

SEROPREVALENCE OF TOXOPLASMOSIS IN REPRODUCTIVE-AGE WOMEN AND ANIMALS WITH FIRST MOLECULAR CHARACTERIZATION OF TOXOPLASMOSIS GONDII ISOLATED FROM CATS IN ASWAN GOVERNORATE, EGYPT

AHMED K. DYAB ^{1,2}; HESHAM E. OSMAN ³; REHAB M. DESOKY ⁴;
HEBA M. NAGEEB ⁵ AND MAHMOUD ABDELHAMID ⁶

¹Department of Medical Parasitology, Faculty of Medicine, Assiut University, Assiut 71515, Egypt.

²Department of Parasitology, School of Veterinary Medicine, Badr University in Assiut, New Nasser City, Assiut, Egypt. ORCID 0000-0002-4021-7904

³Department of medical parasitology, Faculty of Medicine- Sohag University 82511, Egypt

⁴Department of medical parasitology, Faculty of Medicine- Aswan University Aswan, Egypt.

⁵Department of Medical Microbiology & Immunology, Faculty of Medicine, Aswan University, Aswan, 81528, Egypt

⁶Department of Parasitology Faculty of Veterinary medicine, Aswan University, Aswan, 81528, Egypt.

Received: 13 May 2025; **Accepted:** 4 June 2025

ABSTRACT

Toxoplasmosis is a widespread parasitic zoonosis caused by *Toxoplasma gondii*. Toxoplasmosis can cause congenital abnormalities during pregnancy, abortions, and encephalitis in both people and animals. The present study aimed to investigate the seroprevalence of toxoplasmosis in reproductive-age women and ruminants. Moreover, molecular identification was assessed for *T. gondii* isolated from cats, for the first time, in Aswan Governorate, Egypt. Blood samples were obtained, and serum was isolated from reproductive-age women (n=178) and ruminant animals (n=150) from the same locality. Seroprevalence of toxoplasmosis was determined using a rapid test (RT) and ELISA kits. Additionally, fecal samples from 100 cats were collected for the detection of *T. gondii* oocysts, and then processed by PCR for molecular and phylogenetic analysis. The phylogenetic tree was designed using the sequences collected and uploaded to the GenBank database. For human toxoplasmosis, IgM (ELISA) was more diagnostic twice than IgM (RT), and the percentages were 24.2% and 10.1%, respectively. However, IgG (ELISA) prevalence rate was 66.3 %, and the IgG (RT) was 62.9 %. Moreover, the seroprevalence rate of toxoplasmosis in ruminants was 23.3% and 25.3% for IgM (ELISA) and IgM (RT), respectively. The results of toxoplasmosis prevalence in humans and ruminants were statistically significant ($P \leq 0.001$). Toxoplasmosis was 30% of the examined cats. The present study has identified two distinct gene sequences for *T. gondii* that are associated with the gender of cats. Our findings detected that women of reproductive age and companion animals are more likely to be exposed to *T. gondii*.

Keywords: Toxoplasmosis, Seroprevalence, Human, Animals, Molecular, Phylogenetic, Zoonotic, Aswan

Corresponding author: Ahmed K. Dyab

E-mail address: ahmed2015@aun.edu.eg

Present address: ¹Department of Medical Parasitology, Faculty of Medicine, Assiut University, Assiut 71515, Egypt. ²Department of Parasitology, School of Veterinary Medicine, Badr University in Assiut, New Nasser City, Assiut, Egypt. ORCID 0000-0002-4021-7904

INTRODUCTION

Toxoplasma gondii is an apicomplexan and obligatory intracellular parasite that causes toxoplasmosis in both humans and animals globally. Approximately 30% of people worldwide possess the toxoplasmosis infection (Aguirre *et al.*, 2019; Omonijo *et al.*, 2022; Qosimov *et al.*, 2025). The Felidae family, which includes cats, is the final host for *T. gondii*, while humans and other warm-blooded animals serve as intermediate hosts. (Abdelbaset *et al.*, 2022; González-Barrio *et al.*, 2024). Oocyst, tachyzoite, and bradyzoite are the three main morphologies that *T. gondii* displays. Humans contract the parasite by eating undercooked meat that has bradyzoites or by ingesting water or food tainted with sporulated oocysts from cat excrement. Additionally, organ donations, blood transfusions, and congenital transmission to fetuses from infected mothers can also transmit infection (Ducrocq *et al.*, 2021; Schwenk *et al.*, 2021; Araujo Coelho *et al.*, 2024). Recently, some studies indicated that *T. gondii* can spread in people through sexual contact (Tong *et al.*, 2023).

Immunocompromised patients may develop life-threatening consequences such as myocarditis, encephalitis, or disseminated toxoplasmosis, but immunocompetent individuals often show no symptoms from human toxoplasmosis infections (Dalimi *et al.*, 2012; Abdoli *et al.*, 2016). Furthermore, congenital toxoplasmosis is a potentially lethal condition that can cause early delivery, stillbirth, and abortion (Tüzkö *et al.*, 2024). Toxoplasmosis infections have been connected to several behavioral and neuropsychiatric conditions (Milne *et al.*, 2020). Some patients may have ocular problems, seizures, and impaired coordination are possible indications of a weakened immune system (Flegr *et al.*, 2013). There are no particular clinical indicators of human toxoplasmosis, so it is

crucial to use *T. gondii*-specific diagnostic techniques to get an accurate diagnosis (Chorawala *et al.*, 2024).

Toxoplasmosis is a major source of communal infection among animals worldwide. It causes reproductive problems, that lead to significant financial losses in the food animal sector. Given the high incidence of toxoplasmosis in ruminant animals, eating undercooked meat or milk contaminated with *T. gondii* can be a major way for human toxoplasmosis infection (Shariatzadeh *et al.*, 2021; Thebault *et al.*, 2021; Omonijo *et al.*, 2022). Epidemiological investigations of toxoplasmosis are spreading beyond humans to cover other animal hosts in the pursuit of preventative measures. To date, several surveys have been carried out to ascertain toxoplasmosis prevalence rates in humans and animals in different countries, using both serological and molecular techniques (Alzaheb *et al.*, 2018; Bigna *et al.*, 2020; Khan & Noordin, 2020; Sameeh *et al.*, 2021). Serological screening for antibodies to *T. gondii* is recommended for reproductive-age women to identify those at risk of contracting toxoplasmosis (Fanigliulo *et al.*, 2020). Therefore, the current study was conducted to assess the seroprevalence of toxoplasmosis in reproductive-age women and the accompanying animals in Aswan Governorate, Egypt. Additionally, determining the molecular characterization of *T. gondii*, which was isolated from domestic cats for the first time in this study area.

MATERIALS AND METHODS

Ethical considerations

The study was performed in compliance with the instructions of Aswan University Ethical Committee (No. Asw.U./446 /3/20). All patients were counselled, and informed consent was collected from

every patient. Ethical approval for the study on animals was conducted in compliance with all relevant Egyptian laws pertaining to research and publication.

Sampling and processing

Blood samples were obtained from 178 reproductive-age women attending the gynecology and obstetrics clinic of Aswan University, Aswan, Egypt, during the period from December 2022 to January 2024. The patients were between 18 to 50 years old with various gynecological and obstetric complaints. Additionally, blood samples were obtained from 150 ruminant animals (cattle, sheep, and camels). All samples were centrifuged at 3000xg for 10 minutes for serum separation. The separated sera were stored at -20 °C for serological examination. Moreover, one hundred fecal samples from cats were collected separately for fecal examination and molecular analysis. All animals appeared healthy and were in contact with humans in the same study area.

Seroprevalence assays

Antibodies of IgM and IgG against *T. gondii* were detected in both human and animal sera using rapid test (RT) kits. IgM and IgG ELISA kits (GMBH, Wiesbaden, Germany) were utilized following the guidelines provided by the manufacturer. The ELISA plate reader (Humareader, Germany) was used to measure the optical densities at two different wavelengths (450 nm and 630 nm). The ELISA plate reader's built-in software was used in point-to-point mode to ascertain the serum's level of anti-Toxoplasma IgM and IgG, based on a standard curve (Hassanain *et al.*, 2013).

Fecal examination

The fecal samples of cats were examined using the direct smear method to detect *T. gondii* oocysts. Moreover, oocysts were identified using flotation/sedimentation procedures. After being collected and placed in 2.5% potassium dichromate

(1:5), the unsporulated oocysts were inspected under a microscope for the presence of sporulated oocysts after five days.

DNA extraction and molecular analysis

As directed by the manufacturer, DNA was extracted from cat fecal samples using the QIAamp Fast Genomic DNA micro-Kit (Qiagen, Germany). The 529-RE mRNA gene primers were amplified using PCR (Table 1). DreamTaq Green PCR Master Mix (2X) (K1081, Thermo Fisher, USA) was used to amplify specified genes according to the manufacturer's specifications using a Creacon (Holland, Inc) Polymerase Chain Reaction (PCR) system cycler. The data were analyzed using a gel documentation system (Geldoc-it, UVP, England) and Totallab analysis software (www.totallab.com, Ver.1.0.1). Positive amplicons (513 bp) were recovered from the agarose gel. The resultant PCR products were purified using microspin filters and quantified spectrophotometrically. The phylogenetic tree of *T. gondii* was constructed and compared to previously registered sequences in GenBank.

Statistical Analysis

Statistical analysis was done by using SPSS version 25. Data was presented, and a suitable analysis was done using the chi-square test. The *p*-values ($P \leq 0.05$) were statistically significant.

RESULTS

Seroprevalence rate of toxoplasmosis in women & ruminants

The results of anti-*Toxoplasma* specific antibodies (IgM & IgG) using rapid test (RT) and ELISA assay are presented in Table (2). For human toxoplasmosis, IgM (ELISA) was more diagnostic twice than IgM (RT), and the percentages were 24.2% and 10.1%, respectively. On the other hand, regarding the old infection, the two techniques were nearly equal, with

IgG (ELISA) prevalence rate being 66.3 % and the IgG (RT) being 62.9 %. Moreover, the seroprevalence rate of toxoplasmosis in ruminant animals was 23.3% and 25.3% for IgM (ELISA) and IgM (RT), respectively. The results of toxoplasmosis prevalence in humans and ruminant animals were statistically significant ($P \leq 0.001$).

Toxoplasmosis in cats and molecular characterization

Out of 100 cat fecal samples, 30% had a prevalence rate with *T. gondii* by microscopic examination of the oocysts. *T. gondii* oocyst appears approximately spherical, measuring 10 to 12 μm in diameter by micrometry and has a smooth, thin shell, each containing two sporocysts, each with four sporozoites (Figure 1). The present study has identified two distinct gene sequences for *T. gondii* that are associated with gender. Specifically, the gene sequence related to male cat fecal matter is catalogued under accession number PQ558151, while the sequence for

female cats is registered under accession number PQ558152. Utilizing the MAGA program, a total of 24 gene sequences of *T. gondii* were analyzed across various hosts and countries, including one out-group gene, *Entamoeba nuttalli*, which is listed under accession number AB282671. The resulting phylogenetic tree revealed three clusters based on the Euclidean distance among the 24 gene sequences. Notably, the two gene sequences from male and female cats were positioned closely together within the first cluster, which also included six other genes exhibiting a high similarity percentage exceeding 99%. The base pair (bp) length of these related genes was consistently 546, except for one gene, registered under accession number M33572.1, found in Egypt, which had a bp length of 1404. Furthermore, the two gene sequences found in this investigation shared a tight relationship with the *T. gondii* gene found in Northwestern Italy (Table 3 & Figure 2).

Table 1: The primer sequences for PCR.

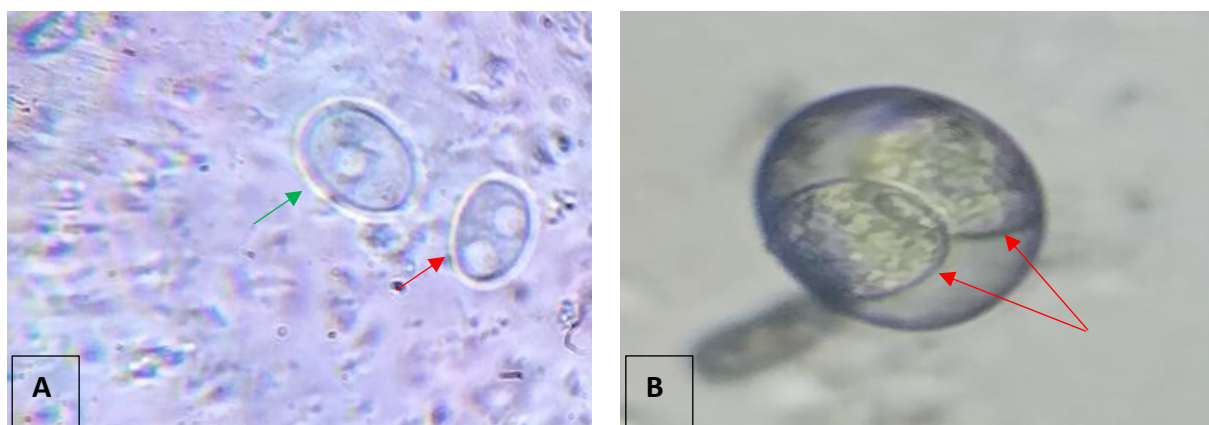
Primer name	Sequence (5'-3')	Gene	bp	Reference
Tox-4	CGCTGCAGGGAGGAAGACGAAA GTTG	529-RE mRNA	532	(Homan et al., 2000)
Tox-5	CGCTGCAGACACAGTGCATCTG GATT			

Table 2. The seroprevalence rate of toxoplasmosis in humans and ruminant animals.

Species	Test	Total examined	Infected (+)	Not infected (-)	Prevalence (%)	P value
Human	IgM (RT)	178	18	160	10.1	P value 0.0000 X ² = 173.67
	IgM (ELISA)		43	135	24.2	
	IgG (RT)		112	66	62.9	
	IgG (ELISA)		118	60	66.3	
Ruminant animals	IgM (RT)	150	38	112	25.3	P value 0.0000 X ² = 61.13
	IgM (ELISA)		35	115	23.3	
	IgG (RT)		91	59	60.6	
	IgG (ELISA)		71	79	47.3	

Table 3. The gene sequences of *T. gondii* according to different hosts and countries.

#	Detected pathogens	Accession number	Country	bp	Host	Identity (%)	Query Cover
1	<i>T. gondii</i>	PQ558151	Upper Egypt	513	Males Cat	Current gene sequence	
2		PQ558152	Upper Egypt	513	Female Cat	Current gene sequence	
3		KT881317	Australia	507	Domestic cats	99.21%	98%
4		MG587997.1	Northwestern Italy	546	Cattle	99.60%	98%
5		MG587998.1	Northwestern Italy	546	Cat	99.60%	98%
6		MG588009.1	Northwestern Italy	546	Swine	99.60%	98%
7		M33572.1	Egypt	1404	Cat	99.60%	98%
8		MG588006.1	Northwestern Italy	546	Sheep	99.60%	98%
9		MG588008.1	Northwestern Italy	546	Wild boar	99.60%	98%
10		MG587992.1	Northwestern Italy	546	Fox	99.60%	98%
11		MG588002.1	Northwestern Italy	546	Goat	99.60%	98%
12		MG588005.1	Northwestern Italy	546	Deer	99.60%	98%
13		MG587996.1	Northwestern Italy	546	Bovine	99.60%	98%
14		MG588011.1	Northwestern Italy	546	Bovine	99.41%	98%
15		MG587988.1	Northwestern Italy	546	Wild boar	99.41%	98%
16		MG587995.1	Northwestern Italy	546	Bovine	99.41%	98%
17		AF249698.1	Iraq	1307	Cat	99.41%	98%
18		MG588010.1	Northwestern Italy	546	Wild boar	99.41%	98%
19		LN714498.1	North Africa	6937759	Dog	99.41%	98%
20		MG588000.1	Northwestern Italy	546	Swine	99.41%	98%
21		MG587999.1	Northwestern Italy	546	Wild boar	99.41%	98%
22		MG588004.1	Northwestern Italy	546	Fox	99.41%	98%
23		MG588003.1	Northwestern Italy	546	Fox	99.41%	98%
24		MG588001.1	Northwestern Italy	546	Bovine	99.21%	98%

**Fig. 1.** *Toxoplasma gondii* oocyst isolated from feces of cats showing: A). Unsporulated oocyst (green arrow) and sporulated oocyst (red arrow), B). Sporulated oocyst has a smooth, thin shell, and each contains two sporocysts (red arrows).

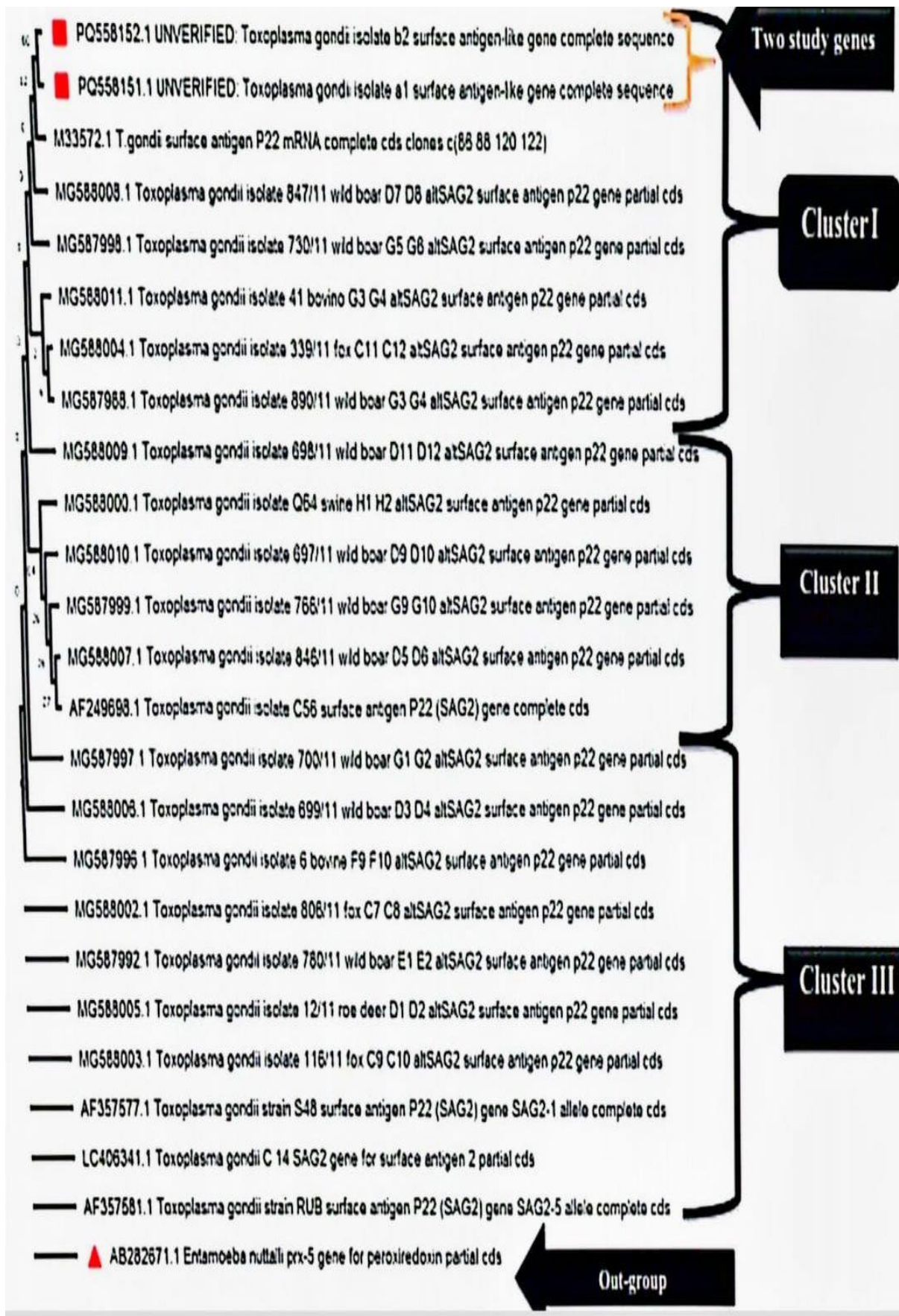


Fig. 2. Phylogenetic tree of *T. gondii* isolates from cats.

DISCUSSION

The seroprevalence of *T. gondii* in ruminant animals and reproductive-age- in the current investigation provided evidence of toxoplasmosis in these hosts. Human toxoplasmosis serological IgM results were 24.2% (ELISA) and 10.1% (RT), while IgG (ELISA) prevalence rate was 66.3 % and IgG (RT) was 62.9 %. Toxoplasmosis in ruminants was (23.3%) and (25.3%) of IgM (ELISA) and IgM (RT), respectively. The results of toxoplasmosis infection were statistically significant in both human & ruminant animals. These findings align with those reported by Ibrahim *et al.* (2017), indicating ELISA seroprevalence of toxoplasmosis in pregnant women (33.79 %) and sheep (17.65 %) in Gharbiya and Menoufia, Egypt. *T. gondii* high frequency in sheep was matched by considerable levels of human positivity. (Shaapan *et al.*, 2008) used a range of serological tests to detect elevated levels of antibodies of *T. gondii* in sheep, Cairo, Egypt, and prevalence rates ranging from 37.0% to 43.7%. Additionally, the presence of antibodies of *T. gondii* was identified in 52.4% and 44.1% of the workers and the animals, respectively, at Tanta abattoir, utilizing the indirect hemagglutination test. The crude *T. gondii* tachyzoite antigen is the starting material for making fractions that are utilized in various serologic assays to diagnose toxoplasmosis, which include IgM and & IgG antibodies. The actual antigenic molecules of *T. gondii* are intricate and varied. It is thought that interactions between the ligands of *T. gondii* and receptors on the target cells are responsible for the remarkably broad variety of hosts that are vulnerable to the parasite (Mohammadpour *et al.*, 2016).

The higher human and animal toxoplasmosis infections in Aswan Governorate, in the present results, may be due to its location in upper Egypt with a

humid and warm environment, which is conducive to *T. gondii* oocysts survival. Various seroprevalence rates were noted at various locations, which may be due to changes in the environment, hygienic conditions, and management techniques (Tavalla *et al.*, 2017; Zhu *et al.*, 2023). It is necessary to update recent ecological and etiological research on risk variables and new sources of human toxoplasmosis to address the mystery of its high prevalence in both humans and animals used for meat and milk production (Tonouhewa *et al.*, 2017; Nayeri *et al.*, 2022). The prevalence rate of toxoplasmosis in final & intermediate hosts varies worldwide depending on the diagnostic techniques, the socioeconomic structure of housing cats, and the eating habits of humans and animals. Whereas environmental variables in many communities show the importance of food and cultural habits in contributing to the socio-epidemiological features assumed to be crucial in the spread of this zoonosis (Al-Malki *et al.*, 2021; Karakavuk *et al.*, 2021; Adel *et al.*, 2024; Amouei *et al.*, 2025).

Our findings revealed a 30% prevalence rate of toxoplasmosis in cats accompanying women owners. This was consistent with previous studies that identified an interaction with cats, which are a key source of human toxoplasmosis infection (Ding *et al.*, 2017; Montazeri *et al.*, 2020). Cats are the final hosts of *T. gondii* and the main source of human & animal toxoplasmosis by releasing *T. gondii* oocysts into the environment. Therefore, consuming contaminated unwashed fruits and vegetables or drinking polluted water might spread the infection (Eslahi *et al.*, 2024). Hence, consuming undercooked contaminated meat of animals is a significant source of human toxoplasmosis (Belluco *et al.*, 2016).

Recent investigations have revealed gender-based distinctions in *T. gondii*,

with two cat fecal matter gene sequences catalogued under accession numbers PQ558151 and PQ558152. The phylogenetic analysis, based on Euclidean distances among 24 distinct genes, delineates three clusters. Notably, the genes are situated in close proximity within the first cluster, suggesting a potential overlap or prior identification in other studies, leading to their recent inclusion in Genbank. Furthermore, research conducted by (Zamora-Vélez *et al.*, 2020), which focused on genotyping of *T. gondii* DNA in cat feces in Colombia, indicated that the phylogenetic analysis resulted in the isolates forming a singular cluster. The analysis incorporating Brazilian and Chinese strains revealed robust support (PP < 0.99) for three principal clades, despite overall backing for the majority of the nodes. In the present study, a cluster of six genes exhibiting a high similarity percentage exceeding 99% was identified, along with the nearest base pair (bp) genes, all of which shared a base pair count of 546, with the exception of one gene under accession number M33572.1, which was located in Egypt and had a base pair count of 1404. Additionally, the two genes closely linked to *T. gondii* were discovered in Northwestern Italy. This aligns with the findings of (Prince *et al.*, 1990) and (Holec-Gąsior *et al.*, 2014), which indicated that the gene sequences of two new monoclonal antibodies produced against a membrane-enriched fraction of *T. gondii* tachyzoites were grouped with the present two genes. These antibodies successfully detected protein P22 on the surface of *T. gondii* through immunoblotting, complement-mediated cytolytic assays, and immunofluorescence.

CONCLUSION

T. gondii seroprevalence was detected for reproductive-age women & animals living in the same area. This study identified *T. gondii* genotypes, that are currently

circulating in cats in Aswan governorate, Egypt. Additional research is required to evaluate *T. gondii* genotypes in various intermediate hosts in Egypt.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

Data Availability Statement

The datasets generated during and/or analyzed during the current study can be found in the main text.

REFERENCES

- Abdelbaset, A.E.; Abushahba, M.F. and Igarashi, M. (2022): *Toxoplasma gondii* in humans and animals in Japan: An epidemiological overview. *Parasitology International*, 87, 102533.
- Abdoli, A.; Barati, M.; Dalimi, A.; Pirestani, M.; Shokouh, H. and Javad, S. (2016): Toxoplasmosis among patients with immunocompromising conditions: A snapshot. *Journal of Archives in Military Medicine*, 4(4), e41832.
- Adel, W.; Srivastava, H.M.; Izadi, M.; Elsonbaty, A. and El-Mesady, A. (2024). Dynamics and numerical analysis of a fractional-order toxoplasmosis model incorporating human and cat populations. *Boundary Value Problems*, 2024(1), 152.
- Aguirre, A.A.; Longcore, T.; Barbieri, M.; Dabritz, H.; Hill, D.; Klein, P.N. and Sizemore, G.C. (2019): The one health approach to Toxoplasmosis: epidemiology, control, and prevention strategies. *Ecohealth*, 16(2), 378–390.
- Alzaheb, R.A. (2018). Seroprevalence of *Toxoplasma gondii* and its associated risk factors among women of reproductive age in Saudi Arabia: a systematic review and meta-analysis. *International journal of women's health*, 537–544.
- Amouei, A.; Mizani, A.; Arabian, M.; Teshnizi, S. H.; Gevorgyan, R.; Amuei, F. and Aghayan, S.A. (2025):

- Prevalence of toxoplasmosis in natural ungulates as human zoonotic meat-borne pathogens: A systematic review and meta-analysis. *Journal of Food Science*, 90(4), e70172.
- Araujo Coelho, D.R.; Oliveira da Luz, R.; Soares Melegario, C.; Vieira, W.F. and Bahia-Oliveira, L.M. (2024): Knowledge gaps and educational opportunities in congenital toxoplasmosis: A narrative review of Brazilian and global perspectives. *Tropical Medicine and Infectious Disease*, 9(6), 137.
- Belluco, S.; Mancin, M.; Conficoni, D.; Simonato, G.; Pietrobelli, M. and Ricci, A. (2016): Investigating the determinants of *Toxoplasma gondii* prevalence in meat: a systematic review and meta-regression. *PloS one*, 11(4), e0153856.
- Bigna, J.J.; Tochie, J.N.; Tounouga, D.N.; Bekolo, A.O.; Ymele, N.S.; Youda, E.L. and Nansseu, J.R. (2020): Global, regional, and country seroprevalence of *Toxoplasma gondii* in pregnant women: a systematic review, modelling and meta-analysis. *Scientific reports*, 10(1), 12102.
- Chorawala, M.; Kothari, N.; Shah, A.; Pandya, A.; Shah, I. and Prajapati, B.G. (2024): Recent Trends in Toxoplasmosis Diagnosis and Management. *Rising Contagious Diseases: Basics, Management, and Treatments*, 314-336. <https://doi.org/10.1002/9781394188741.ch23>
- Dalimi, A. and Abdoli, A. (2012): Latent toxoplasmosis and human. *Iranian Journal of Parasitology*, 7(1), 1–17.
- Ding, H.; Gao, Y.M.; Deng, Y.; Lamberton, P.H. and Lu, D.B. (2017): A systematic review and meta-analysis of the seroprevalence of *Toxoplasma gondii* in cats in mainland China. *Parasites & Vectors*, 10, 1-12.
- Ducrocq, J.; Simon, A.; Lemire, M.; De Serres, G. and Lévesque, B. (2021): Exposure to *Toxoplasma gondii* through consumption of raw or undercooked meat: a systematic review and meta-analysis. *Vector-Borne and Zoonotic Diseases*, 21(1), 40–49.
- Eslahi, A.V.; Mamedova, S.; Nassiba, R. Karanis, P. (2024): Unveiling risks in healthy food: vegetables and fruits are linked to the distribution chain of protozoan parasites. *Food Microbiology*, 104592.
- Fanigliulo, D.; Marchi, S.; Montomoli, E. and Trombetta, C.M. (2020): *Toxoplasma gondii* in women of childbearing age and during pregnancy: seroprevalence study in Central and Southern Italy from 2013 to 2017. *Parasite*, 27, 2.
- Flegr, J. (2013): How and why *Toxoplasma* makes us crazy. *Trends in parasitology*, 29(4), 156–163.
- González-Barrio, D.; Carpio, A.J.; Preite, L.; Miguel-Vicedo, M.; Estévez-Reboredo, R.M.; González-Viadero, M. and Fuentes, I. (2024): *Toxoplasma gondii* exposure in wildlife in Spain: Is there any predictable threat for humans and domestic animals? *Science of the Total Environment*, 173290.
- Hassanain, M.A.; El-Fadaly, H.A.; Hassanain, N.A.; Shaapan, R.M.; Barakat, A.M. and Abd El-Razik, K.A. (2013): Serological and molecular diagnosis of toxoplasmosis in human and animals. *World Journal of Medical Sciences*, 9(4), 243–247.
- Holec-Gąsior, L.; Ferra, B.; Hiszczyńska-Sawicka, E. and Kur, J. (2014): The optimal mixture of *Toxoplasma gondii* recombinant antigens (GRA1, P22, ROP1) for diagnosis of ovine toxoplasmosis. *Veterinary Parasitology*, 206(3-4), 146–152.
- Ibrahim, H.M.; Mohamed, A.H.; El-Sharaawy, A.A. and El-Shqanqery, HE. (2017): Molecular and serological prevalence of *Toxoplasma gondii* in pregnant women and sheep in Egypt. *Asian Pacific Journal of Tropical Medicine*, 10(10), 996-1001.
- Karakavuk, M.; Can, H.; Selim, N.; Yeşilsiraz, B.; Atlı, E.; Şahar, E.A.

- Döşkaya, M. (2021):* Investigation of the role of stray cats for transmission of toxoplasmosis to humans and animals living in İzmir, Turkey. *The Journal of Infection in Developing Countries*, 15(01), 155–162.
- Khan, A.H. and Noordin, R. (2020):* Serological and molecular rapid diagnostic tests for *Toxoplasma* infection in humans and animals. *European Journal of Clinical Microbiology & Infectious Diseases*, 39(1), 19–30.
- Milne, G.; Webster, J.P. and Walker, M. (2020).* *Toxoplasma gondii*: an underestimated threat?. *Trends in parasitology*, 36(12), 959–969.
- Montazeri, M.; Mikaeili Galeh, T.; Moosazadeh, M.; Sarvi, S.; Dodangeh, S.; Javidnia, J. and Daryani, A. (2020):* The global serological prevalence of *Toxoplasma gondii* in felids during the last five decades (1967–2017): a systematic review and meta-analysis. *Parasites & vectors*, 13, 1–10.
- Nayeri, T.; Sarvi, S.; Abedian, R.; Gohardehi, S.; Hosseini, S.A. Daryani, A. (2022):* Milk as a Non-Invasive and Alternative Sample for Serum in the Diagnosis of Animal Toxoplasmosis: A Systematic Review. *Iranian Journal of Public Health*, 51(9), 1964.
- Omonijo, A.O.; Kalinda, C. and Mukaratirwa, S. (2022):* *Toxoplasma gondii* infections in animals and humans in Southern Africa: A systematic review and meta-analysis. *Pathogens*, 11(2), 183.
- Prince, J.B.; Auer, K.L.; Huskinson, J.; Parmley, S.F.; Araujo, F.G. and Remington, J.S. (1990):* Cloning, expression, and cDNA sequence of surface antigen P22 from *Toxoplasma gondii*. *Molecular and Biochemical Parasitology*, 43(1), 97–106.
- Qosimov, S.J.; Sayfullayeva, M. and Abdullayeva, S.S. (2025):* Zoonotic diseases. Diseases transmitted from animals to humans and their treatment. *Global Science Review*, 1(1), 109–112.
- Sameeh, S.; Mahmoud, A.E.; MM Monib, M.E.S. and Eldeek, H.E. (2021):* Latex agglutination test and PCR assays for diagnosis of *Toxoplasma gondii* infection in red meat producing animals in Aswan governorate, southern Egypt. *Slovenian Veterinary Research*, 58(24-Suppl), 281–288. <https://doi.org/10.26873/SVR-1447-2021>
- Schwenk, H.T.; Khan, A.; Kohlman, K.; Bertaina, A.; Cho, S.; Montoya, J.G. and Contopoulos-Ioannidis, D.G. (2021):* Toxoplasmosis in pediatric hematopoietic stem cell transplantation patients. *Transplantation and Cellular Therapy*, 27(4), 292–300.
- Shaapan, R.M.; El-Nawawi, F.A. and Tawfik, M.A.A. (2008):* Sensitivity and specificity of various serological tests for the detection of *Toxoplasma gondii* infection in naturally infected sheep. *Veterinary Parasitology*, 153(3–4), 359–362.
- Shariatzadeh, S.A.; Sarvi, S.; Hosseini, S.A.; Sharif, M.; Gholami, S.; Pagheh, A.S. and Daryani, A. (2021):* The global seroprevalence of *Toxoplasma gondii* infection in bovines: a systematic review and meta-analysis. *Parasitology*, 148(12), 1417–1433.
- Tavalla, M.; Asgarian, F. and Kazemi, F. (2017):* Prevalence and genetic diversity of *Toxoplasma gondii* oocysts in cats of southwest of Iran. *Infection, Disease & Health*, 22(4), 203–209.
- Thebault, A.; Kooh, P.; Cadavez, V.; Gonzales-Barron, U. and Villena, I. (2021):* Risk factors for sporadic toxoplasmosis: a systematic review and meta-analysis. *Microbial Risk Analysis*, 17, 100133.
- Tong, W.H.; Hlavačova, J.; Abdulai-Saiku, S.; Kaňkova, S.; Flegr, J. and Vyas, A. (2023):* Presence of *Toxoplasma gondii* tissue cysts in human semen: Toxoplasmosis as a potential sexually transmissible infection. *Journal of Infection*, 86(1), 60–65.
- Tonouhewa, A.B.N.; Akpo, Y.; Sessou, P.; Adoligbe, C.; Yessinou, E.;*

- Hounmanou, Y.G. Farougou, S. (2017): *Toxoplasma gondii* infection in meat animals from Africa: Systematic review and meta-analysis of sero-epidemiological studies. *Veterinary World*, 10(2), 194.
- Tűzkő, N.; Bartek, V.; Simonyi, A.; Harmath, Á.; Szabó, I.; Virok, D.P. and Beke, A. (2024): Associations between Fetal Symptoms during Pregnancy and Neonatal Clinical Complications with Toxoplasmosis. *Children*, 11(9), 1111.
- Zamora-Vélez, A.; Triviño, J.; Cuadrado-Ríos, S.; Lora-Suarez, F. and Enrique Gómez-Marín, J. (2020). Detection and genotypes of *Toxoplasma gondii* DNA in feces of domestic cats in Colombia. *Parasite*, 27, 25.
- Zhu, S.; VanWormer, E. Shapiro, K. (2023): More people, more cats, more parasites: Human population density and temperature variation predict prevalence of *Toxoplasma gondii* oocyst shedding in free-ranging domestic and wild felids. *PLoS One*, 18(6), e0286808.

التقييم المصلي لانتشار داء المقوسات لدى السيدات في سن الإنجاب والحيوانات مع التوصيف الجزيئي الأول لطفي المقوسات المعزول من القطط في محافظة أسوان، مصر

أحمد كمال دياب ، هشام ابراهيم عثمان ، رحاب محمد دسوقي ،
هبة محمد نجيب ، محمود عبد الحميد محمود

Email: ahmed2015@aun.edu.eg

Assiut University web-site: www.aun.edu.eg

داء المقوسات مرض طفيلي حيواني المنشأ ومنتشر على نطاق واسع ويسببه طفيل التوكسوبلازما غوندي. يمكن أن يسبب داء المقوسات تشوهات خلقية أثناء الحمل والإجهاض والتهاب الدماغ لدى كل من البشر والحيوانات. هدفت الدراسة الحالية إلى دراسة معدل انتشار داء المقوسات المصلي لدى النساء في سن الإنجاب والحيوانات المجتررة، مع التوصيف الجزيئي لطفيل التوكسوبلازما غوندي المعزول من القطط في محافظة أسوان، مصر. جُمعت عينات دم وفصلت مصليات من السيدات في سن الإنجاب بعدد (١٧٨) والحيوانات المجتررة بعدد (١٥٠) من نفس المنطقة. حُدد معدل انتشار داء المقوسات المصلي باستخدام الاختبار السريع (RT) ومجموعات اختبارات المقاييس الامتصاصية المناعية للأنزيم المرتبط (ELISA). جُمعت عينات براز عددها (١٠٠) من القطط للكشف عن أكياس المقوسة الغوندية، ثم تم تحليلها بواسطة تفاعل البوليميراز المتسلسل للتحليل الجزيئي والتطوري. أرسلت التسلسلات التي تم الحصول عليها إلى قاعدة بيانات الجينات وصُممت شجرة التطور. وكانت النتائج بالنسبة لمعدلات الإصابة بداء المقوسات في السيدات (ELISA) أكثر تشخيصًا بحوالي مرتين من (RT) وكانت النسبة ٢٤,٢٪ و ١٠,١٪ على التوالي. ومع ذلك، كان معدل انتشار (ELISA) IgG (٢٣,٣٪) و (٢٥,٣٪) من (RT) IgM، على التوالي. كانت نتائج انتشار داء المقوسات في المجترات البشرية والمجترات ذات دلالة إحصائية ($P \leq 0.001$). كان داء المقوسات مُصيبًا بنسبة ٣٠٪ من القطط التي خضعت للفحص. وقد حددت هذه الدراسة لأول مرة تسلسلين جينيين مميزين للمقوسة الغوندية يرتبطان بجنس القطط. وتُشير نتائجنا إلى أن التعرض للمقوسة الغوندية مرتفع لدى السيدات في سن الإنجاب لما له من آثار علي الأم والجنين. ينصح بإجراء اختبارات الاليزا للسيدات الحوامل لتشخيص المرض مبكرًا.