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Frequency of *Toxocara canis* Eggs in Public Parks of the Urban Area of Mexicali, B.C., Mexico

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Abstract: The aim of the present study was to determine the frequency of *Toxocara canis* eggs in public parks in the city of Mexicali, B.C., Mexico. A total of 32 parks were sampled and examined using the zinc sulphate flotation method. Association between the frequency of *T. canis* eggs and the socioeconomic status and level of education of neighborhoods where the parks are located were evaluated using chi-square test. Twenty public parks (62.5 %) resulted positive and 12 (37.5%) were negative to *T. canis* eggs. Moreover, parasite eggs of *Strongyloides* sp. *Taenia* sp. and *Dipylidium caninum* were found in 8 of the *T. canis* positive parks and in 5 of the 12 negative parks. Furthermore, 7 parks were found to be negative to any parasites eggs. When evaluating the association between the frequency of *T. canis* eggs and the socioeconomic status and level of education of neighborhoods were the parks are located, the highest frequency of *T. canis* eggs (83.3%) was found in parks of high-income neighborhoods and different ($p = 0.059$) of that in parks with low-middle income neighborhoods. The level of education of neighborhoods did not influence the frequency of *T. canis* eggs contamination. These findings show that *T. canis* eggs, the causative agent of visceral larva migrans, are highly present in public parks of the urban area of Mexicali, B.C., Mexico. To prevent the contamination of parks and prevent children from becoming infected with these parasite eggs, control measures are needed.

Key words: *Toxocara* egg, *Toxocara canis*, soil contamination, public parks, zoonosis

INTRODUCTION

Toxocara canis is a common ascarid of dogs worldwide and is recognized as the main causative agent of larva migrans in humans. Larva migrans can invade several tissues causing a variety of clinical manifestations including visceral larva migrans and ocular larva migrans, which are primarily seen in children (Dumenigo and Galvez, 1995). Humans, mainly children, become infected by accidentally ingesting embryonated eggs present in the soil contaminated by dog feces (Magnaval *et al.*, 2001). The embryonated eggs become infected in 9-11 days at 24°C, in 3.5-5 days at 30°C but at temperatures higher than 37°C in dry sandy soils the larva dies before becoming infective, but in clay soils at the same temperature the larva can survive for up to 2 years. The eggs are very resistant to adverse environmental conditions, but are very susceptible to direct sunlight and dry conditions (Gillespie, 1988; Quiroz, 1999).

Children are particularly exposed to the risk of infection with *T. canis* because of their pica habit, playing in contaminated playgrounds and poor hygiene. Consequently several studies have been performed in different countries with varied environmental conditions and have revealed different frequencies of *T. canis* eggs (5.71-68.8%) contaminating the ground of public parks, playgrounds, school yards, house yards and sandpits, demonstrating the high risk for children to become infected (Dumenigo and Galvez, 1995; Laired *et al.*, 1995; Wiwanitkit and Waenlor, 2004; Shimizu, 1993; Uga, 1993; Gillespie *et al.*, 1991; Ruiz *et al.*, 2001; Giacometti *et al.*, 2000; Capuano and Rocha, 2005; Emehelu and Fakae, 1986; Mizgajska, 2001). In Mexico, studies on contamination frequency by *T. canis* eggs have been accounted to be 14.4 % in parks of South Mexico City (Martinez *et al.*, 1998), similar to those found in another study whit frequencies of 10.9% in public parks, 13.3% in public flower beds and 16.7% in home gardens (Vasquez *et al.*, 1996).

In Mexicali soil contamination with *T. canis* ova has not been reported, although, there is evidence of a high seroprevalence (56.7 %) to *T. canis* in dogs in Mexicali, Mexico (Tinoco *et al.*, 2007). Knowing the prevalence of *T. canis* in domestic dogs from Mexicali, it

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was necessary to evaluate the degree of soil contamination in public parks to recognize the risk for children to become infected.

MATERIALS AND METHODS

Study design and sample choice: There are a total of 32 public parks in the city of Mexicali, Mexico. These parks were grouped in two different areas, East and West, which had 14 and 18 parks, respectively. All the parks were included in the study. Soil samples from five equidistant points (eight samples at the sides and two central), were collected from each public park giving a total of 10 soil samples for each park (Canese *et al*., 2001). The study sample was made of 320 soil samples.

The location of the parks sampled were categorized according to socio-economic status (low-middle income and high-income) and level of education (elementary, high school and College) of the neighborhood where they were located, by the Institute of Social Research of the Autonomous University of Baja California (UABC) utilizing data from the Basics Geostatistic Areas (AGEB) by using the Universal Transversal Mercator (UTM) coordinate system. AGEB information was provided by the National Institute of Statistic, Geography and Informatic (INEGI).

Period and collection of the samples: Soil samples were collected for a period of three months, from May to July 2001. Each sample consisted of squares of soil of 20×20 cm and about 400 g collected down to 1 cm deep with a metallic spoon (Canese *et al*., 2001). The samples were placed in plastic bags hermetically sealed, labeled and transported to the Laboratory for immediate analysis. The metallic spoon was disinfected with chlorinated water prior to each sampling.

Processing of the soil samples: Soil samples were examined using a modification of the zinc sulphate flotation method previously described (Canese *et al*., 2001). Briefly, after careful homogenization 66 g were taken from each soil sample and dissolved in 1000 mL of a 33 % solution of zinc sulphate. The mixture was then sieved through a siever with gauze into a receptacle. After 20 min a sample from the superficial layer of the supernatant was taken with a cover slide and placed on a glass slide to be examined microscopically under lower power (100×) to identify *T.canis* eggs using morphological criteria.

The intensity of soil contamination with *T. canis* eggs was classified according to the number of soil samples that resulted positive of the 10 samples taken for each park as: low (1-3 positive samples), medium (4-6 positive samples) and high (7-10 positive samples).

Statistical analysis: Frequency of *Toxocara canis* eggs in public parks was estimated by each of the following factors: urban district areas, socio-economic status, level of education and intensity of soil contamination. The significance of the difference between proportions by urban district areas and intensity of soil contamination was evaluated by chi-square test. Also, the association between the frequency of *T. canis* eggs and the socioeconomic status and level of education of neighborhoods were the parks are located was evaluated using chi-square test. All statistical analysis were performed using the procedure FREQ of the Statistical Analysis System for Windows version 9.1 (2004).

RESULTS

Frequency of *Toxocara canis* eggs was 62.5% (20/32) of the public parks examined (Table 1). Eight of these positive parks showed in addition to *T. canis* eggs of *Taenia* sp., *Dipylidium caninum* and *Strongiloides* sp. Twelve parks (37.5%) related total were negative to *T. canis*, however in 5 of them eggs of *Taenia* sp, *Dipylidium caninum* and *Strongyloides* sp. were also observed (Table 2). Furthermore, there were not statistical differences ($p>0.05$) in the contamination distribution of *T. canis* eggs between the two areas of the city of Mexicali, where frequencies of 57.1 and 66.6% for the East and West were found, respectively. The intensity of soil contamination with *T. canis* eggs was low in 15 (75%) of the 20 positive parks, while the other 5 (25%) showed medium soil contamination (Table 3). Classification of the parks according to the socio-economic status of the neighborhood (Table 4) revealed contamination

Table 1: Frequency of park contamination by *T. canis* eggs in Mexicali, B. C., Mexico, according to the city areas[1/]

Area	Park (n)	*T. canis* (+)	%
East	14	8	57.1[a/]
West	18	12	66.6[a/]
Total	32	20	62.5

1/ equal letters by column indicate no differences ($p>0.05$)

Table 2: Frequency of park contamination by other parasite eggs x *T. canis* eggs status in Mexicali, B. C., Mexico

Parasite egg	*T. canis* (+)	*T. canis* (-)	Total
Strongyloides sp.	5	4	9
Strongyloides sp.+ *Dipylidium caninum*	1	0	1
Taenia sp.	1	1	2
Taenia sp.+ *Dipylidium caninum*	1	0	1
None	12	7	19
Total	20	12	32

Table 3: Intensity of soil contamination with *T. canis* eggs (n=32) in Parks of Mexicali, Mexico[1/]

Intensity	Park (+)	%
Low	15	46.9[a/]
Medium	5	15.6[b/]
High	0	0

[1/]equal letters by column indicate no differences ($p>0.05$)

Table 4: Frequency of contamination with *T. canis* eggs in Parks of Mexicali, according to socio-economic status of neighborhood

Income[1/]	n	(+)	Frequency[2/] (%)
Low-Middle	20	10	50.0[a/]
High	12	10	83.3[b/]
Total	32	20	62.5

[1] Low-Middle: = 20% of population in this neighborhood makes >5 minimal wage and 20% to< 40% of population in this neighborhood makes >5 minimal wage. High: = 40% of population in this neighborhood makes >5 minimal wage. [2/] equal letters by column into age indicate no differences ($p = 0.059$)

frequencies of 50 and 83.3% for Low-Middle Income (LMI) and High Income (HI), respectively, being significantly different among low-middle and high income neighborhoods ($p = 0.059$). The level of education did not influence the frequency of *T. canis* eggs contamination.

DISCUSSION

The frequency of *T. canis* ova in soil from parks of the urban area of Mexicali, B.C., Mexico was found to be high using the zinc sulphate flotation method. Similar results have been observed by other researchers, although the method for sample processing differed (Laired *et al*., 1995; Shimizu, 1993; Uga, 1993; Emehelu and Fakae, 1986; Serrano *et al*., 2000; Chieffi and Muller, 1976). Although it has been suggested that large amounts of soil should be examined by effective methods to accurately determine the frequency of *Toxocara* eggs in the ground (Duwel, 1984), in this study a small amount of soil sample was used to identify the parasite eggs with a recovering rate of 62.5% similar to that previously described of 53-68% (Dada and Linquist, 1979).

The contamination distribution of *T. canis* eggs between the East and West area of Mexicali did not differ statistically. This result showed that contamination by *T. canis* eggs is evenly distributed in all the parks of the urban area of Mexicali. This could be because the parks in both areas have similar maintenance and lack or have deficient perimeter fences that allow the access of dogs. Contrary to results obtained by Capuano where the lowest frequency of *T. canis* eggs was observed in the Central area and the highest in the North area of Sao Paulo, Brazil, probably because its inhabitants have a better socioeconomic and cultural level, thus facilitating veterinary assistance and routine anthelmintic treatments of the dogs. In addition, a lot of them live in buildings, where dogs are not allowed (Capuano and Rocha, 2005).

Toxocara canis eggs found in the parks in Mexicali were non-embryonated contrary to the embryonated ova found in other studies (Laired *et al*., 1995; Capuano and Rocha, 2005; Queiroz *et al*., 2006). This may be due to the fact that the season in which the park sampling was performed corresponded to hot and dry environmental conditions, avoiding the parasite development. It is known that *T. canis* eggs are very resistant to adverse environmental conditions and require several weeks to become infective and this viability and infectiveness last for several months. However, they are susceptible to direct sunlight and dry conditions (Gillespie, 1988; Quiroz, 1999). Studies that reported soil contamination with embryonated *T. canis* eggs also exhibited optimum environmental conditions of humidity and temperature needed for the eggs to become infective (Laired *et al*., 1995; Shimizu, 1993; Capuano and Rocha, 2005; Sarrano *et al*., 2000). Furthermore, this study mostly included soil samples as the majority of the parks sampled lacked of green areas and it has been demonstrated that there is a higher contamination rate with embryonated *T. canis* ova when the samples analyzed were from gardens and green areas as dogs prefer to defecate on grass (Serrano *et al*., 2000; Chawez *et al*., 2000).

Additionally, the highest frequency of *T. canis* eggs was found in high income neighborhoods whereas the lowest was found in the LMI neighborhoods. This may be due to the fact that parks located in high income neighborhoods have more green areas and dogs prefer to defecate on grass (Vasquez *et al*., 1996; Serrano *et al*., 2000; Chavez *et al*., 2000) while parks located in LMI neighborhoods are mostly covered by soil and cement and dogs are not attracted to. Furthermore, the level of education neighborhoods did not influence the frequency of *T. canis* eggs contamination.

Contamination by parasite ova of *Taenia* sp. *Dipylidium caninum* and *Strongyloides* sp. were also found in the parks analyzed, as reported by others authors (Laired *et al*., 1995). Sometimes these parasite eggs were found in addition to *T. canis* and sometimes were the only eggs that prevailed. The presence of other parasite eggs in these parks indicates the additional risk of acquiring other diseases.

Although all the *Toxocara* eggs found were non-embryonated and therefore not infective, preventive measures to avoid children from becoming infected have to be taken. The lack of perimeter fences or the presence of fences in bad conditions in all the parks involved in this study allowing the access of dogs into these parks and thereby contamination with their infective feces may explain the high frequency of *T. canis* eggs in the parks of Mexicali.

Since this study only included soil samples collected during months that are hot and dry in this area, further studies are needed to evaluate the contamination of these parks with *T. canis* ova by monthly analysis and determination of viability of the eggs in a year period to determine the months that represent the highest risk for children.

CONCLUSION

The present study showed that in the city of Mexicali the contamination frequency of *T. canis* eggs in the parks is high and preventive measures to avoid children from becoming infected have to be taken. Moreover, it is suggested that adequate control and preventive measures are established to prevent children that attend the public parks in Mexicali from becoming infected with larva migrans. The implementation of fences to prevent dog access and defecation in these parks, educating children on hygiene habits like washing hands after playing in the dirt, public education on collecting pet droppings from the ground, as well as the implementation of periodic deworming programs for dogs, may help prevent the development of the disease.

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