



**Salahaddin University - Erbil**

# **Toxoplasmosis – Knowledge Among University Student In Erbil In Kurdistan**

**Research Project**

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**Prepared by**

**Emman Jabar Bakr**

**Supervised by**

**Dr. Khder Niazi Nooraldeen**

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## **Abstract**

Toxoplasmosis is a zoonotic disease; the disease is spread worldwide due to *Toxoplasma gondii*. This obligate intracellular parasite has the ability to infect a considerable range of nucleated cells and can propagate in the intermediate host. While this infection is usually asymptomatic in healthy individuals, it can also lead to severe ocular or neurological outcomes in immunocompromised individuals or in developing fetuses. The aim of this study was to evaluate the knowledge and prevention methods against toxoplasmosis among students of Salahaddin University - Erbil, including routes of transmission, symptoms, and prevention. For this purpose, 118 undergraduate students, from different departments participated in the survey. No information was given during the survey. More than half of students (60.17%) reported that they have never heard or read about toxoplasmosis, (55.65%) did not know someone infected with toxoplasmosis. Only 20% of the students knew that toxoplasmosis was caused by infection. A high percentage of the students (76.52%) were reported that there are no clinical manifestations for toxoplasmosis. About half of students (53.04%) were sure of ways to avoid toxoplasmosis. Regarding prevention methods, high percentages of students reported always washing hands after gardening (81.03%), handling cat feces (47.83%), and handling raw meat (86.21%). In conclusion, these findings highlight the urgent need for awareness on *Toxoplasma* and prevention education among university students. Universities should play an effective role in raising awareness among students about the disease.

**Keywords:** knowledge, awareness, toxoplasmosis, university, Erbil

## Introduction

*Toxoplasma gondii* is an intracellular opportunistic parasite that causes toxoplasmosis ( Mahfouz , M.S. And et al 2019 ) . Toxoplasmosis is a worldwide zoonotic infectious disease caused by *Toxoplasma gondii* ( Martine , A and .et al 2020 ) . This parasite can infect humans and all warm - blooded animals , including mammals and birds ( Laboudi , M. et al 2020 ) . The disease is caused by the apicomplexan parasite ( *T. gondii* ) , which infects approximately one third ( 25-30 % ) of the human population worldwide ( Hattoufi , K. and et al 2022 ) . It has been known for many years that *T. gondii* can cause delusions , auditory hallucinations , and other psychotic symptoms . As early as 1951 , shortly after it had been first established that *T. gondii* could infect humans , a woman working with toxoplasmosis in a laboratory became infected , confirmed by a skin test . Among her symptoms were difficulties in concentrating or in following a conversation and feelings of being " far away , as if my body wasn't there ( Torrey , E.F , 2022 ) . Infection in humans usually occurs by consumption of meat from infected animals or by ingestion of water or food contaminated with feces from infected cats ( Hernandez , N.V. and et al 2019 ) . Toxoplasmosis is not transmitted from person - to - person , except in instances of congenital transmission and organ transplantation ( Zhou , Z. and et al 2020 ) . Congenital toxoplasmosis , which is an effect of vertical transmission of tachyzoites from mother to fetus through the placenta , should be also mentioned ( Golec , K.S.and Paulowska , M.2021 ) . The *Toxoplasma gondii* life cycle includes sporogony ( sexual reproduction in definitive hosts ) and schizogony ( asexual reproduction in intermediate hosts ) . Cats are the only definitive hosts of this parasite and become infected by eating meat ( mostly rodents , birds , or slaughterhouse remains ) containing tissue cysts or by ingesting oocysts from the soil . Bradyzoites released from tissue cysts form schizonts in the intestine of cats . After merulation , schizonts release merozoites . Only in cats can the parasite form gametocytes , which further develop into gametes After fertilization , they form oocysts , which are shed in feces . However , only sporulated oocysts containing sporozoites become infective for intermediate hosts . In intermediate hosts , upon oral uptake , sporozoites transform into the invasive tachyzoite stage . Tachyzoites are proliferative , fast- multiplying forms the parasite . They can multiply in a variety cells and eventually encyst in several tissues , particularly in the brain . Tissue cysts can be found in the retina , brain , skeletal and heart muscle . They are the infective stages for intermediate and definitive hosts . ( Golic , K.S.and et al 2021 ) . in cases where the immune system is compromised , such as in a developing fetus or in

patients with HIV , undergoing cancer chemotherapy or immunosuppressive treatment for organ transplantation , the parasite can transition to an active , fast replicating , and tissue damaging tachyzoite form . Depending upon localization of the tachyzoites , active infection can cause , among other conditions , myocarditis , blindness , and encephalitis and is associated with a high mortality rate for HIV patients , even for those on active antiretroviral treatment . The recommended first - line treatment for toxoplasmosis is a combination therapy based on ( 1 ) pyrimethamine and ( 2 ) sulfadiazine , ( 3 ) supplemented with leucovorin ( also known as folinic acid ) to protect against bone marrow suppression ( Hopper , A.T. et al 2019 ) . The aim of the study aimed to assess the knowledge , attitude and preventive behaviour regarding toxoplasmosis among students of salahaddine University in Irbil in Iraq . Information obtained in this study may help for an optimal planning of education on prevention against toxoplasmosis and its sequel in housewives and their families .

## **Material and method**

A representative cross - sectional study was conducted with university students from the Salahaddin University -Erbil , Kurdistan Region , Iraq , to assess the knowledge about some essential aspects of toxoplasmosis as transmission routes , disease manifestations , and preventive practices . The study was carried out with students from all grades of undergraduate students , 450 sample was distributed by area of study . This questionnaire was self - completed without the participation of the researchers , and the identification data was kept anonymous . The first question ( Do you know what toxoplasmosis is ? ) was a defining factor for counting other responses . Another closed questions , in which the respondent could indicate " yes " or " no " , were designed to assess knowledge on the subject . These questions were grouped into categories : After completing the questionnaire , participants received information about toxoplasmosis and prevention practices . To calculate the sample size , we used a 5 % significance level , with an 26,000 population size ( undergraduate students at day time period ) and a confidence coefficient of 95 % . With  $N = 10,000$  , a minimum sample size of 118 students was obtained . To statistical analyses , correct answers received a score of " 1 " and an incorrect score of " 0 " . A quasibinomial linear .



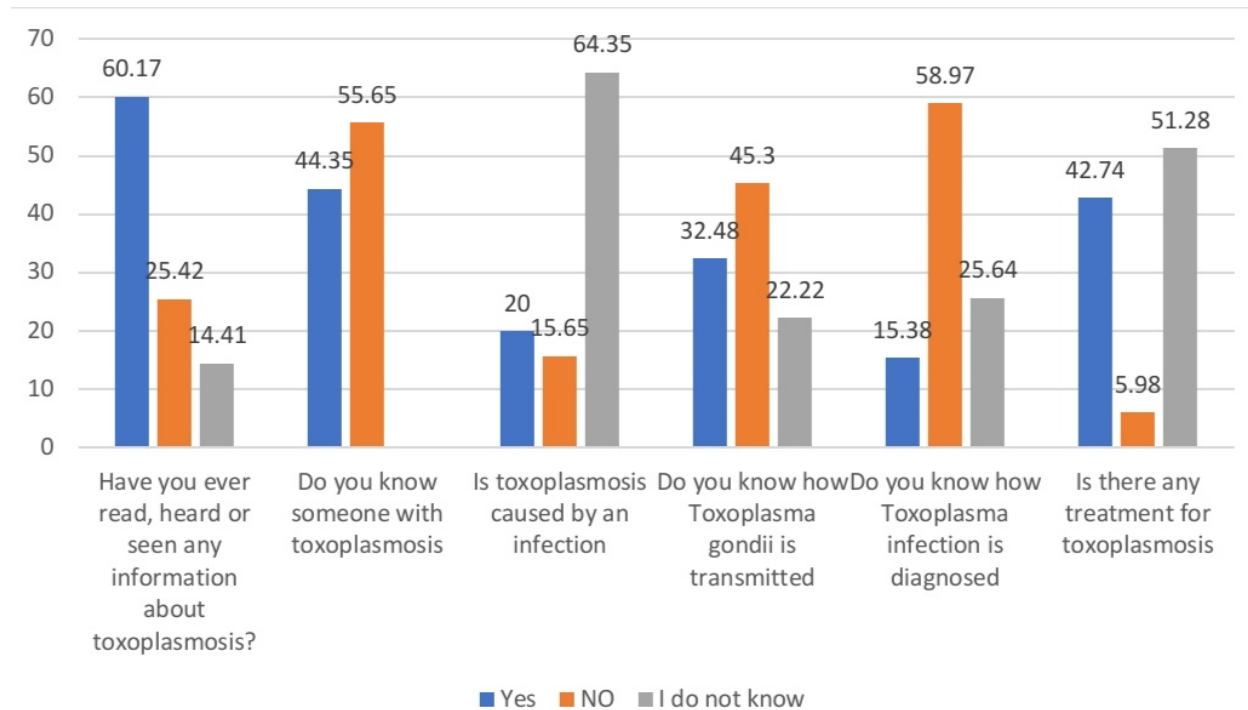
## **Results**

Of the 118 randomly selected students of Salahaddin university - Erbil, most were aged 21 years (28.81%) and lowest was 17 years (1.69%), of whom 22.88% are males and 77.12% were females. Students surveyed in the study were between 17 and over 23 years of age. There was unequal participation from students in rural (17.95%) suburban 20(.51%) and urban (61.54%) areas. Of the five colleges of Salahaddin university -Erbil from which the participants were selected, the highest proportion of respondents was from college of Education (0935%) and the lowest from the college of arts (4.39%). The majority of students 90.43% were single, while 9.57%) were married. Further, 65.52% were from plains (Table 1).

**Table 1: Participants' background characteristics**

<b>Variables</b>	<b>Frequency (%)</b>
sex	
female	77.12%
male	22.88%
College	
Arts	7.6 %
Education	33.9%
Basic education	20.33%
Fine arts	8.5%
Science	29.7%
<b>age</b>	
17 yrs	1.69%
18 yrs	4.24%
19 yrs	16.10%
20 yrs	22.88%
21 yrs	28.81%
22 yrs	20.34%
≥23 yrs	5.93%
Marital status	
Married	9.57%
single	90.43%
<b>Residence</b>	
Rural	17.95%
Suburban	20.51%
Urban	61.54%
<b>Province</b>	<b>%</b>
Erbil	89.83%
Sulaymaniyah	8.47%
Kirkuk	0.85%
Others	0.85%
<b>Landforms</b>	
Highlands	34.48%
Plains	65.52%

More than half of students (60.17%) reported having “ever” heard or read about toxoplasmosis, and (55.65%) did not know someone with toxoplasmosis. However, regarding general knowledge about toxoplasmosis among students in Erbil, whether toxoplasmosis caused by an infection, with 64.35% of students responding (I do not know). Only 20.00% of the students knew that toxoplasmosis was caused by infection; but, at the same time, 32.48% of them knew how *Toxoplasma gondii* is transmitted. Only 42.74% of the students knew that there is a treatment for toxoplasmosis.



Figures 1. General information and knowledge about toxoplasmosis among students of Salahaddin university – Erbil.

54.24% of students reported that they you drink unboiled or untreated water, but only (23.89%) knew that *toxoplasma* infection can be transmitted by consumption of unboiled or untreated water but 57.52% were unsure. About (15.38%) reported that they allow cats to enter to the kitchen and (76.92%) clean cat feces. Only (17.09%) of the students were know about the role of meat, whether eating undercooked meat or handling venison meat were risk factors for toxoplasmosis. A

low percentage (28.81%) thought that people could get toxoplasmosis by eating unwashed fruits or vegetables, and (29.06%) reported that *Toxoplasma* can be found in soil (Table 3).

Table 2 . Risk factors of toxoplasmosis among students of Salahaddin university - Erbil

Questions	Yes	NO	I do not know	Total
Do you drink unboiled or untreated water	54.24%	37.29%	8.47%	100.00%
Can <i>Toxoplasma</i> infection be transmitted by consumption of unboiled or untreated water	23.89%	18.58%	57.52%	100.00%
If you have cats, do you allow cats to enter to the kitchen?	15.38%	49.57%	35.04%	100.00%
Do you clean cat feces?	11.11%	76.92%	11.97%	100.00%
Can cats transmit <i>Toxoplasma</i> infection	47.01%	8.55%	44.44%	100.00%
Can <i>Toxoplasma</i> be found in cat feces?	38.46%	5.13%	56.41%	100.00%
Can <i>Toxoplasma</i> infection be transmitted by consumption of raw meat?	17.09%	17.95%	64.96%	100.00%
Can <i>Toxoplasma</i> infection be transmitted by consumption of unwashed fruits or vegetables?	28.81%	17.80%	53.39%	100.00%
Can <i>Toxoplasma</i> infection be transmitted by blood transfusion?	30.77%	17.09%	52.14%	100.00%
Can <i>Toxoplasma</i> be found in soil?	29.06%	11.97%	58.97%	100.00%

A high percentage of the students, (76.52%) were reported that there is no clinical manifestations for toxoplasmosis. Meanwhile, a high percentage of students (64.04%) were unsure about that if *Toxoplasma* can cause eye disease. Students in the study were most knowledgeable about the fact that toxoplasmosis in pregnant women (55.65%) can lead to miscarriages. At the same time, a high percentage of students (61.06%) knew that unborn and/or newborn children can develop serious complications after infection with toxoplasmosis. A small percentage (21.24%) of

students also knew that toxoplasmosis in a pregnant woman can cause no symptoms. However, (48.28%) of students were unsure about the treatment of toxoplasmosis in babies. development of vision problems in babies infected with toxoplasmosis. (Table 4).

Table 3. Symptoms knowledge of toxoplasmosis among students of Salahaddin university - Erbil

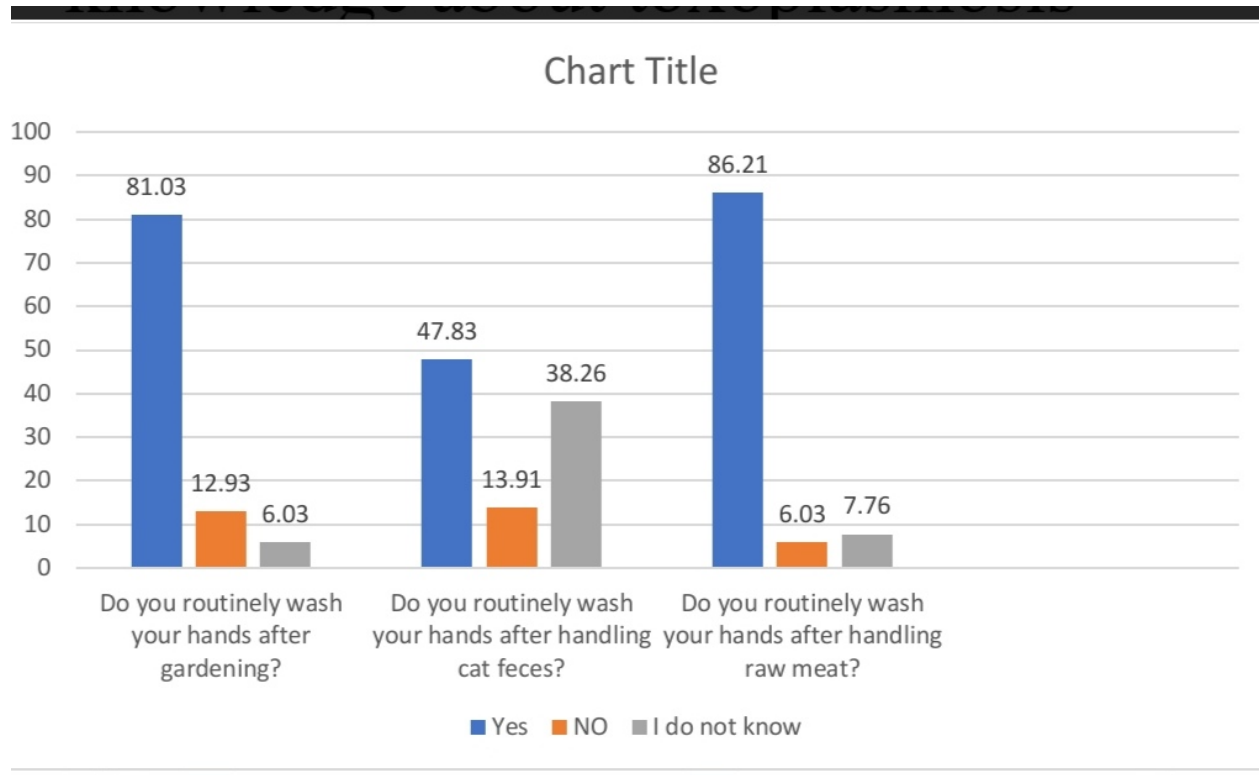
Questions	Ye s	N O	I do not know	Tot al
Do you know the clinical manifestations of toxoplasmosis?	23. 48 %	76. 52 %		100 .00 %
Can <i>Toxoplasma</i> cause miscarriages?	55. 65 %	10. 43 %	33.91 %	100 .00 %
Can <i>Toxoplasma</i> cause eye disease?	24. 56 %	11. 40 %	64.04 %	100 .00 %
Can unborn and/or newborn children develop serious complications after infection with toxoplasmosis	30. 97 %	7.9 6%	61.06 %	100 .00 %
Can toxoplasmosis in a pregnant woman cause swollen glands (lymph nodes)?	44. 74 %	7.0 2%	48.25 %	100 .00 %
Can toxoplasmosis in a pregnant woman cause no symptoms?	21. 24 %	23. 89 %	54.87 %	100 .00 %
Toxoplasmosis ( <i>T. gondii</i> ) is rarely passed from a pregnant woman to her fetus if she was infected before becoming pregnant?	18. 42 %	17. 54 %	64.04 %	100 .00 %
A baby with toxoplasmosis may be treated with medicine.	38. 79 %	12. 93 %	48.28 %	100 .00 %

About half of students (53.04%) were sure of ways to avoid toxoplasmosis, such as the type of cat food (47.83%) and changing the cat's litter box (61.74%). In addition, students were unsure that cooking meat well (42.24%) and thoroughly washing and peeling fruits and vegetables before eating them (46.96%) were also ways to avoid toxoplasmosis. Finally, students were unsure that cleaning all cutting boards thoroughly after each use (43.97%) may prevent toxoplasmosis (Table 5).

Table 4. Prevention knowledge about toxoplasmosis among students of Salahaddin university - Erbil

Questions	Ye s	N O	I do not know	Tot al
Do you know how to avoid toxoplasmosis?	53. 04 %	46. 96 %		100 .00 %
Ways to avoid toxoplasmosis include: feeding your cat dry or commercial cat food and not letting it kill and eat rodents.	47. 83 %	13. 91 %	38.26 %	
Ways to avoid toxoplasmosis include: avoiding stray cats.	68. 70 %	11. 30 %	20.00 %	
Ways to avoid toxoplasmosis include: making sure the cat's litter box is changed daily.	61. 74 %	14. 78 %	23.48 %	
Toxoplasmosis can be prevented by cooking meat well until no pink is seen and the juices run clear.	42. 24 %	16. 38 %	41.38 %	
Toxoplasmosis can be prevented by thoroughly washing and/or peeling all fruits and vegetables before eating them.	46. 96 %	10. 43 %	42.61 %	
Toxoplasmosis may be prevented by cleaning all cutting boards and utensils thoroughly after each use.	42. 24 %	13. 79 %	43.97 %	
Can <i>Toxoplasma</i> be inactivated by freezing meat?	19. 30 %	21. 93 %	58.77 %	

High percentages of students reported always washing hands after gardening (81.03%), handling cat feces (47.83%), and handling raw meat (86.21%). (Table 6).



Figures 2. Preventive behavior about toxoplasmosis among students of Salahaddin university - Erbil

## Discussion

Demographic results of this study indicate that the study population was heterogeneous in terms of sex , college , age , marital status and area of residence . There was an alarming lack of awareness and knowledge among our sample about the cause of toxoplasmosis , the potential presence of the causative agent in cat feces , contaminated water , and raw or undercooked meats , and the association of toxoplasmosis with miscarriage and / or sterility in women . A high percentage of the respondents ( 55.65 % ) knew that toxoplasmosis can cause miscarriages in pregnant women . Previous studies have shown the importance of teaching students about the life cycle of *T. gondii* to minimize their risk of being infected during pregnancy ( 19 , 20 ) . This is particularly important because the majority of pregnant women are at higher risk of being infected through ingesting tissue cysts through eating undercooked meats than from contact with cats , for example ( 7 ) . In addition , knowledge of the risk factors related to toxoplasmosis was also poor in our sample , particularly eating undercooked meat , and that *Toxoplasma* can be found in cat feces , which exposes students to contamination . These risk factors were identified by Cook and colleagues ( 7 ) . Our findings on awareness of risk factors are congruent with those in the Saudi Arabia : Jazan University Female Students showed low awareness that undercooked meat is a risk factor for acquiring toxoplasmosis ( 18 ) . On the one hand , most respondents in this study indicated that toxoplasmosis infection during pregnancy would have negative consequences on the fetus or miscarriage . On the other hand , our findings highlight a lack of knowledge about certain aspects , including symptoms and timing of infection . Moreover , participants in our study showed a lack of knowledge of ways to prevent and avoid toxoplasmosis , especially practices related cooking meats and washing fruits and vegetables ( 7 ) . Our sample reported proper practices and behaviors related to prevention of toxoplasmosis , including washing hands after gardening and after handling raw meat , but poor practices related to washing hands after handling cat feces . Because of the asymptomatic nature of primary toxoplasmosis , counseling of pregnant women is of paramount importance to reduce the risk of fetal infection . Effective counseling for prevention requires teaching the risk factors associated with the transmission of the parasite ( 19 , 20 ) . Dissemination of appropriate knowledge by healthcare professionals to prevent infection is necessary . For example , health education was associated with a 63 % decrease in toxoplasmosis



seroconversion in Belgium ( 12 ) . A Canadian study at prenatal clinics demonstrated that educating women about the risk factors of toxoplasmosis by trained personnel resulted in an improvement of preventive practices and prevented serious pregnancy related complications . Severe congenital infection due to toxoplasmosis usually occurs in countries that do not provide prenatal educational prevention programs for congenital toxoplasmosis ( 11 ) . In Poland , knowledge about toxoplasmosis increased after a multipronged public health educational program ( 25 ) .

## **Conclusion**

In conclusion , these findings highlight the urgent need for toxoplasmosis awareness and preventive education among students of universities . An effective education and outreach program should cover important topics concerning risk factors and measures to prevent toxoplasmosis . Colleges and universities could be great locations to reach and teach this target group about the impact of zoonotic diseases on feminine health , particularly toxoplasmosis .

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