study participants in the Faculty of Pharmacy at the University of Benghazi, (n=190)

Variables	Frequency	Percentage
Gender		
Male	27	14.2 85.8
Female	163	
Age (in years)		
18-20	34	17.9
21-24	90	47.4
>24	66	34.7
Nationality		
Libyan Non-Libyan	187 3	98.44 1.56
Residence Type		
House Flat	106	55.7
Farms	74	38.9
	10	5.4
Residential Area		
Urban Rural	180 10	94.7 5.3

Table 2. Awareness of toxoplasmosis and sources of information among pharmacy students, University of Benghazi (n = 190)

Variable / item	Category / response	Frequency	Percentage
Heard of toxoplasmosis	Yes	76	40.0 %
	No	114	60.0 %
Main sources of information (n =76)	General information	35	46.1 %
	Media	18	23.7 %
	Awareness campaigns	10	13.2 %
	Physician/doctor	6	7.8 %
	College	4	5.3 %
	Internet	3	3.9 %

Only 40.0% (76/190) reported prior awareness of toxoplasmosis while 60% were unaware of this item that knew about a disease called toxoplasmosis (Table, 2). However, this difference is not statistically significant (p= 0.712), and among those aware, the most common source was general unspecific information (46.1%) and media (23.7%), other sources shows little percentage, so there are no significant differences between different sources of information about toxoplasmosis (p= 0.932). Formal educational sources and

health professionals were less commonly cited. This suggests passive exposure rather than structured teaching as the predominant information pathway.

Table 3. Knowledge of causative agent and perceived transmission routes of toxoplasmosis among pharmacy students, University of Benghazi (n = 190)

Variable / item	Category / response	Frequency	Percentage
Cause of toxoplasmosis (n = 76)	Parasite	34	44.7 %
	Bacteria	17	22.4 %
	Virus	8	10.5 %
	Fungi	3	4.0 %
	I don't know	14	18.4 %
Perceived main transmission routes (n = 76)	Contaminated food/other (incl. water)	28	36.8 %
	Direct contact with cats	22	29.0 %
	Contamination with cat feces	13	17.1 %
	Undercooked meat	1	1.3 %

Table 3 summarizes respondent's knowledge of causative agent and perceived transmission of toxoplasmosis. Of 76 pharmacy students who aware of having heard of toxoplasmosis, fewer than half (44.7%) correctly identified a parasite as the causative agent; substantial proportions misattributed the cause to bacteria (n = 17; 22.4%) or reported "I don't know" (n = 14; 18.4%), so knowledge about cause of toxoplasmosis shows significantly different (p = .073). Perceptions of transmission routes with significant different (p = 0.472), were mixed: 28 (36.8%) named contaminated food/water or other non-specified routes, 22 (29.0%) cited direct contact with cats, 13 (17.1%) indicated contamination with cat feces and only 1 (1.3%) identified undercooked meat.

Table 4. Cat ownership and cat practices among pharmacy students, University of Benghazi (n = 190).

Variable / item	Category / response	Frequency	Percentage
Keep cats at home	Yes	44	23.2 %
	No	146	76.8 %
Cleaning cat's litter	Daily	22	50.0 %
	Weekly	18	40.9 %
	No fixed schedule	4	9.1 %
Veterinary examination frequency	Regular	18	40.9 %
	Occasional	15	34.1 %
	Non	11	25.0 %
Cat indoor/outdoor status	Indoor only	18	40.9 %
	Indoor/ out door	26	59.1 %

About one fourth of respondents reported cat ownership (n=44), there are a high significant differences were showed (p = 0.002), among owners, half performed litter cleaning frequently (50.0% daily), no significant differences (p. value .012), and higher level of knowledge about regular and occasional veterinary examination (75%) with highly

significant difference ($p=0.000$), indicating potential risk behaviors that could facilitate Toxoplasma exposure or missed opportunities for preventive advice (table, 4).

Table 5. Clinical awareness, diagnostic and treatment knowledge among pharmacy students, University of Benghazi (n = 190).

Variable	Response	Frequency	Percentage
Recognized symptoms (any)	Yes	164	86.3 %
	No	26	13.7 %
Perceived toxoplasmosis dangerous in pregnancy	Yes	48	25.3 %
	No	142	74.7 %
Recognized fetal/vertical transmission	Yes	164	86.3 %
	No	26	13.7 %
Perceived toxoplasmosis causes miscarriage / prematurity	Yes	103	54.2 %
	No	87	45.8 %
Knowledge of (IgG/IgM) testing	Yes	84	44.2 %
	No	106	55.8 %
Knowledge appropriate treatment	Yes	70	36.8 %
	No	120	63.2 %

Although the vast majority of students (86.3%) in the entire sample (n = 190) are able to recognize toxoplasmosis symptoms and an equal percentage are aware of vertical (fetal) transmission and 54.2% out of them aware causes premature birth or miscarriage, there are still significant clinical knowledge gaps. Fewer people report being familiar with important diagnostic and management components (44.2%) with IgG/IgM serologic testing and 36.8% with appropriate treatment, and only 25.3% believe that toxoplasmosis is dangerous during pregnancy (table 5).

Discussion

This study assessed awareness and knowledge of toxoplasmosis amongst students of pharmacy at the University of Benghazi. Overall awareness was modest – only 76/190 (40.0%) of respondents had ever heard of toxoplasmosis, and of these, fewer than half (34/76; 44.7%) correctly identified a parasite as the causative agent. Despite most participants reporting knowing symptoms (164/190; 86.3%), detailed understanding of severity, congenital risk, diagnosis, and treatment was limited: severity/ risk factors: 48/190, 25.3%; belief in fetal transmission: 84/190, 44.2%; knowledge of IgG/IgM testing: 29/190, 15.3%; knowledge of appropriate treatment: 10/190, 5.3%. These findings suggest superficial familiarity with toxoplasmosis but inadequate depth of knowledge necessary for competent counseling and public health action.

This pattern outlined here – low overall awareness and significant gaps in disease-specific knowledge of university students – is consistent with the findings of various regional and international studies. Ait Hamou et al. reported limited awareness among university students in Rabat, Morocco, with a large number of students lacking proper knowledge of transmission and prevention measures [6]. Similar knowledge deficits were also noted among female cohorts at universities in Jordan and Saudi Arabia, where the knowledge of congenital risk and preventive practices was found to be suboptimal [8,9]. Investigations from other contexts similarly demonstrate that while general familiarity with symptoms of toxoplasmosis may be common, recognition of transmission routes key to prevention, notably undercooked meat and contaminated food/water, and methods of diagnosis are often suboptimal [21,5]. Investigations of nursing and allied health students similarly document lapses in knowledge about transmission and prevention in pregnancy and

confirm that such deficiencies are not confined to pharmacy students [22]. In total, these data suggest a repeating global pattern whereby superficial awareness does not translate into accurate, actionable knowledge among young adults and future health professionals. The observed gaps are of particular concern in view of the serious congenital consequences of primary infection during pregnancy [2,3]. While 54.2% of respondents perceived toxoplasmosis as dangerous in pregnancy, fewer recognized vertical transmission or its association with miscarriage/preterm birth; such under-recognition risks missed opportunities for prevention counseling and antenatal screening. Pharmacy students – as future frontline medication experts and health educators – require sufficient knowledge to counsel pregnant women on appropriate avoidance behaviors (hand and food hygiene, safe handling of cats/litter, properly cooked meat) and to understand serologic screening and referral pathways [4,1]. Low familiarity with IgG/IgM testing and treatment among respondents highlights a curricular gap with potential clinical implications; several studies emphasize the clinical importance of timely serologic testing and appropriate management to reduce fetal risk [1,20]. The long clinical and research history of toxoplasmosis underlines both the complexity of the infection and the continuing need for improved prevention and diagnostic efforts [23]. The strong association of gender with awareness in our sample suggests demographic differences in prior exposures to information; similar demographic and educational predictors have been reported elsewhere and may reflect cultural, curricular, or information access differences [7,13]. No association was seen between age group and awareness in the supplied counts, suggesting that within this relatively narrow range of student ages, awareness does not vary appreciably with age. Previous studies have determined that targeted educational interventions such as lectures, workshops, and campaigns can significantly enhance knowledge and preventive practices [19,20,11]. Since the most common information source among those aware was unspecific "general information," structured curricular integration and campus awareness campaigns are likely to be more effective in the delivery of accurate evidence-based messages than passive media exposure alone [6,24]. Public health guidelines and international health organization recommendations endorse systematic screening and education initiatives for at-risk populations as a strategy to prevent congenital toxoplasmosis [25].

Conclusion

This investigation concludes that pharmacy students at the University of Benghazi possess inconsistent and inadequate knowledge concerning the clinical presentation, routes of transmission, and congenital consequences of toxoplasmosis. Such deficiencies pose a direct threat to public health, as they impair the competency of future healthcare providers in delivering crucial preventive counseling, especially to women of reproductive age. For this reason, we strongly recommend creating focused educational programs for pharmacy students. By consistently adding this training to their curriculum and supporting it with campus health programs, we can change these students from having mixed levels of knowledge into confident leaders who can teach others how to prevent toxoplasmosis.

Recommendations:

- Integrate focused toxoplasmosis content into pharmacy courses (etiology, transmission, diagnosis, treatment, pregnancy risk).
- Develop short continuing education modules and patient counseling scripts for pharmacy students and practicing pharmacists.
- Conduct campus awareness campaigns emphasizing food safety, hand hygiene, safe handling of cat litter, and risks during pregnancy.
- Repeat the study with a larger, multi-faculty sample and include pre-/post-assessments around educational interventions.

Conflicts of interest

The authors declare no conflicts of interest.

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