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Detection of Toxocara eggs in contaminated soil from various public places of Chennai city and detailed correlation with literature

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Abstract Toxocarosis is one of the most prevalent human helminthosis caused by larvae of *Toxocara canis* and *Toxocara cati,* the most widely distributed nematode parasites of dogs and cats respectively. Soil is considered as the principal source of transmission of *Toxocara* infection to human beings. With increasing population of dogs and cats, soil contamination with ova or eggs of *Toxocara* can be detected in public and private locations of city backyards, playgrounds, streets, sand pits and so on, regardless of the season of the year. In this context the present study was carried out to estimate the extent of soil contamination with *Toxocara* eggs in public parks, playgrounds and few kennels situated in different parts of Chennai city. A total of 105 soil samples from 40 public places and 5 kennels were screened for the presence of parasitic eggs. *Toxocara* eggs were recovered from 5 soil samples indicating an overall prevalence rate of 4.75 %. Out of 80 samples collected from public places, three samples, one each from Mogappair, My lady park (Periamet) and Madras Veterinary College showed the presence of *Toxocara* spp. eggs indicating an overall prevalence of 3.75 per cent. Out of the 25 samples from 5 kennels, two samples one each from Tambaram and Thorappakkam kennels were positive for *Toxocara* eggs with prevalence of 8 per cent. Low prevalence of *Toxocara* eggs in soil samples of these areas can be attributed to the less population of pups, the carriers of adult worms and the active source of soil contamination. The progress made in ABC (animal birth control) programme carried out by both governmental and non-governmental organizations has contributed to reduction of birth rate in dogs and thereby reduced the chances of soil contamination with *Toxocara* eggs to a certain extent in Chennai city.

Keywords *Toxocara* ova · Soil contamination · ABC programme · Chennai

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Introduction

Toxocara larva migrans or Human Toxocarosis is a helminthic zoonosis caused by larval stages of *Toxocara canis* and less frequently by *Toxocara cati*, the adult stages of which are found in the canid and felid intestines respectively. It poses a serious human health problem in temperate and tropical climates. Toxocarosis results in a wide variety of syndromes in humans, which include visceral larva migrans, ocular larva migrans, Covert Toxocarosis, Common Toxocarosis and Cerebral Toxocarosis, although most infections are probably subclinical (Holland and Smith 2006).

The most widely recognized source of human infection is ingestion of embryonated eggs through contaminated soil and this occurs most frequently in toddlers. Eggs are found in soil of public/private places such as playgrounds, parks, beaches, gardens and backyards. The long term survival of *Toxocara* spp. outside their hosts coupled with high reproduction status, is responsible for significant contamination of soil with infective eggs. With increasing population of dogs and cats, soil contamination with eggs of *Toxocara* are detected in public and private locations of city backyards, playgrounds, streets, sand pits etc., regardless of the season of the year from various parts of the world (Gawor et al. 2008; Jarosz et al. 2010). The existence of viable *Toxocara* eggs in superficial layers of sand

presents a potential public health hazard. For this reason more studies have been carried out in recent years to determine the prevalence of *Toxocara* eggs in the soil of parks and especially in the sands in children's playground in different parts of the world.

Chennai is located at 13.04°N and 80.17°E on the southeast coast of India and in the northeast corner of Tamil Nadu. Chennai features a tropical wet and dry climate. For most of the year, the weather is hot and humid. The hottest part of the year is late May and early June. The average annual rainfall is about 1,400 mm (55 in). Chennai city is having a dog population of about one lakh of which the stray dog population comes around 30.000. These dogs are freely in the environment and produce offsprings which may contaminate the environment with *Toxocara* ova. Soil contamination with *Toxocara* ova is reported worldwide (Holland and Smith 2006). However public health impact and soil contamination of *Toxocara* ova has been sporadically reported from India (Das et al. 2009).To fill up the lacunae, the present study was envisaged to study the soil contamination with *Toxocara* ova in various places of Chennai city.

Materials and methods

The soil samples were collected randomly from 40 public places and five kennels situated in various part of Chennai. Two sets of soil samples were collected from public places like parks, playgrounds etc. and kennels. About 50 g of soil sample from 5 cm deep layer was taken from each area into plastic containers and brought to the laboratory (Coelho et al. 2001).

The soil samples were processed for recovering the ova by the method of Dunsmore et al. (1984) as described by Mondarino-Pereira et al. (Mandarino-Pereira et al. 2010) with modifications. 30 g of soil sample was taken in a 50 ml centrifuge tube and soaked overnight in tap water with three drops of Tween 80. The contents were mixed thoroughly in the tube for ten minutes. Two centrifuge tubes of 15 ml were filled with the mixture and centrifuged for 10 min at 2,000 rpm. The supernatant was discarded and Sodium Nitrate solution ($NaNO_3$) (d = 1.20) was added until half of the tube and the sediment was suspended. The tubes were topped with $NaNO_3$ and allowed to stand for 25 min. Later a coverslip was touched on the meniscus and placed on a microscopic slide and observed under 10X of compound microscope.

Results

Toxocara eggs were recovered from 5 of 105 soil samples collected from 40 public places and 5 kennels indicating an overall prevalence rate of 4.75 %. Out of 80 samples collected from public places, three samples, one each from Mogappair, My lady park (Periamet) and Madras Veterinary College showed the presence of *Toxocara* spp. eggs indicating an overall prevalence of 3.75 per cent (Table 1). Among 25 soil samples collected from five kennels, two samples from private kennels of Tambaram and Thorappakkam showed presence of *Toxocara* spp. eggs with a prevalence rate of 8 per cent (Table 2). Based on the morphology, these eggs belonged to *T. canis*. The soil samples positive for *Toxocara* eggs, collected from various places of Chennai were mapped (Fig. 1).

Discussion

The frequency of *Toxocara* eggs in soil samples from public places of Chennai city was found to be low. The prevalence rate of *Toxocara* ova soil contamination of 0–100 per cent has been reported from different parts of the world (Table 3). The sample size for various prevalence studies of *Toxocara* ova was from 6 to 816 (Habluetzal et al. Habluetzel et al. 2003; Das et al. 2009). The highest rate of prevalence of *Toxocara* ova contamination was reported from countries like Japan, Germany, Nigeria,

Table 2 Prevalence of *Toxocara* ova in kennels of Chennai

S.No.	Kennels	Result
1.	Blue cross of India, Velachery, Thiruvotriyur and PFA, Choolai	Negative
2.	Thoraippakkam and Tambaram	Positive

Table 1 Prevalence of *Toxocara* ova in public places of Chennai

S.No.	Places	Result
1.	Mogappair, My Lady Park and Madras Veterinary College campus	Positive
2.	Aminjikarai, Chindradipet, Periamet, Secrateriat, Choolai, Choolaimedu, Nehru Stadium, Nungambakkam, Semmozhi Poonga, Porur, Kattuppakkam, Adayar, Egmore, Arumbakkam, Marina Beach, Besant Nagar Beach, Madhavaram, Thiruvotriyur, Pallavakkam, Pattabhiram, Chitlappakkam, Tambaram, Pulianthope, Minjur, Kilpauk, Chetput, Minambakkam, Kodambakkam, Mambalam, Saidapet, Guindy Park, St.Thomas Mount, Thrisulam, Chrompet, Velachery, Mylapore and Purasawalkam	Negative

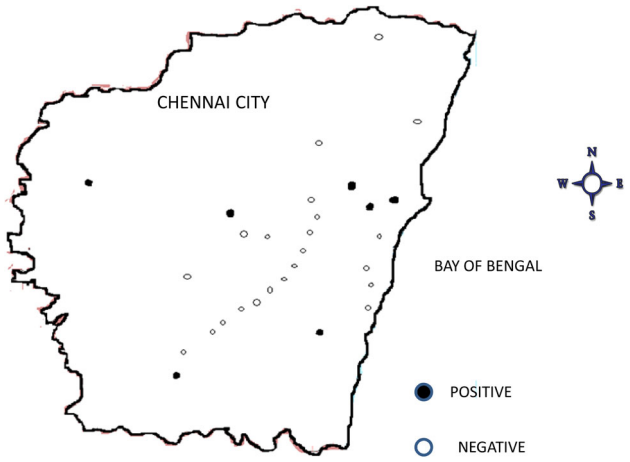

Fig. 1 Mapping of soil contamination of *Toxocara* ova in Chennai city, India

Brazil and Mexico (Uga 1993; Duwel 1984; Maikai et al. 2008; Coelho et al. 2001; Gracia et al. 2007). The less prevalence rate of 4.75 per cent in this study can be attributed to less number of soil samples screened from each place and also less quantity of soil samples (30 g) utilized for the study. It has been suggested that large amount of soil should be examined to determine the frequency of *Toxocara* ova in ground accurately (Duwel 1984). The change in the environmental conditions over these periods of time can also be a reason for the less prevalence rate as many environmental factors determine the sustainability of *Toxocara* eggs in the environment (Dunsmore et al. 1984). However lowest prevalent rate of *Toxocara* ova contamination was reported in countries like Australia, India, Spain, Canada etc. (Franzco et al. 2003; Das et al. 2009; Ruiz de Ybanez et al. 2001; Gualazzi et al. 1986).

Table 3 The prevalence of *Toxocara ova* from different places of world (1980–2011)

Places	No. of samples	Prevalence (%)	Reference
New Jersey, USA	629	0.4	Surgan et al. 1980
Maryland, USA	146	11	Childs 1985
Michigan, USA	114	22	Ludlam and Platt 1989
CT, USA	319	14.40	Chorazy and Richardson 2005
Michigan, USA	114	22	Karen et al. 1989
London, UK	503	66	Snow et al. 1987
London, UK	521	6.3	Gillespie et al. 1991
NS, Canada	567	2.30	Gualazzi et al. 1986
Victoria, Australia	180	0.55	Franzco et al. 2003
Melbourne, Australia	108	1	Carden et al. 2003
Perth, Australia	66	0	Dunsmore et al. 1984
Utrecht, Netherlands	108	7	Jansen et al. 1993
Dublin, Ireland	53	6	Holland et al. 1991
Dublin, Ireland	228	15	O'Lorcain 1994
Havana city, Cuba	45	42.2	Dumenigo and Galvez. 1995
Mexico city, Mexico	145	12.5	Vasquez et al. 1996
Mexicali, Mexico	32	62.5	Gracia et al. 2007
Heliopolis, Egypt	600	30.3	Oteifa and Moustafa 1997
Songkhla, Thailand	102	19	Uga et al. 1997
Malaysia	44	45.5	Loh and Israf 1998
Kualalumpur, Malaysia	89	1	Uga et al. 1996
Surabaya, Indonesia	223	17	Uga et al. 1995
Madrid, Spain	175	9.71	Angulo et al. 1987
Salamanca, Spain	263	6.6	Simon and Conde 1987
Salamanca, Spain	698	4.5	Conde et al. 1989
Murcia, Spain	644	1.24	Ruiz de Ybanez et al. 2001
Argentina	475	2.80	Alonso et al. 2001
Amman, Jordan	226	15.48	Abo Shehada 1989
Minas Gerais, Brazil	23	17.40	Guimaraes et al. 2005
Sorocaba, Brazil	30	53.0	Coelho et al. 2001
Cambo Grande, Brazil	74	20	de Araujo et al. 1999

Table 3 continued

Places	No. of samples	Prevalence (%)	Reference
Saopolo, Brazil	120	17.5	Santarem et al. 1998
Saopolo, Brazil			Queiroz et al. 2006
Saopolo, Brazil	31	29	Santarém et al. 2008
Aracatuba, Brazil	535	0	Nunes et al. 2000
Seropedica, Brazil	25	8	Mandarino-Pereira et al. 2010
Prague, Czechoslovakia	200	24	Valkounova 1982
Frankfurt, Germany	562	87.10	Duwel 1984
Warnemunde, Germany	126	2	Schottler 1997
Tokushima, Japan	46	63.30	Shimizu 1993
Osaka, Japan	40	75	Abe and Yasukawa 1997
Hyogo Prefecture, Japan	13	100	Uga 1993
Sapparo, Japan	107	8.41	Matsuo and Nakashio 2005
Basrah, Iraq	180	12.20	Mahdi and Ali 1993
Konya, Turkey	48	4.16	Guclu and Aydenizoz 1998
Ankara, Turkey	170	30.60	Oge and Oge 2000
Istanbul, Turkey	132	8.33	Toparlak et al. 2002
Elazir, Turkey	744	3.22	Kaplan et al. 2002
Van, Turkey	107	25.97	Ayaz et al. 2003
Aydin, Turkey	111	18.91	Gurel et al. 2005
Kirikkale, Turkey	480	15.60	Aydenizoz Ozkayhan 2006
Ankara, Turkey	259	15.05	Avcioglu and Burgu 2008
Erzurum, Turkey	214	64.28	Avcioglu and Balkaya 2011
Poznani, Poland	534	10	Mizgajska 1997
Krakow, Poland	160	23	Mizgajska 2000
Poznani, Poland	112	6.3	Masnik 2000
Elblag, Poland	72	14	Jarosz 2001
Gdansk, Poland	162	13	Rokicki et al. 2007
Wroclaw, Poland	100	6	Mizgajska 1999
Kolaczkowo, Poland	200	14.5	Jarosz et al. 2010
Ancona, Italy	22	14	Giacometti et al. 2000
Marche Region, Italy	6	50	Habluetzel et al. 2003
Kathmandu, Nepal	122	23	Rai et al. 2000
BuenosAires, Argentina	242	13.2	Fonrouge et al. 2000
Shiraz, Iran	112	6.3	Motazedian et al. 2006
Santiago, Chile	288	13.5	Castillo et al. 2000
Bogota, Columbia	376	5.8	Polo Terán et al. 2007
Eastern Nigeria	400	42.5	Chiejna and Ekwe 1986
Kaduna, Nigeria	608	50.4	Maikai et al. 2008
Madras, India	527	18.41	Gunaseelan et al. 1985
Calcutta, India	450	7.25	Biswas et al. 1986
Punjab, India	208	19.71	Singh et al. 1997
Andhra Pradesh, India	168	6.5	Kumar and Hafeez 1998
Chandigarh, India	120	4.16	Grover et al. 2000
Bangalore, India	208	23	D'Souza et al. 2002
Assam, India	130	6.12	Singh et al. 2004
Pondicherry, India	816	2.21	Das et al. 2009
Chennai, India	105	4.75	Present study

Toxocara eggs found in the positive samples were non embryonated contrary to the embryonated ova found in other studies (Ruiz de Ybanez et al. 2001). This may be due to the fact that the season in which sampling was performed corresponds to a hot and dry environmental condition avoiding the parasite development.

Along with this, the progress made in ABC (animal birth control) programme carried out by both governmental and non-governmental organizations contributed to reduction of birth rate in dogs and thereby reduced the chances of soil contamination to a certain extent with *Toxocara* eggs. This can also attribute to the low prevalence rate observed in this study when compared to the prevalence rate reported twenty seven years back by Gunaseelan et al. (1985). The reduction of *Toxocara* ova over a period of time was also reported from Poznani, Poland (Mizgajska 1997; Masnik 2000), Ankara, Turkey (Oge and Oge 2000; Avcioglu and Burgu 2008), London, UK (Snow et al. 1987; Gillespie et al. 1991), Salamanca, Spain (Simon and Conde 1987; Conde et al. 1989) and Saopolo, Brazil (Santarem et al. 1998; Queiroz et al. 2006).

During the study, it has been found that majority of the public places are frequented by dogs, but mainly adults. The absence of high prevalence of *Toxocara* eggs in these areas can be attributed to the fact that young pups are the carriers of the worms and the active source of soil contamination.

Out of twenty five samples collected from five kennels only two were positive. Even though the chances of getting *Toxocara* eggs are more in kennels with pups, the less prevalence rate in this study can be due to the maintenance conditions followed in kennels. In three kennels, the washings from the puppy shelters are directly connected to the common drainage and the floors are found to be concreted except in one kennel, and they follow regular treatment of floors with disinfectants and regular deworming of pups and adult dogs.

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