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Risk Factors and Prevalence of Toxocariasis in Healthy Adults in South Khorasan Province, Eastern Iran

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Abstract

Background: Toxocariasis is a common zoonotic helminthic disease with worldwide distribution. Seroepidemiological data related to human toxocariasis and its risk factors are limited in the east of Iran.
Objectives: The current study evaluated the seroprevalence of toxocariasis and associated risk factors in clinically healthy individuals aged 18 years or older in eastern Iran.
Methods: We took 450 samples from clinically healthy individuals referred to medical laboratories for health screening between March and May 2022 in Birjand, Iran. The seroprevalence of IgG antibody against *Toxocara* was performed using the enzyme-linked immunosorbent assay (ELISA) kit (IBL, Germany). Logistic regression was used to analyze the association between toxocariasis and potential risk factors by SPSS 21.0 software. A probability P value less than 0.05 was considered statistically significant.
Results: The sample included 210 (56.6%) men, and 240 women (53.3%) who were aged 18 to 81 years (mean 35 ± 13 years). The *Toxocara* ELISA was positive in 36 (8%) individuals. The statistical analysis showed that washing hands before eating (odds ratio (OR) = 0.1, 95% CI: 0.05 - 0.3, P < 0.0001), contact with cats and dogs (OR = 0.1, 95% CI: 0.05 - 0.3, P < 0.00001), and raw meat consumption (OR = 4.8, 95% CI: 2.2 - 11.4), P < 0.0004) were risk factors associated with *Toxocara* infection.
Conclusions: The relatively low seroprevalence of *Toxocara* infection in our study can be caused by environmental and socio-cultural conditions and moderate to high hygiene standards in Birjand. It is suggested that more extensive studies be conducted with larger sample sizes in at-risk groups in this area.

Keywords: *Toxocara*, ELISA, Prevalence, Diagnosis, Immunoglobulin G

1. Background

Toxocariasis is a common zoonotic helminthic disease primarily distributed in subtropical and tropical regions (1). Humans can be infected with toxocariasis by ingesting soil and vegetables contaminated with the eggs of *Toxocara canis* or *Toxocara cati*. In some cases, the infection can be acquired by direct contact of hands with the hair of dogs or, in rare cases, via the consumption of larvae in the raw meat of *Toxocara*-infected paratenic hosts.

Humans are accidental hosts for toxocariasis. The parasite can complete its life cycle in humans. Therefore, eggs are not excreted in human fecal samples (2). Human toxocariasis, in most cases, is clinically asymptomatic. Clinical manifestations of toxocariasis include visceral larva migrans (VLM), ocular larva migrans (OLM), and covert and atypical toxocariasis according to the affected organ (3). The diagnosis of human toxocariasis is performed mainly by a combination of clinical examination and enzyme-linked immunosorbent assay (ELISA) for the excretion-secretion antigen (4).

Seroprevalence varies from as low as 1% in Spain to 86% in Santa Lucia, with a tropical climate (5). Based on seroprevalence studies, toxocariasis is more prevalent in socioeconomically poor children in tropical and subtropical regions. The seroprevalence of human toxocariasis is predominant in people under 20 years and urban regions in different parts of Iran. The prevalence of human toxocariasis with overall 28 records from all over Iran was reported as 9.3% (95% CI: 6.3 - 13.1%) (6).

Several risk factors are related to the prevalence of *Toxocara* infection in humans, such as keeping cats and dogs

and raw consumption of vegetables (7).

2. Objectives

However, sero-epidemiological data related to human toxocariasis and its risk factors are limited in eastern Iran. Therefore, we studied the seroprevalence of human toxocariasis and associated risk factors among clinically healthy individuals in Birjand district, eastern Iran, for the first time. This study aimed to attract public attention to *Toxocara* infection in the country's eastern regions, especially South Khorasan province.

3. Methods

3.1. Study Location and Patient Selection

A cross-sectional study was performed in Birjand, Iran. South Khorasan province is located in the east part of Iran, on the border with Afghanistan, with a predominant desert climate (8). According to a 25% infection prevalence in a previous study (9), the sample size was calculated as follows:

$$n = \frac{z^2 \left(1 - \frac{a}{2}\right) \times p \ (1 - p)}{d^2} \quad (1)$$

$$n = \frac{(1.96)^2 \times 0.20 \ (1 - 0.20)}{0.0016} \approx 400 \quad (2)$$

In order to adjust for missing data, the sample size was increased to 450 people selected from clinically healthy individuals between March and May 2022. The healthy subjects above 18 years old who were voluntarily admitted to hospitals for health screening were regarded as clinically healthy individuals. The exclusion criteria were hemolyzed samples and infection with other intestinal parasites.

3.2. Data Collection

A questionnaire was used to collect risk factors and epidemiological data (age, gender, residential area, washing hands before eating, consuming raw/undercooked meat and vegetables, and contacting cats and dogs). The content validity of this questionnaire was checked and confirmed by experts. The reliability of the questionnaire was also confirmed owing to the questions' objectiveness and frequent use in previous studies.

3.3. Sampling and Laboratory Analysis

Approximately 5 mL of blood was collected from each participant in a clot activator tube. The collected sera were stored at -20°C until testing. The IgG antibodies against *Toxocara* were detected by *T. canis* excretory-secretory (TES) antigens using a commercial ELISA kit (IBL, manufactured in Hamburg, Germany) following the manufacturer's instructions. Briefly, serum samples were incubated and conjugated with alkaline phosphatase, followed by the tetramethylbenzidine (TMB) substrate.

Absorbance readings were performed at 450 nm. The average absorbance reading for three negative control sera plus two standard deviations was considered a cutoff value. The OD values $\geq$ 0.3 were reported positive.

3.4. Statistical Analysis

Frequency analysis was performed to describe the participants' characteristics and the parasite prevalence. Logistic regression was used to analyze the association between toxocariasis and potential risk factors by SPSS 21.0 software. Odds ratios (ORs) were considered statistically significant if the 95% CI did not include one. A probability P value less than 0.05 was considered statistically significant.

4. Results

A total of 450 clinically healthy individuals (210 men and 240 women) aged 18 to 81 years (mean 35 $\pm$ 13 years) were randomly referred to medical laboratories for health screening in Birjand, Iran. Table 1 shows the demographic characteristics of the sample. The majority (28.8%) of individuals were in the age range of 21 - 30 years. The *Toxocara* ELISA was positive in 36 (8%) of the 450 individuals. The highest prevalence rate of toxocariasis was reported in individuals over 61 years old (14.2%, 95% CI 0.3 - 12.9) (Table 1). Moreover, statistical analysis showed that washing hands before eating (OR = 0.1, 95% CI 0.05 - 0.3), P < 0.0001), contact with cats and dogs (OR = 0.1, 95% CI 0.05 - 0.3, P < 0.00001), and raw meat consumption (2.2 - 11.4) (OR = 4.8, 95% CI 2.2 - 11.4), P < 0.0004) were risk factors associated with *Toxocara* infection. However, there were no relationships between toxocariasis and age, gender, residency, and raw vegetable intake.

5. Discussion

The current study evaluated the seroprevalence of toxocariasis among clinically healthy individuals and potential factors associated with *Toxocara* infection in South Khorasan province, eastern Iran. The prevalence of toxocariasis among asymptomatic individuals worldwide varies

Table 1. Odds Ratios of Risk Factors Associated with Seropositivity to Toxocariasis in the Study Population in Birjand, Iran

Characteristics	Number (n)	Seropositive, No. (%)	Odds Ratio (95% CI)	P Value
Age				
≤ 20	55	4 (7.25)	Reference	
21 - 30	130	10 (7.6)	1.06 (0.3 - 3.5)	0.9
31 - 40	102	9 (8.8)	1.2 (0.3 - 4.2)	0.7
41 - 50	99	7 (6)	0.9 (0.2 - 3.4)	0.9
51 - 60	40	4 (10)	1.4 (0.3 - 6)	0.6
≥ 61	14	2 (14.2)	2.1 (0.3 - 12.9)	0.4
Gender				
Male	240	22 (9.1)	Reference	0.3
Female	210	14 (6.6)	0.7 (0.3 - 1.4)	
Washing hands before eating				
No	190	30 (15.7)	Reference	
Yes	260	6 (2.3)	0.1 (0.05 - 0.3)	< 0.0001
Contact with dog and cat				
No	290	8 (2.7)	Reference	
Yes	160	28 (17.5)	7.4 (3.3 - 16.8)	< 0.00001
Residency				
Urban	285	18 (5.9)	Reference	
Rural	165	18 (11.5)	1.8 (0.91 - 3.59)	0.08
Raw vegetable consumption			1.2 (0.6 - 2.5)	0.53
Yes	110	12 (10.9)	1.6 (0.7 - 3.4)	0.1
No	320	22 (6.8)	Reference	
Raw meat consumption				
Yes	51	9 (17.6)	4.8 (2.2 - 11.4)	0.0004
No	399	17 (4.2)	Reference	

from 2% to 80% (10). Many factors, such as lifestyle, geographical conditions, and detection methods, play a role in such differences. Moreover, the seroprevalence of anti-*Toxocara* IgG antibodies was significantly lower in the present study than in previous studies in Peru (44.92%) (11), United States (13.9%) (12), Brazil (51.6%) (13), and South Korea (51.2%) (14). The prevalence of anti-*Toxocara* IgG was higher in the current study than in the same study from Denmark (2.4%) (15) and approximately consistent with an Egyptian study (7.7%) (16). In this study, the overall seroprevalence of IgG antibodies against toxocariasis was 8%, slightly lower than the mean value (9%) of previous studies conducted in different parts of Iran (6, 17). In a previous study performed in Iran, 49 (15.54 %) healthy people were seropositive for toxocariasis, and a significant risk factor was contact with cats and dogs but not age and gender (18), while in the current study, the seroprevalence was 8% and a significant risk factor was washing hands before eating, contact with cats and dogs, and raw meat consumption. In the current study, seroprevalence increased along with age but was not associated with gender, residency, or raw vegetable intake. In the present study, the seroprevalence was increased with age, consistent with those reported previously (12, 14). In this study, there was no statistically significant association between toxocariasis and age, gender, residency, and raw vegetable intake.

We observed no statistically significant association between *Toxocara* infection seropositivity and age, gender, residency, and raw vegetable intake. However, in contrast to some studies (19, 20), we found that contact with a dog or cat could be a risk factor for *Toxocariasis*. In the present study, the prevalence was higher in men than women, but this difference was not statistically significant. To our knowledge, the past epidemiological studies regard-

ing sero-epidemiological data related to human toxocariasis and its risk factors are limited in the east of Iran.

5.1. Conclusions

This study's relatively low seroprevalence of toxocariasis can be due to environmental conditions and relatively good health status in Birjand. It is suggested that more extensive studies be conducted with larger sample sizes in at-risk groups in this area.

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Footnotes

Authors' Contribution: All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by Rahmat Solgi, Sanaz Ebrahimi, Amir Tavakoli Kareshk, Mohammad Darvishi, Nayereh Asadi, Vahid Bagheri, and Gholamreza Barzegar. Rahmat Solgi wrote the first draft of the manuscript and all authors commented on previous versions. All authors read and approved the final manuscript.

Conflict of Interests: The authors declare no conflict of interest. R. S., V. B., and A. T. K. declare that they are the reviewers of the modern care journal but have not had any role in reviewing this manuscript.

Data Reproducibility: The dataset presented in the study is available on request from the corresponding author during submission or after its publication.

Ethical Approval: The Ethics Committee of Birjand University of Medical Sciences approved this experimental study before recruiting participants (IR.BUMS.REC.1400.430, link: ethics.research.ac.ir/EthicsProposalView.php?id=251207).

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Informed Consent: The purpose of this study was explained to all participants and relevant parties, and then written informed consent was obtained from all of them. Medical laboratory specialists collected blood samples after receiving consent forms and questionnaires.

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