Original article

Seroprevalence of toxocariasis and its related risk factors among municipal street sweepers in Shiraz District in Fars Province, southern Iran

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ABSTRACT

Background: Sweeping the street is a hazardous job that exposes the workers to soil-transmitted diseases, in particular, toxocariasis. In this cross-sectional study, the seroprevalence of *Toxocara* infection among street sweepers in Shiraz, southern Iran was assessed. **Methods:** Overall, 384 subjects, aged 24–64 years (all men), were randomly selected for the detection of antibodies to *Toxocara* by an enzyme-linked immunosorbent assay (ELISA). **Results:** Anti-*Toxocara* antibodies were detected in sera of 101 (26.3%) out of 384 subjects. Most of the seropositive cases were in the age group of 31–50 years, yet no significant difference was found between age and *Toxocara* seropositivity ($P > 0.05$). Out of 101 seropositive cases, 21 (20.8%) had a work experience of fewer than 5 years and 80 cases (79.2%) had a work experience greater than or equal to 5 years. However, no significant association was observed between work experience and *Toxocara* seropositivity. **Conclusion:** The findings of the study indicate that street sweepers are at high risk of infection with *Toxocara* infection. Therefore, appropriate preventive measures should be taken to reduce the risk of infection in this vulnerable group.

1. Introduction

Human toxocariasis is a roundworm infection caused by the ingestion of *Toxocara canis* and *Toxocara cati* eggs.¹ After ingestion, the eggs hatch and larvae penetrate the intestinal wall and are carried by the circulation to a wide variety of tissues and may cause complications that involve the liver, eye, brain, and other human organs.¹ Most of the humans' cases who become infected with *Toxocara* do not have serious symptoms but some may have manifestations including ocular larva migrans (OLM) or visceral larva migrans (VLM). Signs and symptoms of OLM and VLM may include vision loss, eye inflammation or damage to the retina, fever, fatigue, coughing, wheezing, and abdominal pain.^{2,3} Serological surveys indicate that the prevalence of toxocariasis in less industrialized, tropical countries varies from 30 up to 80%.^{4–8} Seroprevalence of human toxocariasis in Iran is reported to be from 1 to 34.5%.⁹ In a study by Miladi et al. in Arak in Markazi Province, in central Iran, anti-*Toxocara* antibodies were detected in sera of 4.2% of the individuals referred to diagnostic laboratories.¹⁰ In another study by Momeni et al. on 397 sera samples of 2–20 years old individuals in

Urmia, in West Azerbaijan Province of Iran, 12 (3%) of cases were seropositive for toxocariasis.¹¹ In a study by Ebrahimi-Fard in Mazandaran province, located along the southern coast of the Caspian Sea in Iran, the seroprevalence of toxocariasis in 322 healthy adults with eosinophilia was reported to be 23.5%.¹² A study in Shiraz, capital of Fars province in southern Iran on 6–13 years old schoolchildren, revealed *Toxocara* infection in 25.6% of the cases.¹³ Although epidemiological studies and reports of toxocariasis have been done in different areas of the world, no estimate of the global disease burden exists, and major knowledge gaps still remain in the epidemiology of toxocariasis.³ Sociodemographic and environmental factors such as age, geographical region, job, poverty, ethnicity, and contact with dogs and cats appear to be associated with *Toxocara* seropositivity.¹⁴

Contaminated soil is an important source of infection for *Toxocara* for both adults as well as children. Considering the importance of awareness of the seroprevalence of toxocariasis in high-risk groups such as street sweepers who are exposed to contaminated dust and soil and are prone to acquiring toxocariasis, the current study aimed to assess the seroprevalence of toxocariasis among street sweepers in Shiraz

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County, in southern Iran.

2. Methods

2.1. Study area

This study was conducted in Shiraz district, which is the capital of Fars Province in southern Iran. The population of the Shiraz is 1,869,001 (the fifth populated city in Iran). The district is located at an altitude of 1545 m above the sea level at geographical coordinates of 29°36'37" N latitude and 52°31'52" E longitudes. The area has a relatively hot summer and moderate winter. Annual precipitation is about 204 mm. Agriculture has always been a major part of the economy in Shiraz. Fars province (especially Shiraz) is the area where a high prevalence of human toxocariasis has been reported in children in previous studies.^{9,13,15} Street sweepers are continuously exposed to contaminated soil and mixed hazardous garbage which significantly affects their occupational health. Considering that the study area is one of the tourism poles in Iran, urban cleanliness is one of its main policies. Therefore, due to the existence of about 2600 street sweepers in this area and a lack of information about the seroepidemiology of toxocariasis among these people, this group of people was selected for this study. The district included 10 municipal areas and the numbers of participants were selected based on the populations of the street sweepers in each municipal area. Fig. 1 shows the study area along with the municipal areas where the samples were collected.

2.2. Blood sampling

Among 2600 street sweepers in the study area, 384 cases were selected by simple random sampling in 2018. Informed written consent

was obtained from all of the individuals and the study was approved by the Research Ethics Committee of Shiraz University of Medical Sciences (SUMS) (ethical code: IR.sums.med.rec.1397.581). The enrollment criteria were being a municipal street sweeper in Shiraz District, and having at least one year of work experience while the exclusion criteria were generally not feeling well, having fever and reluctant to provide the blood.

All through sampling, a data collection sheet was used to take the sociodemographic data of the subjects along with determinants concerning the *Toxocara* risk factors. About a 5 ml venous blood sample was taken from each participant and transferred to the laboratory of parasitology, at SUMS. Sera were separated from the blood then kept at -20°C until use.

2.3. Preparation of *Toxocara* antigens and detection of anti-*Toxocara* antibodies

Toxocara larvae excretory-secretory antigens (TES) were prepared as described by Zibaei et al.¹⁶ Briefly, *T. canis* eggs were isolated from the uteri of female worms and embryonated in 2.5% formalin/ringer solution at 25°C for 30 days. The second stage larvae were collected and cultivated in RPMI medium. Culture supernatant containing TES antigens were collected, concentrated and were kept at -20°C until used in an ELISA system.

To perform the ELISA, flat-bottom 96-well microplates (Corning, USA), were coated with $5\text{ }\mu\text{g/mL}$ of the *Toxocara* ES antigens and kept overnight at 4°C . Using an automated ELISA plate washing, the plates were washed, three times, with washing buffer (PBST: 0.05% Tween 20 in PBS). After blocking with 3% skimmed milk, diluted sera (1/100 dilution in PBST solution) were added and the plates were incubated at RT for 1.5 h. After washing as before, horseradish peroxidase-

Fig. 1. Map of Iran, Fars Province and workplace (municipal areas) of street sweepers.

conjugated goat anti-human IgG (Sigma, USA; 1/4000 in PBST) was added and after 1 h of incubation, and washing, OPD solution (100 µL/well of 0.4 mg/mL OPD, 0.3% H₂O₂ in 0.1 M citrate buffer, pH 5) was used to visualize the reaction. Using a microplate reader (ELX800, Bio-Tek, USA), the plate was read at 490 nm. *Toxocara* positive serum sample along with the negative control sera was applied in every test run and a cutoff point was calculated by the mean of negative controls OD values and two standard deviations.

2.4. Statistical analyses

SPSS software (version 18) was used for statistical analyses. Descriptive statistics tests were used for independent variables while a Chi-square test was used to determine the association between variables and positive results. Eventually, a value of $p < 0.05$ was considered as significant level.

3. Results

The subjects of the study were 384 street sweepers, who all were men. The mean age of the participants was 41.02 (± 8.4) year. Anti-*Toxocara* antibodies were detected in sera of 101 (26.3%) out of 384 subjects. Most of the seropositive cases were in the age group of 31–50 years. No significant association was found between age and *Toxocara* seropositivity ($P > 0.05$). Out of 101 seropositive cases, 21 (20.8%) had work experience of fewer than 5 years and 80 (79.2%) cases had a work experience greater than or equal to 5 years. However, no significant association was observed between work experience and *Toxocara* seropositivity. The seroprevalence of toxocariasis among those whose previous occupation was related to their current job (contact with soil and dust) was higher than those whose previous job was unrelated. Also, no associations were found between *Toxocara* seropositivity and having acute respiratory disease or respiratory disease along with fever and wearing the mask in the studied subjects. Table 1 shows the seroprevalence of *Toxocara* infection according to sociodemographic characteristics along with some of the *Toxocara* risk factors in studied street sweepers.

Table 1
Sociodemographic features of the street sweepers and relative seropositivity to *Toxocara* in Shiraz County, Fars Province, southern Iran.

Characteristics	Frequency (No.)	Percent (%)	Positive for anti- <i>Toxocara</i> antibodies		P Value
			No.	%	
Age(year)					
20–30	43	11.2	12	27.9	0.316
31–40	148	38.6	38	25.6	
41–50	132	34.5	38	28.7	
≥ 51	60	15.7	13	21.6	
Contact with dust					
Low	51	13.4	11	21.5	0.248
Moderate	114	29.8	34	29.8	
High	119	31.2	32	26.8	
Very high	98	25.7	24	24.4	
Previous job					
No previous job	311	81	81	26.04	0.573
Related	52	13.5	15	28.8	
Unrelated	21	5.5	5	23.8	
Acute pulmonary disease					
No	375	97.7	97	25.8	0.347
Yes	9	2.3	4	44.4	
Wearing mask					
Often	108	28.1	26	24.07	0.390
Always	276	71.9	75	27.1	

4. Discussion

Toxocara infection is an important but neglected zoonosis with a relatively high prevalence in both developing and developed countries. In the current study, the seroprevalence of *Toxocara* infection was evaluated in street sweepers, as a high-risk group for this infection, in an area in Fars Province southern Iran, where anti-*Toxocara* antibodies were detected in 26.3% of the subjects. In a previous study by Sadjjadi et al. in the same area, *Toxocara* seroprevalence among 6–13-year-old children was found to be 25.6%.¹³ In another study in the same area, anti-*Toxocara* antibodies were detected in sera of 5 out of 200 (2.5%) patients, 3 of them with hypereosinophilia.¹⁷ The rate of infection in children in the previous study and also the municipality workers in the current study is almost the same and this is actually due to the fact that both groups are at high risk for this infection.

Differences in the *Toxocara* seroprevalence rates in studies conducted in southern Iran (Fars province) can be due to the variation in study population groups (sex, age, job, residence area, etc.). In a study conducted in Ilam Province, West of Iran, the seroprevalence of *Toxocara* antibodies in children ≤ 10 years old, was reported to be 22%.¹⁸ Again these differences in the seroprevalence rate might be attributed to the population studied, the weather condition, health facilities, the applied serologic assays as well as the rate of soil contamination in the studied areas. The high seroprevalence of *Toxocara* in our study could be due to the high prevalence of *Toxocara* infection in dogs and cats population.^{19–21} The prevalence of *Toxocara* infections in stray dogs and cats in Fars Province, southern Iran, where the current study has been conducted, is reported to be from 3% up to 50%.

It has been demonstrated that the rate of *Toxocara* seropositivity increases by age, as the age increases, the chances of getting infected also increase.^{2,22}

According to the findings of a study in Egypt, the parasitic infestations were more prevalent among street sweepers (21.7%) in comparison with the control groups.²³ In another study on street sweepers in Nigeria, the frequency of parasitic infestations (intestinal parasites) was found to be quite high (63.5%) when compared to the control counterparts.²⁴ The high prevalence of infection in the street sweepers in these studies and also in our study highlights the fact that these groups of workers are at high risk for *Toxocara* infection, mainly due to their exposure to the soil and specks of dust, as the sources of contamination for *Toxocara* infection. Therefore, in keeping with previous studies, it can be suggested that *Toxocara* infection is a job-related infection. Support for this view comes from several studies including a study in Austria which showed a *Toxocara* seroprevalence of 44% in farmers, 27% in veterinarians, 25% in slaughterhouse staff, 17% in hunters and only 2% in the control groups.²⁵

Population-based studies regarding *Toxocara* infection in healthy people indicated the common covert toxocariasis with no overt clinical signs and symptoms in these subjects.^{26–28} In keeping with this, in the present study, the differences in the respiratory disease between seropositive and seronegative cases were not significant. This indicated that most of the seropositive cases in our study may have covert toxocariasis. Inherited to the restrictions in most of the cross-sectional seroprevalence study, our study is not an exception and has some limitations. The sample size was not too big enough, and proper data about the exposure of the subjects to dogs and cats were not available.

5. Conclusion

This study represents the high prevalence of toxocariasis in street sweepers in a populated city (Shiraz) in Fars Province, southern Iran. Thus, appropriate preventive measures should be taken to reduce the risk of infection in this high-risk group of the community.

Declaration of competing interest

None.

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References

- Fialho PM, Correa CR. A systematic review of toxocariasis: a neglected but high-prevalence disease in Brazil. *Am J Trop Med Hyg.* 2016;94:1193–1199.
- Liu EW, Chastain HM, Shin SH, et al. Seroprevalence of antibodies to toxocara species in the United States and associated risk factors, 2011–2014. *Clin Infect Dis.* 2018;66:206–212.
- Ma G, Holland CV, Wang T, et al. Human toxocariasis. *Lancet Infect Dis.* 2018;18:e14–e24.
- Macpherson CNL. The epidemiology and public health importance of toxocariasis: a zoonosis of global importance. *Int J Parasitol.* 2013;43:999–1008.
- Schoenardie ER, Scaini CJ, Brod CS, et al. Seroprevalence of toxocara infection in children from southern Brazil. *J Parasitol.* 2013;99:537–539.
- Ajayi OO, Duhlińska DD, Agwale SM, Njoku M. Frequency of human toxocariasis in jos, plateau state, Nigeria. *Memórias do Inst Oswaldo Cruz.* 2000;95:147–149.
- Liao C-W, Sukati H, D'lamini P, et al. Seroprevalence of Toxocara canis infection among children in Swaziland, southern Africa. *Ann Trop Med Parasitol.* 2010;104:73–80.
- Magnaval J-F, Michault A, Calon N, Charlet J-P. Epidemiology of human toxocariasis in La Reunion. *Trans R Soc Trop Med Hyg.* 1994;88:531–533.
- Zibaei M, Sadjjadi SM. Trend of toxocariasis in Iran: a review on human and animal dimensions. *Iran J Vet Res.* 2017;18:233–242.
- Miladi H, Didehdar M, Hajihosseini R, Rafiei F, Eslamirad Z. Evaluating correlation between serum liver enzymes and toxocariasis: a case control study. *Asian Pac J Trop Dis.* 2016;6:460–462.
- Momeni T, Mahami-Oskouei M, Fallah E, Safaiyan A, Mahami-Oskouei L. Latent and asymptomatic Toxocara infection among young population in Northwest Iran: the necessity of informing people as a potential health risk. *Sci Tech Rep.* 2016;2016:3562056.
- Ebrahimifard SF, Fakhar M, Sharif M, Shirvani SDN. Seroprevalence of toxocara infection among adult individuals with eosinophilia in Babol, 2013. *J Mazandaran University Med Sci.* 2015;25:355–362.
- Sadjjadi S, Khosravi M, Mehrabani D, Orya A. Seroprevalence of toxocara infection in school children in Shiraz, southern Iran. *J Trop Pediatr.* 2000;46:327–330.
- 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;97:1846–1850 (in eng).
- Sarkari B, Alirezaei R, Layegh Gigloo A, et al. Seroprevalence and risk factors for Toxocara infection among children in a rural community in Fars province, southern Iran. *Parasite Immunol.* 2018;40:e12582.
- Zibaei M, Sadjjadi SM, Sarkari B, Uga S. Evaluation of Toxocara cati excretory–secretory larval antigens in serodiagnosis of human toxocariasis. *J Clin Lab Anal.* 2016;30:248–253.
- Sarkari B, Lari M, Shafiei R, Sadjjadi SM. A Comparative seroprevalence study of toxocariasis in hypereosinophilic and apparently healthy individuals. *Arch Pediatr Infect Dis.* 2015;3:e17911.
- Shokouhi S, Abdi J. Seroprevalence of toxocara in children from urban and rural areas of Ilam province, west Iran. *Osong Public Health Res Perspect.* 2018;9:101.
- Garedaghi Y. Seroprevalence of toxocariasis in children in East-Azerbaijan province, Iran. *Cukurova Med J.* 2013;38:581–586.
- Sadjjadi SM, Oryan A, Jalai AR, Mehrabani D. Prevalence and intensity of infestation with Toxocara cati in stray cats in Shiraz, Iran. *Vet Arh.* 2001;71:149–157.
- Zibaei M, Sadjjadi SM, Sarkari B. Prevalence of Toxocara cati and other intestinal helminths in stray cats in Shiraz, Iran. *Trop Biomed.* 2007;24:39–43.
- Cong W, Zhang X-X, Zhou N, et al. Toxocara seroprevalence among clinically healthy individuals, pregnant women and psychiatric patients and associated risk factors in Shandong Province, Eastern China. *PLoS Neglected Trop Dis.* 2014;8:e3082.
- Ewiss AA, Mohamed ES, Rahma MA, Hifnawy TM, Arafa AE. Occupational health-related morbidities among street sweepers and waste collectors at Beni-Suef, Egypt. *Egyptian J Occup Med.* 2013;37(1):79–94.
- Mba OO. Intestinal parasites among waste-handlers in jos metropolitan area of plateau state, Nigeria. *Sahel Med J.* 2004;7:13–17.
- Deutz A, Fuchs K, Auer H, Kerbl U, Aspöck H, Köfer J. Toxocara-infestations in Austria: a study on the risk of infection of farmers, slaughterhouse staff, hunters and veterinarians. *Parasitol Res.* 2005;97:390–394.
- Uhlíková M, Hübner J. Seroprevalence of toxocara canis infection in Czech Republic. *Cent Eur J Publ Health.* 1998;6:195–198 1998.
- Abo-Shehada M, Sharif L, El-Sukhon S, Abuharfeil N, Atmeh R. Seroprevalence of Toxocara canis antibodies in humans in northern Jordan. *J Helminthol.* 1992;66:75–78.
- Fenoy S, Cuellar C, Guillen J. Seroprevalence of toxocariasis in children and adults in Madrid and Tenerife, Spain. *J Helminthol.* 1996;70:109–113.