Orginal article

Soil contamination with *Toxocara* spp. Eggs in the Public Parks of Tripoli City, Libya

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Abstract
Toxocara spp. is a highly prevalent nematode that parasitizes the gastrointestinal tract of dogs and other canids. The eggs shed in the host's feces can survive for a very long time in the environment and infect other canids and humans. Little information is available on the prevalence of and the risk factors associated with toxocariasis in Libya. To assess soil contamination with *Toxocara* spp., one hundred and five soil samples from public parks in different localities in Tripoli were examined by Dunsmore modified technique. The overall prevalence of *Toxocara* spp. in soil from public parks was 59.0% (62/105 samples). Our findings show a widespread soil contamination in public parks with *Toxocara* spp. eggs. Combined, these are a potential public health risk.

Keywords: *Toxocara* spp; Public parks; Soil; Libya

Introduction

Dogs and other canids are the definitive hosts for *Toxocara canis.* The mature worms in the intestines shed large numbers of unembryonated eggs into the feces, and the eggs become embryonated in the external environment. Therefore, the infection is commonly acquired after ingestion of embryonated *T. canis* eggs that are present in soil contaminated with dog feces. Children are the most susceptible to infection because they are often playing in the places which are easily contaminated moreover, of their habits of pica (Overgaauw 1997; Despommier 2003).Several studies from all over the world demonstrated high rates (10-30%) of soil contamination with *Toxocara* eggs in parks, playgrounds, sandpits and other public places (Tavassoli *et al*. 2008). *T. canis* eggs are reported to be found in soil more commonly than other parasites or other *Toxocara* spp. (Glickman and Magnaval 1993). The study of the prevalence and zoonotic importance of *T. canis* remains a major concern for scientists in both developed and under-developed countries (Overgaauw *et al*. 2009; Klimpel *et al*. 2010).

In Libya, data on the prevalence and epidemiology of pet parasitic infections and zoonosis are sparse. We hope that this study will highlight the importance of the prevalence of soil contamination of public parks by *Toxocara* spp. for the benefit of the animals and humans in contact with them. This study aimed to investigate the prevalence of *Toxocara* spp. in soil from public parks in Tripoli.

Materials and Methods

Study area

This study was done in the metropolitan area of Tripoli, the largest city and capital of Libya. It has a population of about 1.1 million people and a population density of 4,500/km^2. Tripoli is located in the north-western part of Libya at 32° 54' north and 20° 4' east. It has a hot subtropical semi-arid climate with long, hot, dry summers and relatively wet, mild winters with a Mediterranean rainfall pattern. In summer, temperatures often exceed 38°C and can reach into the forties. In December, temperatures can reach as low as 0°C, but the average is between 9 and 18°C. The average annual rainfall is less than 400 mm, but it can be very erratic.

Soil analysis for *Toxocara* eggs

In the Tripoli area there are about 35 parks (green area) with a total area of approximately 1.7 km^2. Twenty-one public parks were selected randomly from the four areas of Tripoli, and five soil samples were taken from each park (Table 1). The specific parks covered by the study are shown in table (2).

Table 1. Number of parks sampled from each of the four regions of Tripoli.

Regions	No. of parks (samples/per park)	Number of samples
Center	10 (5)	50
West	5 (5)	25
South	4 (5)	20
East	2 (5)	10

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Table 2. Number, names and locations of the public parks included in the study.

Center	West	South	East
Saraya park(1)	Saraj	Abu Salim	Shat Alhinsher
Saraya park(2)	Hay Alandalus	Tripoli National	Al Tarsana
Al-shat (1)	Gurji	Tripoli National	
Al-shat (2)	Gurji	Tripoli National	
Bab benghashir	Sports city		
Sooq althaltha			
Sooq althaltha			
Al jalaa			
Fashloum			
Al dahra			
10	5	4	2

The selection of samples from each park focused on the places where children play. Each sample consisted of 250–300 g soil from an area of 20 cm^2 to a depth of 8 cm because *Toxocara* eggs are more abundant in the top soil (Uga *et al*. 1989). Samples were obtained using a cylindrical soil sampling tool, and the samples were placed in polyethylene bags. The sampling was done from late May to early June.

Parasitological examination of the soil samples was done according to (Dunsmore *et al*. 1984). The soil samples were sieved through a 4-mm^2 mesh sieve to remove stones and large pieces of organic matter. A sample of 30 g of soil was soaked overnight in 100 ml of distilled water containing a few drops of Tween-80. The mixture was then homogenized using an electric mixer (Multimixer and Creamer) for 10 min and allowed to stand for 5 min. Two 15-ml centrifuge tubes were filled with the mixture and centrifuged for 10 min at 2000 rpm. The supernatant was discarded, 3.98 M aqueous $NaNO_3$ solution (specific gravity 1.18–1.20) was added to the tube, and the sediment were suspended. The tubes were filled to the top with $NaNO_3$ solution and a slide was placed on the meniscus and left for 25 min. and observed under a microscope.

Results

Soil infection with *T. canis*

From each of the 21 public parks that were sampled, five soil samples were examined. A public park was considered infected if one or more soil samples were infected. The prevalence within the public parks could vary from 0% (0/5) to 100% (5/5) positive. The highest frequency of positive samples were in eastern Tripoli (70%), followed by the center (64%), the south (55%) and finally the west (48%) (Table3).

Table 3. Frequency and prevalence of *Toxocara* spp. in soil samples from public parks in Tripoli

Tripoli region	Frequency of the proportion of infected garden per region					Number of gardens (number of samples)	Prevalence of infected samples
	20	40	60	80	100		
Center	1	1	5	1	2	10 (50)	64% (32/50)
West	1	1	3	0	0	5 (25)	48% (12/25)
South	0	1	3	0	0	4 (20)	55% (11/20)
East	0	1	0	0	1	2 (20)	70% (7/10)
Total	2	4	11	1	3	21 (105)	59% (62/105)

Discussion

Contamination with *Toxocara* eggs and zoonotic helminths is a matter of concern for public health workers worldwide, especially in developing countries (Alonso *et al.* 2001). In recent years, the number of pet owners in Tripoli has increased. In addition, the number of stray dogs and cats is increasing, and all these animals defecate in parks and other public areas (Abdi 2003). Therefore, examined the extent of contamination of soil with *Toxocara* spp. at sites of public health was importance in Tripoli.

We found a contamination rate with *Toxocara* spp. eggs of 59.0% (62/105 soil samples) in soil samples collected from public parks in different locations of Tripoli. Contamination of public parks was highest in eastern Tripoli (70%; 7/10), followed by Tripoli Center (64%; 32/50) and southern Tripoli (55%; 11/20). The lowest prevalence of contamination (48%; 12/25) was in western Tripoli. Therefore, contamination was high in all four areas of Tripoli. Reported contamination rates vary widely, and the prevalence rate we observed in Tripoli is not exceptional.

Public parks and playgrounds that provide free access to pets and stray animals are open to contamination that serves as a source of infection of uninfected animals. Further, street food vendors discard leftovers, which attract stray and scavenging animals. Surprisingly, pets are brought to such public places to defecate, thereby contaminating the soil. When children play on such contaminated soil, they are clearly open to infection.

Some physical properties of the soil, including humidity, oxygenation and compactness, can influence egg survival in the environment (Xavier *et al*. 2010). Importantly, the use primarily of sand in playgrounds, which does not retain water well, probably plays a role in the low contamination of playgrounds. *Toxocara* eggs are resistant to environmental conditions and can remain infectious for years in a favorable environment, but low humidity is lethal to *Toxocara* eggs (Martinez-Moreno *et al*. 2007; Teixeira *et al*. 2008). In Italy and Iran, it was noticed that public parks were more contaminated with *Toxocara* eggs than the playgrounds (Habluetzel *et al*. 2003; Zibaei *et al*. 2010). That is comparable with the results of Mizagaska (2001) who reported that the most contaminated areas were city backyards, with 38–53% of soil samples positive for *Toxocara* eggs. The presence of puppies could increase the probability of finding fertile *Toxocara* spp. eggs in the soil surface, as puppies release more eggs in their feces than adult dogs.

Over the past two decades, many reports have documented contamination rates of *Toxocara* eggs in several countries (Habluetzel *et al*. 2003;Tinoco-Gracia *et al*. 2007; Zibaei *et al*. 2010). However, it is not possible to compare the present study directly with these surveys because of the different sampling and detection methods used in these studies. Nevertheless, the contamination rates observed here are relatively similar to those reported previously.

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