

Prevalence of *Toxocara species* eggs in soil samples of public health importance in and around Bareilly, Uttar Pradesh, India

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Abstract

Aim: The objective of this study was to determine the possible extent of soil contamination at different public places with *Toxocara species* eggs.

Materials and Methods: A Total of 327 samples of soil were collected and examined from different locations which are of public health importance like public parks, playgrounds, door mat dusts, Sidewalks or road sides, in Bareilly, Uttar Pradesh, to establish the prevalence of *Toxocara* eggs. Samples were also categorised in to sandy type (225) and clay type (102) which were examined by Dunsmore modified technique.

Results: 42 samples out of 327 (12.84%) were found to be contaminated with the *Toxocara* spp.eggs and public parks were more contaminated than the other sites we studied. Clay type soil samples were found to be more contaminated than sandy type with a prevalence of 17.64%.

Conclusions: The prevalence of this zoonotic parasite in soil has implications for the spread of human disease in these areas. The authors believe that this may constitute a significant health risk, particularly to children.

Key words: Bareilly, prevalence, soil, *Toxocara* eggs

Introduction

Toxocariasis is a zoonotic disease caused by the larvae stage of *Toxocara canis* (*T. canis*) and *Toxocara cati* (*T. cati*), which are the common roundworms living in the intestines of almost all new-born puppies, kittens and in some adult dogs and cats [1]. It is also found in a larval form in the tissues of all these animals and in many birds and mammals, including humans. Infected Dogs and cats which harbour adult worms pass the *Toxocara* eggs into the environment in their faeces. During a period of maturation, a larva develops within the egg and it is then infective if ingested. Children are most commonly infected when they eat soil contaminated with eggs or put objects contaminated with eggs into their mouths [2].

Human Toxocariasis occurs after ingestion of infective eggs of *Toxocara* spp. and the subsequent migration of larvae, particularly to liver, lungs, muscles and brain. It accounts for considerable preventable childhood illnesses and blindness and is often associated with poor hygiene. Although the clinical features vary, three syndromes are recognised: Toxocaral visceral larva migrans, ocular larva migrans and covert Toxocariasis [3]. Dog's ownership which is widening in urban agglomerations creates a continuing increasing trend. A growing danger of contamination of human environment with infectious stages of zoonoses originating from dogs and cats is related to this phenomenon. Soil sampling shows widespread contamination of the

environment, parks and playgrounds in particular, with the eggs of *T. canis* [4,5].

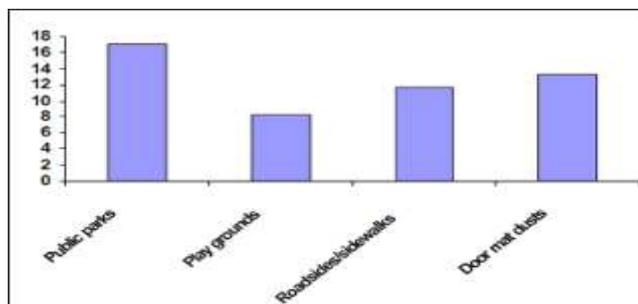
Several reports of soil sampling from different parts of the world, demonstrated widespread contamination of the environment, parks and play grounds in particular, with the eggs of *Toxocara* species [6,7,8]. In India, several surveys revealed prevalence ranging from 2.21-40.4% [9,10,11]. In addition, the assessment of soil contamination requires reliable techniques for separating parasites from soil particles to facilitate identification. Many techniques have been described, and they vary in the materials used and the percentage of parasites recovered [12,13].

When studying the prevalence of soil contamination by zoonotic parasites, some variables must be taken into consideration. The soil texture is one of those important variables once that interactions between the soil structure and the flotation solutions can interfere with parasite recovery. Nevertheless, the relationship between soil texture and the presence of *Toxocara* spp. eggs is not direct. Samples with similar grain size composition can vary in the number of eggs present due to other factors such as intensity of contamination, action of earthworms, wind and rainfall [12,13].

During the course of sampling and laboratory analyses, many factors influence the results of soil examinations. These include sample site selection, the number and volume of samples, depth of sampling,

Table-1. *Toxocara* eggs prevalent at different locations in and around Bareilly.

Site of collection	Number of sites examined	Number of samples examined	Number of positive samples	% positive
Public parks	16	94	16	17.02
Play grounds	6	60	5	8.33
Road side /sidewalks	5	128	15	11.71
Doormat dusts	5	45	6	13.33
Total	32	327	42	12.84

Figure-1. *Toxocara* eggs prevalent at different locations in and around Bareilly

season of examination, method of egg recovery, preservation of samples and laboratory skills [12]. Since a primary source of exposure for children is contaminated parks and playgrounds, this study was conducted to determine the level of contamination with *Toxocara* spp. eggs in these sites. Therefore the objective of this study was to determine the prevalence of *Toxocara* eggs in soil samples from places of public health importance in and around Bareilly, Uttar Pradesh.

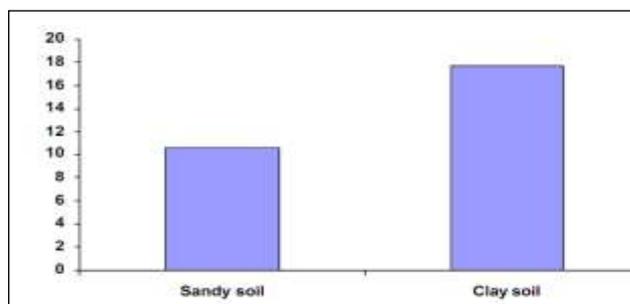
Material and Methods

Study area: The study area, Bareilly city is the district town of Bareilly, Uttar Pradesh. It is situated on the side of the river Ramganga (a tributary of the river Ganges), 243 km West of Lucknow, the capital city of Uttar Pradesh, and 254 km East of Delhi. The climate is hot, humid subtropical, however, the winters are bit cold, with a temperature ranging from 4 to 15°C and the annual rainfall is around 500-700 mm. The study area has good veterinary facilities, a sizeable dog- owning population and a growing stray dog problem. During 10 months period, from September 2010 to June 2011, a total of 327 samples (approximately 100 gm each) were collected from each of the site like public parks, play grounds, doormat samples, sidewalks or road sides in Bareilly. An eight-centimeter PVC pipe was used to collect the soil samples because *Toxocara* spp. eggs are more abundant in the top 0±8 cm than in deeper layers [14].

Design of study/sources of sample collection: Four types of samples were chosen for collection like 1) public parks 2) play grounds 3) road sides / sidewalks and 4) door mat. Samples were also categorised in to sandy type and clay type. Parks were smaller type which was located in the residential areas. These parks were fenced by iron rods but the access of dogs could not be prevented by the fence. Selected play grounds were fenced properly where invasion of dogs was less.

Table-2. *Toxocara* eggs in different soil type

Type of soil	Number of samples examined	Number of positive samples	% positive
Sandy soil	225	24	10.66
Clay soil	102	18	17.64
Total	327	42	12.84

Figure-2. *Toxocara* eggs in different soil types

These were situated nearby to schools and colleges. Road side / sidewalk samples were taken from both the sides of streets of the colonies where dogs are freely roaming. Forty four door mat samples were collected from the hostels, Divisions, and veterinary hospital of IVRI, Izatnagar. The soil samples were divided into sandy type and clay type.

Parasitological examination: To recover parasitic eggs, the soil samples were examined by Dunsmore modified technique, a centrifugal-floatation technique with the use of Sodium Nitrate (NaNO_3 , $d = 1.22$) as the floatation fluid. The possibility of observation of eggs of parasites increases when the amount of soil increases [13]. From the previous studies in which the authors mentioned that the 30 g of soil is the maximum quantity of soil that can be efficiently processed, we used 30 g of soil in our study. Soil samples were used after they had been sieved through 4mm² meshes to remove stone and large pieces of organic matter. In a beaker of 100 ml, 30 g of soil were soaked overnight with 50 ml of distilled water and three drops of Tween-80. The mixture was homo-genized using an electric mixer (Multimixer and Creamer, Tattil, India) for 10 min and rested for 5 min. Two centrifuge tubes of 15 ml were filled with the mixture and centrifuged for 10 min at 2000 rpm. The supernatant was discarded and NaNO_3 was added to the half of the tube and the sediment were suspended. The tubes were filled to the top with NaNO_3 and a slide placed in the menisci for 25 min. Three slides were used for each tube and then observed under microscope. No attempt was made to differentiate between eggs of *T. canis* and *T. cati*. Based on the morphology and morphometry the helminth ova were identified as *Toxocara* spp. [15].

Results

A total of 327 soil samples were examined and 42 (12.84%) were found to contain eggs of *Toxocara*

species (Table-1, Fig-1). Out of 94 samples examined from public parks 16 were found positive for *Toxocara* species eggs, with a prevalence of 17.02%. The public parks were found to be more contaminated than other sites that were examined. Next higher prevalence was seen in door mat samples (13.33%), followed by samples of road sides or sidewalks with a prevalence of 11.71%. The least prevalence of 8.33% was found in playgrounds. Clay type soil harboured a higher percentage of *Toxocara* eggs when compared with sandy soil, with 24 / 225 sandy soil samples being positive for *Toxocara* eggs at a prevalence rate of 10.66%. However, 18/102 clay type soil samples were positive for *Toxocara* eggs, with the prevalence percentage of 17.64 (Table-2, Fig-2).

Discussion

We explored possible extent of soil contamination for this zoonotic infection. The present study was carried out to ascertain contamination rates at the sites of public health importance in Bareilly. Our study revealed 12.84% prevalence of *Toxocara* eggs in soil samples collected from different locations of Bareilly city. Out of 94 samples examined from public parks 16 were found positive for *Toxocara* species eggs, with a prevalence of 17.02%. The public parks were found to be more contaminated than other sites that were examined. Next higher prevalence was seen in door mat samples (13.33%), followed by samples of road sides or sidewalks with a prevalence of 11.71%. The least prevalence of 8.33% was found in playgrounds. Clay type soil harboured a higher percentage of *Toxocara* eggs when compared with sandy soil, with 24 / 225 sandy soil samples being positive for *Toxocara* eggs at a prevalence rate of 10.66%. However, 18/102 clay type soil samples were positive for *Toxocara* eggs, with the prevalence percentage of 17.64%.

Similar surveys revealed prevalence ranging from 2.21% to 40.4% in India [9,10,11]. Since the public parks and play grounds have free access to pet and stray animals, they potentially act as source of contamination. Further, street food vendors discard left out food that attracts the stray and scavenging animals. Surprisingly, pets are brought to such public places for defecation, thereby contaminating the soil. When children play over such contaminated soil, the ova could lead to larva migrans in such individuals. In the present study we found play grounds being less contaminated with the *Toxocara* eggs than other sites, as the play ground soil in the study areas were composed mainly of sand, which does not retain water well and the low humidity is lethal to *Toxocara* eggs. Some physical properties of the soil, including humidity, oxygenation and compactness, can influence egg survival in the environment [12].

Although the soil samples used in present study were collected in the autumn and winter, yet exposure of the soil to prolonged periods of sunlight along with the nature of the sandy soil, could contribute to the

destruction of *Toxocara* spp eggs. Road sides and sidewalks are the places where stray dogs are attracted by left out food materials, also serving as a common defecating places for dogs, are a potential source of *Toxocara* egg transmission. We found that doormat dust samples are contaminated next to the public parks samples as the doormat dust contains accumulated soils of different sites and most of the doormats of the IVRI hostels were shown positive for *Toxocara* spp eggs, as dogs were seen frequently sitting on doormats, where they defecate on the mats.

Over the past two decades, many reports have documented contamination rates of *Toxocara* eggs in several countries [2,16,17]. Although it is not possible to compare present study directly with these surveys because of the different sampling and detection methods used, the contamination rates observed here are relatively similar to those reported previously. Eggs of *Ancylostoma*, *Capillaria*, *Trichuris* and *Toxascaris leonina* have been recovered from various public parks [2,11]. The occurrence of *Toxocara* eggs in public parks, especially in the vicinity of children play areas is a matter of concern for public health. The examination of soil in our study revealed that the contamination of public parks is higher (17.02%) than the contamination of soil at other sites. A similar situation was noticed in Iran and Italy where the public parks were more contaminated with *Toxocara* eggs than the playgrounds [2,16].

The result of the present study shows that the area's most heavily contaminated with *Toxocara* eggs are public parks permanently inhabited by dogs and cats. This report is comparable with results of study of Mizagaska, (2000), that the most contaminated areas were city backyards with 38–53% of soil samples positive for *Toxocara* eggs [18]. 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 faeces than adults. Also, *Toxocara* eggs are resistant to environmental conditions and can remain infectious for years in a favourable environment [19,20].

Previous investigations of soil contamination by zoonotic parasites in public places have focused on the prevalence of *Toxocara* spp. due to the importance of visceral larva migrans [2,10,11]. Overgaauw [21], found that the presence of feral cats, heavily infected with *T. cati* (21%) is a complicating factor in the prevention of environmental contamination. However, contamination by *Ancylostoma* spp. should be also considered in these studies. The detection of *Ascaris* eggs in a few samples in the present study suggests that the soil was contaminated by human (*Ascaris lumbricoides*) or pig faeces (*Ascaris suum*). This suggests problems with the basic sanitation in Bareilly city.

Conclusion

Since, free access of pet and stray animals to public places is hazardous, keeping in view public

health safety, prompt disposal of animal excreta and control of free access of stray animals to public places is recommended. Pet owners must also be educated for regular deworming and the visitors should be made aware of such soil borne helminthic zoonosis. Preferably guidelines must be provided regarding hygiene and environmental sanitation at places of public health importance. The knowledge of the areas contaminated with *Toxocara* eggs will help in the planning of effective measures to prevent the infection.

Author's contributions

SS designed study, processing and screening of samples, analysis and interpretation of data and preparation of manuscript. SNR, SS and MDN collected, processed, screened the samples and drafted the manuscript. OKR, SCG and AK revised the manuscript. All authors read and approved the final manuscript.

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Competing interests

Authors declare that they have no competing interests.

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