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Brief Report

Soil Contamination with Eggs of *Toxocara* spp. in Yazd, Central Iran

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ABSTRACT

Background and objectives: Soil contamination with *Toxocara* spp. eggs is the main source of human toxocariasis. The aim of this study was to determine rate of soil contamination with *Toxocara* spp. eggs in Yazd, central Iran.

Methods: During September 2014 to February 2015, a total of 220 soil samples were collected from public parks, primary schools, green areas, kindergartens, suburban areas, streets, residential complexes, backyards and a bus terminal in the city of Yazd, Yazd Province. Soil samples were investigated for the presences of *Toxocara* eggs by flotation technique using sucrose solution (1.2 g/cm^3) and using light microscopy. Data analysis was carried out by SPSS (version 23) software package.

Results: A total of 220 soil samples from nine different places were examined. Of these samples, 51 (23.2%) were contaminated with *Toxocara* spp. eggs. The contamination rate was 26.3% in public parks, 19.2% in primary schools, 28.6% in green areas, 22.2% in kindergartens, 24% in suburban areas, 8.3% in streets, 18.8% in residential complexes, 19% in backyards and 28.6% in the bus terminal. There was no significant difference in the soil contamination rate with *Toxocara* spp. eggs between different sampling places ($\chi^2 = 3.096$, d.f = 8 and P= 0.92) and sampling areas (χ^2= 2.289, d.f = 2 and P= 0.318).

Conclusion: The high rate of soil contamination with *Toxocara* spp. eggs in Yazd emphasize on the need for preventive measures, such as improving sanitation, providing public health education and controlling stray dogs and cats near children play areas.

Keywords: Toxocara, Soil contamination, Yazd Province, Iran.

INTRODUCTION

The soil-transmitted helminthes are a group of parasitic nematodes that are considered as a health problem in both developing and developed countries (1). Human toxocariasis is caused by the larvae of *Toxocara canis* and *Toxocara cati*, the mature forms of which are found in the intestine of canids and felids, respectively (1). *Toxocara leonine* is another member of the Ascarididae family that naturally infects cats and dogs. Infected animals can release approximately 50,000 eggs per gram feces (2). The eggs become embryonated in soil after three to six weeks and then infective for the hosts (3).

In public spaces, dogs and cats can shed *Toxocara* spp. eggs into the environment through defecation, thereby increasing the risk of infection, especially in children (4). Therefore, soil contamination seems to be a direct indicator of the risk of *Toxocara* spp. infection.

Toxocariasis may have a wide variety of clinical manifestations, but most of the infections are subclinical (5). Many studies have been recently carried out to determine the prevalence of *Toxocara* spp. eggs in the soil of parks, playgrounds, backyards, gardens, beaches, sandpits and other urban and rural areas. Based on different reports, the prevalence of *Toxocara* spp. eggs in the soil of various countries and regions varies from 2% to 88% based on the sanitary behaviors of residents and pet owners, the type and number of dogs and cats, access of stray animals to public places, climatic conditions (e.g., temperature and humidity), geographical features, sample size and the method of egg detection (5). The present study was conducted to evaluate soil contamination rate with *Toxocara* spp. eggs in Yazd, central Iran.

MATERIAL AND METHODS

Yazd is the center of the Yazd Province with geographical longitude of 540, 17′ and longitude of 310, 54′. According to the 2011 census, the population of Yazd is 1,074,428. Yazd is one of the driest cities in Iran, with a hot climate, an average annual rainfall of 60 mm and 31.5% humidity. In summer, temperature rises above 40 °C in blazing sunshine and in the winter, temperature sometimes fall well below 0 °C. There is no surface water and the city has historically relied on groundwater through the system of connected underground wells (qanat). Yazd is divided into three areas: areas 1 and 2 have comparatively larger green parks and backyards, which are mainly located in the old part of the city. The residents in these areas mainly have average hygiene and income. Area 3 consists of small parks and tall buildings, which are located in the modern part of the city. The residents in this area mainly have good hygienic status and high income.

During September 2014 to February 2015, a total of 220 soil samples were selected by multi-stage cluster sampling. The samples were collected from public parks, primary schools, green areas, kindergartens, suburban areas, streets, residential complexes, backyards and bus terminals in Yazd.

Each specimen contained approximately 150 grams of loose soil, mainly from the flowerbeds and depth of 2-8 cm. All samples were placed in plastic containers, labeled and dried at room temperature (1). Two grams of each sample were separated by using 150 µm mesh sieves, and transferred into tubes. Then, 10 ml of Tween 80 (0.05%) were added to the mixture. After vortexing, the mixture was centrifuged for five minutes at 1500 rpm. The supernatant was discarded and the sediment were resuspended with sucrose solution (1.2 g/cm^3) filled up to approximately 1 cm from the top of the tube. The tubes were then centrifuged for 15 min at 1500 rpm. Finally, the tubes were filled to the top with sucrose solution and a cover slip was placed on the tubes for 30 min. The cover slips were examined under a light microscope using 10X and 40X magnification.

Data were analyzed by SPSS (version 23) software package. P-values less than 0.05 were considered statistically significant. Variables with P-values less than 0.20 in the univariate models were considered for multivariate analysis. A backward stepwise model was used to detect the main effects in the final model.

RESULTS

A total of 220 soil samples were collected from nine different places in three areas of Yazd. We detected *Toxocara* spp. eggs in 51 (23.2%) samples (Table 1).

The highest contamination rates were related

to green areas (28.6%), bus terminal (28.6%) and public parks (26.3%).

In addition, the contamination rate was lowest in the streets (8.3%). According to the results of the Chi-square test, soil contamination with *Toxocara* eggs did not differ significantly between different places (χ^2 = 3.096, d.f=8 and P=0.92) nor different areas (χ^2= 2.289, d.f=2 and *P*=0.318) of Yazd.

The prevalence of soil contamination with *Toxocara* spp.
eggs are shown in table 2.

Table 1- Soil contamination with *Toxocara* spp. eggs in different places in Yazd, central Iran

Sampling location	Number of sampling sites	Number of positive sampling sites (%)	Number of collected samples	Number of positive samples (%)
Parks	16	10 (62.5)	76	20 (26.3)
Primary schools	6	3 (50)	26	5 (19.2)
Green areas	8	3 (37.5)	28	8 (28.6)
Kindergartens	3	1 (33.3)	9	2 (22.2)
Suburban areas	5	3 (60)	25	6 (24)
Streets	6	1 (16.7)	12	1 (8.3)
Residential complexes	4	2 (50)	16	3 (18.8)
Backyards	7	2 (28.6)	21	4 (19)
Bus terminal	1	1 (100)	7	2 (28.6)
Total	56	26 (46.4)	220	51 (23.2)

Table 2- Soil contamination with *Toxocara* eggs in different areas of Yazd, central Iran.

Sampling Areas	Number of sampling sites	Number of positive sampling sites (%)	Number of samples	Number of positive samples (%)
Area 1	20	10 (50)	83	20 (24.1)
Area 2	16	9 (56.3)	59	17 (28.8)
Area 3	20	7 (35)	78	14 (17.9)
Total	56	26 (46.4)	220	51 (23.2)

DISCUSSION

Many studies claim that soil contamination with helminth eggs and protozoan oocysts can be a source of human infections. Playing in contaminated areas makes children more vulnerable to contracting toxocariasis (4). The present study investigated the prevalence of *Toxocara* spp. eggs in soil samples collected from public places in Yazd, central of Iran. We found a 23.2% soil contamination rate with *Toxocara* spp. eggs in this city. Undoubtedly the level of soil contamination with *Toxocara* spp. eggs is directly related to the sampling place. The prevalence of *Toxocara* spp. eggs in the soil of various countries and regions varies from 2% to 88% (5).

We found a high rate of soil contamination in parks in Yazd. Lack of fencing around public parks and green areas in Yazd allows stray dogs and cats to have easy access to these places and contaminate the areas with *Toxocara* eggs. A study in Turkey reported a significant difference in soil contamination rates between fenced and non-fenced parks (6).

In addition to parks, the green areas are where mainly children play around, which are suitable places for defecation of dogs and cats (7).

The green areas and streets had the highest and lowest contamination rates, respectively.

In this study, primary schools and kindergartens were also among the highly contaminated areas of Yazd. Presence of children in these places and direct contact with soil could result in development of toxocariasis. Seroprevalence of toxocariasis in school children in Sari and children aged 1-9 years in west of Iran was reported to be 25% and 5.3%, respectively (8, 9). The highest prevalence rates for toxocariasis are usually observed in the Southeastern United States, Mexico, Hawaii, East and Western Europe, Australia, the Philippines and South Africa (10). In the present study, the soil contamination rate in residential complexes and backyards was 18.8% and 19%, respectively. Few people in Yazd keep dogs as a pet in their dwellings, and also these places are mostly surrounded by walls. Thus, the most possible explanation for the high soil contamination with *Toxocara* spp. eggs might be related to stray cats.

The suburban areas and bus terminal are located in the outskirts of Yazd, which are home to a large number of stray dogs and cats. Due to garbage dump in the suburban areas and high population of passengers in the terminal, these locations are important for acquiring toxocariasis. We observed no significant difference between contamination rates in different areas of Yazd, but lower soil contamination in area 3 compared to areas 1 and 2 can be explained by the residents' good hygiene behaviors, higher socioeconomic status and smaller number of stray dogs and cats in this area, which are known factors involved in increased risk of developing toxocariasis (7). Given the hot climate in Yazd, we expected that most of the observed *Toxocara* spp. eggs as inactive, but many embryonated eggs were also seen, indicating presence of active and acute infections in dogs and cats in Yazd.

CONCLUSION

Soil contamination rate with *Toxocara* spp. eggs is high in Yazd, especially in children play areas. Our findings emphasize on the need for implementing preventive measures, such as improving sanitation conditions, providing public health education and controlling stray dogs and cats near places that children play by placing effective fences.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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