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Toxocara infection in pregnant women: seroprevalence and risk factors

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Abstract

Background Human toxocariasis caused by *T. canis* is a worldwide and typically neglected zoonotic parasitic disease. Certain behaviors such as a geophagia habit, poor personal hygiene, close contact with young dogs, and ingestion of raw meat, as well as age, and socioeconomic status, affect the prevalence of the disease. In this study, we aimed at investigating the frequency of *Toxocara* infection among pregnant women and the epidemiological factors associated with disease.

Methods Toxocariasis-specific IgG antibodies were measured using a commercial ELISA technique in 200 pregnant women between December 2021 and May 2022. A questionnaire filled by participants included options for demographic information (age, gender, residency), gestational age, number of previous pregnancies, history of abortion, drug use, comorbidities, history of parasitic disease, and keeping pets (dogs or cats).

Results In total, 15 (7.5%) of the 200 participants (mean age 29.7 ± 18.7 years) had anti-*T. canis* antibodies. High-titer antibodies were most prevalent among the subjects aged 25–29 years. Logistic regression analysis showed that the pregnant women who had a history of abortions ($P = 0.029$), and keeping pets and contact with dogs and cats ($P = 0.031$) had an increased risk of acquiring toxocariasis. The study showed that demographic characteristics such as age group, pregnancy trimester, and underlying conditions were not significantly associated with toxocariasis ($P > 0.05$).

Conclusion Considering the significant prevalence of toxocariasis in pregnant women as well as its health risks, preventive health measures against the toxocariasis risk factors seem more necessary.

Keywords *Toxocara canis*, Toxocariasis, Pregnant women, Seroepidemiology, Alborz

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Introduction

Human toxocariasis is a zoonotic parasitic disease caused by the migration of the nematode helminths *Toxocara* species (*T. canis* in dogs or *T. cati* in cats) larvae to the organs and tissues of animals and birds [1]. Human infection occurs when *Toxocara* larval eggs are accidentally ingested or through the consumption of raw or undercooked meat and giblets [2]. Subsequently, the larvae are released into the small intestine, penetrate the intestinal wall, and are transported through the bloodstream to tissues and organs, but do not develop into adult forms [3]. The larvae preferentially migrate to the liver, brain, and eye, causing the syndromes of visceral larval migration, ocular larval migration, neural toxocariasis, and covert *Toxocara* infection [4].

The diagnosis of human toxocariasis is mainly based on clinical, epidemiological, and laboratory data, which include imagining exams, blood exams, eosinophilia, total IgE levels, and serological tests [5]. Enzyme-linked immunosorbent assay is one of the most important tests that are available for the immunodiagnostic of toxocariasis using *Toxocara* excretory-secretory antigens. Due to the greater sensitivity and specificity of the *Toxocara*-ELISA, investigations demonstrate that this method is a better technique for detecting patients having visceral or ocular involvement consistent with toxocariasis [5–9].

In many developing countries, toxocariasis is a neglected zoonotic disease in humans, and this parasite is classified among the top six parasitic infections of public health priority by the World Health Organization and the Centers for Disease Control [11]. Several studies worldwide have described the extent of the high prevalence of toxocariasis. Globally, *Toxocara* infection is found in many countries, and prevalence rates can reach as high as 40% or more [12]. The serological studies on the prevalence of *Toxocara* in pregnant women in Iran are very limited. In a relatively similar study, the rate of seropositivity of anti-*Toxocara* antibodies by indirect ELISA in pregnant women in Ilam City western Iran was reported to be 21.2% [13].

It has been shown that people with chronic helminthic infection are more susceptible to intracellular pathogens, and these infections can subsequently cause congenital malformation [14]. However, limited reports of congenital infections caused by *Toxocara* have been published, which is largely due to the lack of attention to the investigation of the infection, despite its universality, in pregnant women. The only record of congenital *Toxocara* infection in humans occurred in a premature infant with retinopathy with blood eosinophilia whose mother was seropositive for *Toxocara* species [15]. In developing countries such as Iran, the serological investigation of this parasite has received less attention, and few studies have been conducted to determine the seroprevalence of toxocariasis in high-risk groups such as pregnant women.

Previous studies showed that a significant difference was observed between the prevalence of *Toxocara* seropositivity in pregnant women and some demographic and clinical parameters [16]. Therefore, the study aimed to estimate the prevalence of anti-*Toxocara* serum antibodies in pregnant women referred to the women's hospital, which is a hospital focused on the demanding specialist medical care of women and newborns. Considering the knowledge of the serological status of pregnant women as one of the high-risk groups for *Toxocara* infection, they can provide useful information for this group and the health care of the community.

Materials and methods

Study participants

A cross-sectional study was conducted between December 2021 and May 2022 including pregnant women followed at Kamali Comprehensive Specialized Hospital, Vice-Chancellor for Education at the Alborz University of Medical Sciences, Iran. A standardized questionnaire was designed and applied during face-to-face interviews. The questionnaire included data about participants' demographics such as age, pregnancy trimester, abortion history, the number of past pregnancies, history of drug use, potential risk factors for *Toxocara* infection (pet keeping and exposure to domestic animals), and detailed information on clinical characteristics and conditions such as diabetes, heart disease, central nervous system disorders, liver, and kidney diseases that may be considered "underlying diseases". The human research ethical approval for the study was granted by the Ethical Committee at the University of Medical Sciences in Alborz (IR.ABZUMS.REC.1401.142), and informed consent was obtained from the participants before data collection. A written informed consent form was received from each study participant.

Serum samples collection

Under sterile conditions, five milliliters of venous blood were drawn from each subject in a clean blood collection tube by trained medical laboratory technicians. Serum samples were separated by centrifuging at 2,500 rpm for five minutes. The sera were collected in two mL tubes and stored at -20 °C until being used for the detection of anti-*Toxocara* IgG antibodies by serological assay.

Laboratory test

Anti-*Toxocara* antibodies were detected by a commercial ELISA kit (*T. canis* IgG-ELISA, NovaTec Company, Dietzenbach, Germany) as described by the manufacturer in the test instructions. The results were calculated as follows if the absorbance values (OD at 450 nm) were less

Table 1 Results of the univariate analysis of the studied variables

Characteristics	Statistical analysis		Total	OR (95% CI)[†]	*P*-value*
	Positive cases (%)	Negative cases (%)			
Age group (years)					
< 25 (15–24)	2 (13.3)	31 (16.8)	33 (16.5)	0.06 (0.05–0.54)	0.149
25–29	6 (40.0)	57 (30.7)	63 (31.5)	0.03 (0.02–0.05)	
30–34	3 (20.0)	56 (30.3)	59 (29.5)	0.04 (0.02–0.06)	
35–39	3 (20.0)	36 (19.5)	39 (19.5)	0.62 (0.35–0.94)	
> 39 (40–49)	1 (6.7)	5 (2.7)	6 (3.0)		
Pregnancy trimester					
First	4 (26.7)	35 (18.9)	39 (19.5)	0.47 (0.39–0.59)	0.460
Second	5 (33.3)	54 (29.2)	59 (29.5)	0.02 (0.01–0.13)	
Third	6 (40.0)	96 (51.9)	102 (51.0)	0.12 (0.30–4.83)	
Abortion history					
Yes	1 (6.7)	63 (34.1)	64 (32.0)	0.00 (0.00-0.01) *	0.029*
No	14 (93.3)	122 (65.9)	136 (68.0)	5.37 (4.04–7.11)	
Past pregnancies (times)					
None	3 (20.0)	36 (19.5)	39 (19.5)	0.07 (0.05–0.09)	0.840
Once	8 (53.4)	72 (38.8)	80 (40.0)	0.04 (0.02–0.05)	
Twice	2 (13.3)	47 (25.4)	49 (24.5)	0.06 (0.04–0.11)	
Third	2 (13.3)	14 (7.6)	16 (8.0)	0.06 (0.02–0.14)	
Fourth	0 (0.0)	8 (4.3)	8 (4.0)	0.02 (0.01–0.04)	
Fifth	0 (0.0)	4 (2.2)	4 (2.0)	0.05 (0.03–0.07)	
Sixth	0 (0.0)	2 (1.1)	2 (1.0)	0.01 (0.01–0.02)	
Seventh	0 (0.0)	2 (1.1)	2 (1.0)	0.01 (0.00-0.12)	
Underlying conditions[£]					
Yes	1 (6.7)	37 (20.0)	38 (19.0)	0.80 (0.33–1.38)	0.200
No	14 (93.3)	148 (80.0)	162 (81.0)	0.06 (0.04–0.08)	
Pet keeping					
Yes	13 (86.7)	15 (8.1)	28 (14.0)	0.01 (0.01–0.02)	
No	2 (13.3)	75 (91.9)	172 (86.0)	5.64 (3.34–7.95) *	0.031*
History of drug use[µ]					
Yes	4 (26.7)	90 (48.6)	94 (47.0)	9.21 (3.52–19.54)	0.091
No	11 (73.3)	95 (51.4)	106 (53.0)	0.08 (0.04–0.36)	
Total	15 (100.0)	185 (100.0)	200 (100.0)		

*Significant association by the χ^2 test; [†]OR: Odds ratio with 95% confidence interval; [£]Underlying conditions include diabetes, heart disease, central nervous system disorders, and liver and kidney diseases

than 9 NTU: negative; 10 NTU: cut-off point; between 9 and 11 NTU: grey zone which needs to be repeated; and more than 11 NTU: positive, as recommended by the manufacturer.

Statistical analysis

Positive result percentages by subgroup were estimated with a 95% confidence interval. Outcome data were initially evaluated by univariate analysis (Pearson's chi-squared test), and variables with a statistical significance of < 0.20 in the univariate model were included in logistical regression analyses to assess risk factors associated with pregnant women's seropositivity. From the regression coefficients for each predictor variable, odds ratio (OR) values were estimated per point together with the 95% CI. Results with *P*-values of less than 0.05 were considered to be statistically significant.

Results

Out of 200 pregnant women who participated in the study, 15 (7.5%) had positive anti-*Toxocara* antibodies. Table 1 lists demographic data on the studied people. The results of the present study showed that toxocariasis was prevalent in pregnant women in the Karaj district; therefore, evaluating the association between toxocariasis and several potential predictor variables to determine risk factors for the infection was performed. In the multivariate logistic regression analysis, abortion history (AOR = 5.40; 95% CI: 4.04–7.02; $P = 0.017$), and pet keeping (AOR = 3.75; 95% CI: 4.48–7.18; $P = 0.036$) had a statistically significant association with infection among the pregnant women. It should be mentioned that the statistical significance between the prevalence and the history of abortion does not mean the protective effect of *Toxocara*-related antibodies and this finding is probably due

to the low volume of the studied samples. The analysis suggests that *Toxocara* infection is not significantly associated with other considered socio-demographics using the multivariate logistic regression analysis.

The history of drug medication in the last months before completing the questionnaire was recorded in 106 women: 18 (17.0%) were in the first, 31 (29.2%) were in the second and 57 (53.8%) were in the third trimester of pregnancy. The drugs that were taken included: Metronidazole, Folic acid, Multivitamins, hypo-hyperthyroidism drugs, Cefixime (antibiotic), Estradiol and Progesterone, Insulin, and Ranitidine. Of those who had a history of taking medicines, 10 (66.7%) had anti-*Toxocara* antibodies.

Discussion

The *Toxocara* seropositivity in the current study (7.5%) suggested that toxocariasis is present among pregnant women. The findings obtained in the current study were consistent with a previous study result from Brasília, Brazil (7.4%) [17]. The current seroprevalence was much lower than the findings in Nigeria (382/413, 92.5%) [18]. In a study by Raissi and colleagues in Ilam, the prevalence of anti-*Toxocara* antibodies in pregnant women was reported as 21.2% [13].

Keeping pets such as dogs and cats is a known risk factor for human infection due to the potential for soil contamination in public places with parasite eggs. In our study, a significant relationship was found between toxocariasis and contact with dogs and cats ($P = 0.031$). One reason for this could be pet contact with stray dogs and cats, which are more likely to come into contact with contaminated soil, thus having the potential for transmission. On the other hand, according to some researchers, the possibility of transmission of this disease by animals through direct physical contact with humans is high, because the ovum excreted in the feces of dogs and cats takes 2 weeks to reach the infectious stage. Therefore, soil is necessary as a reservoir of *Toxocara* for the spread of the disease [19].

In the current study, there was a significant relationship between a history of abortion and seropositivity of anti-*Toxocara* IgG antibodies ($P = 0.029$). Regarding the seropositivity of *Toxocara* and abortion, there are controversial results. In the study of Santos et al. [20] among pregnant women with a positive *Toxocara* serological assay, 55.6% had reproductive disorders (abortion, difficulty conceiving, premature birth). Pereira and colleagues showed that in pregnant women with IgG positive for *Toxocara*, 21.7% had at least one miscarriage, but they did not consider this variable as a significant risk factor [17]. In contrast, Taylor et al. found a statistically significant relationship between serum positivity against *Toxocara* IgG antibodies and previous abortions [21]. They found that in 35.0% of seropositive pregnant women, there is a history of miscarriage compared to 8.6% of serologically negative cases. Some researchers discuss the possibility of larval migration through host tissues and causing tissue damage that is associated with abortion [22]. Despite the only recorded case of congenital infection in human toxocariasis, the CDC does not consider this parasite to be a placental transmissible pathogen [23, 24]. However, there is evidence of vertical transmission by *Toxocara* species in definitive hosts. The larvae of *Toxocara* in the paratenic host show the capacity and tendency to migrate during pregnancy [25]. On the other hand, cases of *Toxocara* mammary transmission due to breastfeeding to children have been reported, all of which reinforce the importance of conducting studies in this field in humans [24].

We examined the level of IgG antibodies in different months of pregnancy; our results indicated the peak rise of anti-*Toxocara* IgG in the seventh month of pregnancy. The results of studies showed that the maternal IgG antibodies could migrate through the placenta and it is suggested that this starts from the 16th week of pregnancy and then rises continuously from the 22nd week until the fetus shows a level of IgG antibodies similar to an adult [23].

Our data demonstrated that there is no significant association between the prevalence of *Toxocara* infection and underlying conditions in pregnant women ($P = 0.200$). Although chronic medical conditions, what many may consider "underlying conditions", include diabetes, heart disease, obesity, cancer, and kidney disease. Underlying diseases make people more vulnerable to the infection [26].

Finally, the findings of the current study showed that *Toxocara* seropositivity was not associated with some pregnancy risk factors (age group, pregnancy trimester, number of past pregnancies, and history of drug use) in the studied subjects that were analyzed separately ($P > 0.05$).

Limitations

The present study faced limitations including resource constraints and lack of access to confirmatory serological tests such as western blotting. A molecular test with high sensitivity/specificity can be performed to overcome some limitations such as cross-reactivity. Another limitation is the age distribution of the studied subjects; the number of pregnant women in different age groups was heterogeneous. On the other hand, in the current study some risk factors in contracting toxocariasis such as consumption of raw and undercooked meat or sitting vegetables, as well as the level of education and occupation of the participants, were not investigated, which should be investigated in future studies.

Conclusion

This study was conducted due to the lack of information about toxocariasis from the studied subjects, as far as we know, this is the first study to investigate *Toxocara* infection in pregnant women in our region. The findings of the present study show that toxocariasis is common in the studied individuals and there is a significant relationship between *Toxocara* infection in pregnant women and a history of abortion as well as keeping pets. It is recommended that more samples from pregnant women be screened and analyzed using serological techniques such as WB or molecular-based methods as confirmatory tests.

Abbreviations

AOR	Adjusted odds ratio
CDC	Centers for disease control and prevention
CI	Confidence interval
COR	Crude odds ratio
CT	Covert toxocariasis
ELISA	Enzyme-linked immunosorbent assay
ES	Excretory-secretory
IgG	Immunoglobulin G
NT	Neural toxocariasis
OD	Optical density
OT	Ocular toxocariasis
T. canis	*Toxocara canis*
T. cati	*Toxocara cati*
VT	Visceral toxocariasis
WB	Western blot
WHO	World Health Organization

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Author contributions

MZ and MN: Conceptualization, supervision, methodology, investigation, data curation, formal analysis, original draft writing, writing-review and editing, and project administration. AB, SAH, FB and ZH: Methodology. AH and SB: Data curation. All authors read and approved the final manuscript. Contributors who do not meet the criteria for authorship are listed in the acknowledgments section.

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Data availability

All data are presented in the manuscript.

Declarations

Ethics approval and consent to participate

The human research ethical approval for the study was granted by the Ethical Committee at the University of Medical Sciences in Alborz, and informed consent obtained from the participants prior to data collection (IR.ABZUMS.REC.1401.142). Written informed consent form was received from each study participant (for those under the age of 15 years, written informed consent form was received from their legal guardians). All methods were carried out in accordance with relevant guidelines and regulations.

Consent to participate

As noted in the manuscript, the written informed consent of all participants was obtained at the beginning of the investigation.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Ziegler MA, Macpherson CNL. *Toxocara* and its species. CAB Reviews. 2019;14:1–27.
2. Azizi S, Oryan A, Sadjjadi SM, Zibaei M. Histopathologic changes and larval recovery of *Toxocara Cati* in experimentally infected chickens. Parasitol Res. 2007;102:47–52.
3. Zibaei M, Sadjjadi SM, Uga S. Experimental *Toxocara Cati* infection in gerbils and rats. Korean J Parasitol. 2010;48:331–3.
4. Auer H, Walochnik J. Toxocariasis and the clinical spectrum. Adv Parasitol. 2020;109:111–30.
6. Magnaval JF, Faber R, Maurieres P, Charlet JP, de Larrad B. Application of the Western blotting procedure for the immunodiagnosis of human toxocariasis. Parasitol Res. 1991;77:697–702.
7. Ishiyama S, Ono K, Rai SK, Uga S. Method for detecting Circulating *Toxocara canis* antigen and its application in human serum samples. Nepal Med Coll J. 2009;11:9–13.
8. Maraghi S, Rafiei A, Hajihosseini R, Sadjjadi SM. Seroprevalence of toxocariasis in hypereosinophilic individuals in Ahwaz, Southwestern Iran. J Helminthol. 2012;86:241–4.
9. Roldan WH, Espinoza YA. Evaluation of an enzyme-linked Immunoelectrotransfer blot test for the confirmatory serodiagnosis of human toxocariasis. Mem Inst Oswaldo Cruz. 2009;104:411–8.
10. Zibaei M, Sadjjadi SM, Karamian M, Uga S, Oryan A, Jahadi-Hosseini SH. A comparative histopathology, serology and molecular study, on experimental ocular toxocariasis by *Toxocara Cati* in Mongolian gerbils and Wistar rats. Biomed Res Int. 2013;2013:109580.
11. Berrett AN, Erickson LD, Gale SD, Stone A, Brown BL, Hedges DW. *Toxocara* Seroprevalence and associated risk factors in the united States. Am J Trop Med Hyg. 2017;97:1846–50.
12. Ma G, Holland CV, Wang T, Hofmann A, Fan CK, Maizels RM, et al. Human toxocariasis. Lancet Infect Dis. 2018;8:e14–24.
13. Raissi V, Taghipour A, Navi Z, Etemadi S, Sohrabi Z, Sohrabi N, et al. Seroprevalence of *Toxoplasma gondii* and *Toxocara* spp. Infections among pregnant women with and without previous abortions in the West of Iran. J Obstet Gynaecol Res. 2020;46:382–8.
14. Salgame P, Yap GS, Gause WC. Effect of helminth-induced immunity on infections with microbial pathogens. Nat Immunol. 2013;14:1118–26.
15. Maffrand R, Avila-Vázquez M, Princich D, Alasia P. Toxocariasis ocular congénita En Un recién Nacido prematuro [Congenital ocular toxocariasis in a premature neonate]. Pediatr (Barc). 2006;64:599–600.
16. Pereira ELGM, Ferreira IB, Victorino RB, Lescano SAZ, Giuffrida R, Kmetiuk LB, et al. Serosurvey of *Toxoplasma gondii* and *Toxocara* spp. co-infection in pregnant women in low-income areas of Brazil. Front Public Health. 2024;12:1340434.
17. Pereira LC, Elefant GR, Nóbrega YM, Vital T, Nitz N, Gandolfi L, et al. *Toxocara* spp. Seroprevalence in pregnant women in Brasília, Brazil. Rev Soc Bras Med Trop. 2016;49:641–3.
18. Ikotun K, Sowemimo O, Chou CM, Ajenifuja K, Chuang TW, Asaolu S, et al. High Seroprevalence of *Toxocara* antibodies in pregnant women attending an antenatal clinic at a university hospital in Ile-Ife, Nigeria. Trans R Soc Trop Med Hyg. 2020;114:301–7.
19. Rastgoo F, Rostaee Z, Mosleh F, Hasannezhad A, Ghorbaani Barnaaji H, Abolghazi A. Study of soil contamination by *Toxocara* spp. Eggs in Fasa, South of Iran from April to December 2018. J Fasa Univ Med Sci. 2019;9:1743–8.
20. Santos PC, Lehmann LM, Lorenzi C, Hirsch C, Telmo PL, Mattos GT, et al. The seropositivity of *Toxocara* spp. Antibodies in pregnant women attented at the university hospital in Southern Brazil and the factors associated with infection. PLoS ONE. 2015;10:e0131058.
21. Taylor MR, O'Connor P, Hinson AR, Smith HV. *Toxocara* titres in maternal and cord blood. J Infect. 1996;32:231–3.

22. Shoop WL. Vertical transmission of helminths: hypobiosis and amphiparatenesis. Parasitol Today. 1991;7:51–4.
23. Hashira S, Okitsu-Negishi S, Yoshino K. Placental transfer of IgG subclasses in a Japanese population. Pediatr Int. 2000;42:337–42.
24. Hironaka HC, Casanova LD. Immunoglobulins concentration in umbilical cord blood and in maternal blood at delivery. Acta Cir Bras. 2003;18:169–6.
25. Schoenardie ER, Scaini CJ, Pepe MS, Borsuk S, de Avila LF, Villela M, et al. Vertical transmission of *Toxocara canis* in successive generations of mice. Rev Bras Parasitol Vet. 2013;22:623–6.
26. Dhainaut JF, Claessens YE, Janes J, Nelson DR. Underlying disorders and their impact on the host response to infection. Clin Infect Dis. 2005;41:481–9.

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