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Toxocara spp. Eggs Contamination in Publics Parks and Gardens from Chiclayo, Peru

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Abstract

Toxocariasis is a prevalent zoonotic disease in the district La Victoria, Chiclayo, Peru. Monitoring in recreational areas is essential for the implementation of control programs. For this reason, the frequency of *Toxocara* eggs contamination in public spaces and its association with maintenance status were evaluated. Soil samples from 14 parks and 9 gardens were analyzed from September to December 2019. Sampling was obtained by the 5-point method, collecting 500g of soil at 4 extreme points and 1 center point of each park and garden. The samples were processed using the flotation concentration method with saturated sugar solution (Sheather's method). Soil analysis showed that 100% of the parks and gardens were contaminated with *Toxocara* spp. eggs. The median number of eggs per 100g of soil in all parks and gardens was 1.6. In addition, a higher level of contamination is found in moderately maintained parks, well maintained parks and parks distributed in the center of the district. It is concluded that the district of La Victoria has high level of contamination of parks and gardens with *Toxocara* spp. eggs.

Keywords: Contamination, soils, *Toxocariasis*, Public space.

Introduction

Toxocariasis is a zoonotic disease caused mainly by nematodes of the superfamily Ascaridoidea. *Toxocara canis* and *Toxocara cati*. Zoonotic species of the genus *Toxocara* are gastrointestinal parasites, mainly in domestic dogs and cats [1]. *Toxocara* spp. can also infect a wide range of wild carnivores, poultry, cattle, sheep, pigs, earthworms and accidentally man, this last has been a paratenic host [2]. The adult female parasite produces up to 200 000 eggs per day that are expelled in the feces of animals of definitive hosts. The eggs are deposited in the soil where they mature into an infective form for both humans and pets, being paratenic or definitive hosts [3]. *Toxocara* spp. eggs can survive for years in various types of soils under optimal environmental conditions of heat and humidity [4].

Accidental ingestion of *Toxocara* spp. eggs present in contaminated soil is the main route of zoonotic infection. Among the most vulnerable populations are children, due to their play activities in constant contact with soil and pets [5]. Pets are also infected with this route of transmission [6]. Other reported routes of infection are the consumption of vegetables contaminated with eggs, the consumption of meat from paratenic hosts and compulsive habits in humans such as onychophagy and geophagy [7]. The main clinical repercussions in humans are visceral larva migrans syndrome and ocular larva migrans syndrome, while in pets, they may be asymptomatic or associated with diarrhea and vomiting [8,9].

Members of the genus *Toxocara* have a cosmopolitan distribution, reporting cases of infection in humans and animals worldwide. Reports of human toxocariasis prevalence show a range from 2.9 to 75% in Peru, a South American country [3]. In addition, prevalence in contaminated public spaces in Peru is estimated between 50% to 100% [10]. There are reports that show the Peru is an endemic area of toxocariasis, where contamination of parks and gardens reach a prevalence of 90.9% in Huánuco [11], 90% in

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Ayacucho [12], , 72.2% in Trujillo [13] and 66.7% in Abancay [14]. These reports are evidence of the potential zoonotic risk for habitants from urban areas who visits public green areas. These green areas are frequented by stray and pet animals (dogs and cats), as well as their owners. Given this potential health risk, it is necessary to have updated information on the level of *Toxocara* egg contamination in parks, to develop control programs to contribute to the mitigation of this parasitosis. For this reason, the present study evaluates the contamination of parks and gardens with *Toxocara* spp. eggs in the district of La Victoria in the province of Chiclayo in Peru.

Material and Methods

The study was executed in parks and gardens in the district of La Victoria in the province of Chiclayo, Department of Lambayeque in Peru, from September to December 2019. "La Victoria" district has an area of 29.36 km2 and variable altitude from 17 to 29 m.a.s.l. [15]. The climate is a subtropical desert, with an environmental temperature ranging from 15 to 27.8°C and an average relative humidity of 78% [16].

Sampling

The soil of parks and gardens was collected using the five-point methodology, being a methodology widely used for sampling in open spaces [17,18]. Samples were obtained from the 4 ends of the park or garden and one from the center. Each sample obtained from one of the 5 points of the park had a depth of approximately 2 to 3 cm obtaining 400 g of soil at each point. The samples were stored in sterile labeled polyethylene bags, obtaining a total of 5 samples (with a total of 2 kg) per park or garden.

All parks and gardens registered by the city hall of La Victoria District were sampling. A total of 14 parks and 9 gardens were record by the management of public services of the city hall of La Victoria district. Samples were collected from all parks and gardens in the District of La Victoria; sampling in all public space registered in the District City Hall.

Soil processing

Soil samples were transferred to the Parasitology Laboratory of the Faculty of Veterinary Medicine - Pedro Ruiz Gallo National University to be processed using the flotation concentration method with saturated sugar solution [19]. The samples were previously sieved in sieves of three types of mesh to remove large particles (grass, stones, plastics, etc.). The sieving result was washed in a beaker with 250 ml of distilled water and allowed to settle for 15 min. The supernatant was discarded and resuspended with saturated sugar solution, the content was homogenized and centrifuged for 5 minutes at 1500 rpm. Subsequently, a part of the supernatant was extracted with a pipette and a few drops were placed on a slide, covered with a slide and observed under a microscope at 10x and 40x. A soil sample of a park o garden where at least one *Toxocara* spp. egg was observed in the microscope was considered a positive public space to *Toxocara* contamination [19].

Parks and Gardens Categorization

Space publics were categorized according to their state of conservation: well preserved (presence of grass in the entire area), regular or moderately preserved (presence of grass in 50% of the area) and poorly preserved (no grass in the entire area) [20]. Also were categorized according to their location in the district according to the records of "La Victoria" City Hall, being downtown, pericentric urbanizations and young towns.

Statistical analysis

Only descriptive statistics are reported due to the entire population was included in the analysis. Categorical variables are expressed as absolute frequencies and percentages. Quantitative variable (Eggs per 100 g soil) are reported with median and interquartile range due to Gaussian distribution was not followed. Shapiro-Wilk test was used to evaluated the distribution assumption with a 0.05 significance level. All statistical analysis was performed with the Stata software (StataCorp LP, College Station, TX).

Results

Of the 23 parks and gardens sampled, 100% were contaminated with *Toxocara* spp. eggs and had a median of 1.6 eggs per 100 grams of soil; the median parasite load in gardens and parks were 1.2 and 1.7 eggs per 100 g of soil, respectively (Table 1).

In the district of La Victoria, the presence of moderately maintained parks was greater, and there were more public recreational areas in the urbanizations around the center of the district. The lowest parasite load was present in the bad conservations parks and gardens; meanwhile, the higher parasite load was in the city center (Table 2).

When analyzing the contamination between parks and gardens, a higher proportion of contaminated parks were found in good condition compared to gardens. We also found a higher proportion of contaminated gardens distributed in the center, but a higher proportion of parks in the pericentric urbanizations. A higher parasite load was found in parks and gardens in good care; parasitic load was also higher in both parks and gardens in the city center compared to pericentric urbanizations and young towns (Table 3).

Discussion

The aim of this study was to evaluate the *Toxocara* eggs contamination of parks and gardens in the district of La Victoria, Chiclayo, Peru. Our results show that all the parks and gardens evaluated were contaminated with *Toxocara* eggs. This Toxocara eggs contamination is also reflected in other departments of Peru finding 90.9% of contaminated parks in Huánuco [11], 90% in Ayacucho [12], 72.2% in Trujillo [13] and 66.7% in Abancay [14]. This high prevalence shown in Peru would be associated to the lack of public policies to control parasitic zoonosis and the lack of training on responsible pet ownership [21].

The continuity of the life cycle of *Toxocara* spp. in parks and gardens of La Victoria is influenced by the constant transit of stray and domestic dogs with few control measures [22]. It is known that owners walk their pets on public roads of La Victoria without excreta control; this is reported by Llontop and Eneque, where 96% of the people surveyed, indicate that their dog excretes outside the house and 94% do not pick up their pets' excreta [23]. This is an epidemiological situation of high zoonotic potential, since having knowledge that public spaces are constantly visited by habitants of urban areas such as children (a more vulnerable population due to their recreational habits) and dogs (with high population density in Latin American cities), which interact with other biotic and abiotic factors influencing the high prevalence and wide geographic distribution reported [24].

The zoonotic potential of Toxocara contamination parks is aggravated by the absence of control measures in public spaces. In the development of this study, it was observed that the sampled parks did not have garbage cans in good condition, warning signs (pet restriction and excreta collection order) and lacked fences. In addition, the presence of dogs with and without owners was identified moving near children, where they played near the pet feces in these public spaces. This neglect is also reflected in other public spaces in Peru [14]; given this situation, it is necessary to improve surveillance programs in parks and gardens by municipal and government authorities [25].

Additionally, the high degree of contamination found in the parks and gardens evaluated may be associated with environmental factors. The province of Chiclayo has a warm, desert and oceanic climate with an annual temperature of 15 to 27.8°C and a relative humidity that ranges from 78% to 85%, while spring is the ideal season to find higher levels of Toxocara contamination in parks and gardens [24]. In this regard, in the present study, sampling was carried out during the months of September to December, coinciding with the spring season.

The present study also found that the highest levels of contamination are reported in well-maintained parks and gardens. Well-maintained public spaces present a larger area of vegetation cover, this condition provide humidity and constant shade, avoiding the drying of eggs by the prolonged and direct action of the sun rays [13,20,26–28]. It is also known that temperatures above 35°C inactivate Toxocara eggs and very low temperatures delay their development [27]. Our results are consistent with other studies carried out in Chiclayo and Lima, where a higher degree of contamination of parks and gardens with a regular and good state of conservation has been reported [26,29].

Conclusion

We could conclude that all parks and gardens in the District of La Victoria are contaminated with *Toxocara* spp. eggs. The parks and gardens that were moderately preserved, well preserved and those located in the center of the district presented higher levels of contamination by *Toxocara* spp. eggs. Authorities need to generate control programs to mitigate this zoonotic parasitic disease.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

TABLE 1. Contamination with *Toxocara* spp. eggs in parks and gardens in the district of La Victoria, Chiclayo, Peru.

	Positive	Negative	Eggs per 100g soil	
	n (%)	n (%)	Median	IQR
Parks	14 (100)	0 (0)	1.7	1.2 - 2.6
Gardens	9 (100)	0 (0)	1.2	1.1 – 2.6

*IQR: Interquartile range.

TABLE 2. Characteristics of the samples of parks and gardens evaluated in the district of La Victoria, Chiclayo, Peru.

Type of classification	Categories	Total samples	Positive	Eggs per 100g soil
			n (%)	Median (IQR)
State of conservation of the park or garden	Bad	3	3 (13)	0.8 (0.7 - 1.1)
	Regular	12	12 (52.2)	1.8 (1.2 – 2.8)
	Good	8	8 (34.8)	1.9 (1.2 - 2.8)
Provenance of samples	Downtown	5	5 (21.7)	2.9 (2 – 3)
	Pericentric urbanization	14	14 (60.9)	1.5 (1.1 - 2.3)
	Young town	4	4 (17.4)	1.1 (0.9 - 2.2)

*IQR: Interquartile range.

TABLE 3. Presence of *Toxocara* spp. eggs by type of public space and according to conservation status and origin in the District of La Victoria, Chiclayo, Peru.

Type of classification	Categories	Total Samples	Positive Samples		Eggs per 100g soil	
			Parks	Gardens	Parks	Gardens
			n (%)	n (%)	Median (IQR)	Median (IQR)
State of conservation of the park or garden	Bad	3	0 (0)	3 (100)	0.8 (0.7 - 1.1)	0.8 (0.7 – 1.1)
	Regular	12	7 (58.3)	5 (41.7)	1.8 (1.2 – 2.8)	1.9 (1.2 – 2.6)
	Good	8	7 (87.5)	1 (12.5)	1.9 (1.2 - 2.8)	3.0 (-)
Provenance of samples	Downtown	5	2 (40)	3 (60)	2.9 (2 – 3)	2.9 (1.2 – 3.0)
	Pericentric urbanization	14	10 (71.4)	4 (28.5)	1.5 (1.1 - 2.3)	1.5 (0.9 – 2.3)
	Young town	4	2 (50)	2 (50)	1.1 (0.9 - 2.2)	0.9 (0.8 – 1.1)

* IQR: Interquartile range.

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