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Research Article

Intestinal Parasitic Infections in Schoolchildren and Their Pets in a Municipality from Havana, Cuba: Implications of Zoonotic Risk

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Abstract

While canine pets offer significant psychological and physical benefits to their owners, especially children, there are well-documented health risks associated with pathogens that can be transmitted to humans.

To determine the prevalence of intestinal parasites, with an emphasis on zoonotic ones, in children and their dogs, and to identify risk factors associated with infection, a cross-sectional descriptive study was conducted in children from primary schools in the Cerro municipality, province of Havana.

One hundred and three children (36 with dogs and 67 without pets) from fifth and sixth grades were selected. Three stool samples were collected on alternate days, and one stool sample was collected from their pets using conventional coproparasitological techniques between September and December 2023.

The results showed a prevalence of 38.8% of intestinal parasites in the children studied. *Blastocystis* spp. (30.1%) and *Giardia duodenalis* (17.5%) were the most prevalent zoonotic species. *Ancylostoma caninum* (8.3%) was the most frequent zoonotic parasite in dogs. Male sex was the only variable that showed statistical significance, associated with a higher risk of infection. There were no significant differences in the prevalence of intestinal parasites in the group of children with dogs compared to those without pets, and no statistical association in the analyzed epidemiological variables.

It is important to develop a One Health approach for the control of these zoonoses, as dogs can act as important sentinels of public health.

Introduction

Intestinal parasitic infections have a high prevalence rates and a wide global distribution, primarily in the tropical and subtropical regions of developing countries. Intestinal protozoa and helminths thrive in environments characterized by warm temperatures, high humidity, poor hygiene and sanitation, consumption of unsafe water, and overcrowding [1].

In Cuba, the prevalence of intestinal parasitic zoonoses is influenced by geographic, climatic, socioeconomic, and cultural conditions. As background to this study, research conducted over the last two decades has provided relevant clinical and epidemiological data, demonstrating that 68.3% of public spaces in Havana are contaminated with *Toxocara* sp. eggs. The municipalities of Havana Vieja, Centro Habana, and Cerro stand out, with embryonated eggs present in 100% of the areas analyzed [2]. In another study conducted in Havana on 461 stray dogs in 2005, the prevalence of zoonotic intestinal parasitic species showed a predominance of *Ancylostoma* spp. (21%) and *Dipylidium caninum* (16.2%)

[3]. These findings could indicate that pet ownership influences the prevalence of intestinal parasites in children, primarily associated with overcrowding and unfavorable hygienic conditions.

Given that studies conducted in the Cerro municipality have demonstrated the impact of intestinal parasitic infections (IPI) on children, as well as the environmental contamination of helminth eggs in parks within this municipality [4], an update on intestinal parasitosis in school-aged children, a vulnerable group for intestinal parasitic infections (IPI), is necessary. Given the importance of studying intestinal parasitic zoonoses in the country and considering their impact on animal and human health, with special attention to children and pets, the following research was carried out integrating components of human and veterinary medicine under the One Health concept.

Materials and methods

Study design

A descriptive cross-sectional study was conducted from September to December 2023 in 103 children from three primary schools in the Cerro municipality, Havana province. The study population comprised all fifth- and sixth-grade students from these schools in this municipality.

Three stool samples were collected from each student included in the study, obtained through spontaneous defecation. The samples were collected in clean, dry containers and transported to the National Reference Laboratory for Intestinal Parasitism at the Institute Pedro Kourí Institute (IPK). All samples were analyzed by direct method with lugol solution, flotation technique and by the Kato Katz technique [5]. Additionally, the modified Ziehl-Neelsen stain, specific for intestinal coccidia, was performed on diarrheal samples. Students with pets (dogs) were asked to provide a preserved fecal sample obtained in a similar manner to the one described above.

Inclusion and exclusion criteria

Inclusion criteria:

- Children whose parents and/or guardians express their willingness to participate in the research. In the case of children with good language comprehension and developing decision-making capacity (school-aged children over 7 years old), their consent to participate in this research was requested. If children with intellectual disabilities were included at ages, at which they could give consent, the decision to participate or not was based on the consent of their guardians.
- Children of both sexes between the ages of 10 and 12 years old attending the three selected schools.
- Pets (dogs) living in the homes of the selected children.

Exclusion criteria:

- Children taking any antiparasitic medication at the time of the survey or within the previous two months.
- Pets taking any antiparasitic medication at the time of the survey or within the previous two months.

Statistical analysis

A database was created in Excel (Microsoft, 2010) containing identification, clinical, and epidemiological data. Data processing was initially performed using exploratory data analysis. The chi-square test for comparing proportions and Fisher's exact test for small groups were used to analyze the variables. Analyses were performed using the software packages EPIINFO version 6.04, GraphPad Prism version 5.01 for Windows, and Epidat 3.1. Differences were considered statistically significant when the p - value was less than 0.05.

Ethical considerations

The research was approved by the Ethical Committee of IPK (code CEI-IPK-37-23) following the Helsinki Declaration and Guidelines.All children infected with any parasite of medical importance were consulted and treated by pediatricians involved in every health area according to national therapeutic guidelines. Veterinarians treated dogs infected with pathogen parasites with regime protocols defined in national guidelines.

Results

After analyzing stool samples from 103 children, 38.8% tested positive for intestinal parasites (95% CI: 28.9–48.7). The most frequently identified parasitic specie was *Blastocystis* spp., with 31 positive children (30.1%), followed by *Endolimax nana* (20.4%), *Giardia duodenalis* (17.5%), and *Entamoeba histolytica/dispar* (12.6%). Only one case each of the helminth species *Enterobius vermicularis* (1.0%) and *Ascaris lumbricoides* (1.0%) was diagnosed.

Investigation of 36 canine fecal samples revealed that only five were parasitized, for a prevalence of 13.2% (95% CI: 4.4–28.1). The most frequent parasitic agent was the zoonotic species *Ancylostoma caninum*, with a total of three positive dogs (8.3 %), followed by two other zoonotic species, *Trichuris vulpis* and *Toxocara canis*.

Analysis of potential differences in the prevalence of intestinal parasites between children with and without dogs revealed no significant differences ($p > 0.05$). The frequency of infection was higher in children without dogs (44.8%; 95% CI: 32.1–57.4) at home than in those living with dogs; however, this difference was not statistically significant (Table 1).

When evaluating the association of parasitic infections with epidemiological factors and clinical symptoms reported

Table 1: Prevalence of intestinal parasites in children with and without canine pets at home belonging to primary schools in the municipality of Cerro, Havana, 2023

Study groups	Positive		Negative		*p* value
	No.(%)	(95% CI)	No.(%)	(95% CI)	
Children with pets (*n* = 36)	10 (27.8)	(11.8-43.8)	26 (72.2)	(56.2-88.2)	0.09
Children without pets (*n* = 67)	30 (44.8)	(32.1-57.4)	37 (55.2)	(42,6-67.9)	

in the survey, it was found that males had a higher risk of intestinal parasite infection (52.2%) compared to females (28.1%). No statistically significant differences were found for the other epidemiological and clinical variables evaluated ($p > 0.05$) (Table 2).

When specifically comparing the frequency of infection of the zoonotic intestinal parasite species identified in children with canine pets and in children without pets, it was observed that *Blastocystis* spp. infection was more frequent in children without canine pets than in those with pets. For the other two species (*Giardia duodenalis* and *Entamoeba histolytica/ dispar*) no statistically significant differences were found (Table 3).

Discussion

The prevalence of intestinal parasitism in the school children studied in this research was 38.8%. Reports from other studies conducted in Cuba have shown a higher prevalence, such as the case of school children in San Juan y Martínez in the province of Pinar del Río, who showed a prevalence of 91% [6], and another study carried out in Matanzas by Navarro, et al., reported a prevalence of 48.9% in school children [7]. However, in a recent investigation done by Rodríguez, et al., in children and dogs from three Health councils in the municipality of 10 de Octubre, they reported a prevalence of 36% [8].

In Cuba, numerous studies have been conducted to determine the prevalence of intestinal parasite infections and related clinical and epidemiological aspects in school-aged children. Most of these studies are local or focus on very specific clinical and epidemiological situations [9,10]. Hence the need to increase this type of research in the country, including studies that also address the most common parasitic infections in domestic pets. Two studies that report the presence of zoonotic parasitic species exemplify this need: a clinical case of cutaneous larva migrans in Pinar del Río [11], and a study conducted in 23 parks in Havana, 21 of which were contaminated with *Toxocara* sp. eggs [2].

Blastocystis spp. and *G. duodenalis* were the most prevalent zoonotic intestinal parasites in the study. *Blastocystis* spp. is considered among the few enteric parasites whose prevalence can reach 20% of the general population in industrialized countries and 50% in developing countries [12]. High prevalence rates of *Blastocystis* spp. have been reported in regions of Peru and Venezuela, at 66% and 81%, respectively [13,14]. In Cuba, a study conducted on children treated at the "Juan Manuel Márquez" Pediatric Hospital determined a prevalence of this enteric parasite of 25% [15], and in another study conducted on preschool children in the city of Matanzas, *Blastocystis* was the second most frequent pathogen, with 38.5% [9]. Cañete, et al. reported similar results in 104 children, with *Giardia duodenalis* and *Blastocystis spp*. were the most common parasites found, with prevalence rates of 54.8% and 38.5% respectively [16].

Table 2: Relationship between the epidemiological variables studied and the infection with intestinal parasites in children from three primary schools in the Cerro municipality, Havana, 2023.

Epidemiological variables		Children with intestinal parasites		Prevalence Rate [95% CI]	*P* value
	Category	Yes	No		
Drinking unboiled/untreated water	Yes No	24 16	35 28	1.08 [0.77-1.51]	0.81
Sucking thumb	Yes No	8 32	15 48	0.87 [0.47-1.62]	0,83
Walking barefoot	Yes No	12 28	19 44	1.0 [0.59- 1.69]	0.84
Washing hands before eating	Yes No	36 4	56 7	0.97 [0.43-2.16]	0.79
Eating unwashed vegetables and fruits	Yes No	3 37	7 56	1.32 [0.50-3.52]	0.79
Sex	Yes No	24 16	22 41	1.71 [1.13-2.62]	0.02*

Table 3: Comparison of the prevalence of zoonotic intestinal parasites by species in children with and without canine pets from three primary schools in the Cerro municipality, 2023

Zoonotic intestinal parasite species	Schoolchildren infected with zoonotic intestinal parasites						*p* value prevalence rate (CI 95%)
	Children with dogs (*n* = 36)			Children without dogs (*n* = 67)			
	No.	(%)	(95% CI)	No.	(%)	(95% CI)	
Blastocystis spp.	7	19.4	(5.1-33.8)	26	38.8	(26.4-51.2)	0.04 0.50 (0.24-1.04)
Giardia duodenalis	4	11.1	(3.1-26.1)	14	20.9	(10.4-31.4)	0.21 0.53 (0.19-1.50)
Entamoeba histolytica /E. dispar	2	5.6	(0.7-18.7)	11	6,4	(6.8-26.0)	0.11 0.34 (0.08-1.44)

Given that both parasites are intimately associated with poor environmental sanitation and lack of clean water supply, it is crucial that these factors are addressed effectively with effective control measures in place in terms of health and educational achievement.

Interestingly, research conducted on children in a rural area of Senegal showed a prevalence of 100%, demonstrating the high prevalence of this intestinal parasite in developing countries [17]. In our country, in recent years, a predominance of *Blastocystis* infections has been observed in prevalence studies of the pediatric population, even exceeding the rates of *G. duodenalis*, confirming this intestinal protozoan as the most frequently diagnosed in both school-aged and preschool children in Cuba [8,9,18].

The parasitic species diagnosed in dogs were characterized by a low prevalence of zoonotic species, with *Ancylostoma caninum* being the most frequently diagnosed parasite (8.3%). This result contrasts with reports of this species in previous years, where it has ranged between 25% and 47% [19,20]. This difference could be due to the number of dogs analyzed, which in this study was only 36, while in previous studies it exceeded the one hundred of dogs.

Globally, *Toxocara canis*, *Ancylostoma caninum*, *Echinococcus granulosus*, and *Giardia duodenalis* (assemblies A and B) are reported to be among the most important zoonotic intestinal parasites. The prevalence of these gastrointestinal parasites in epidemiological studies depends on several factors, including the animal's age, living conditions, the ability to assess true prevalence (influenced by the parasitological technique used), and the number of fecal samples examined [21].

The prevalence of helminths identified was 11.1% (4/36), which was slightly higher than the 6.0% reported in the study by Rodríguez, et al. [8]. Furthermore, the low prevalence of intestinal parasitosis in dogs in this study could be influenced by the recent COVID-19 pandemic, as hygiene measures have been intensified, potentially affecting helminth transmission. Similarly, the vast majority of dogs evaluated were adults, which, in the specific case of *Toxocara canis* infection, could explain why only one case tested positive for this zoonotic helminth, given that puppies are at much greater risk of contracting this parasite [22].

This investigation confirmed that there were no significant differences for the variables analyzed, except for sex, in which a higher frequency of infection was observed in boys compared to girls. These results coincide with other reports from our Latin American region, specifically in Peru and Colombia, where male sex was identified as a risk factor. Specifically, Fajardo, et al. in Colombia identified that 70.2% of parasitized cases in school children were male [23], and Cruz, et al., in a study conducted in Peru, revealed that the majority of children infected with intestinal parasites (78.1%) were male [24]. A recent investigation in Iran similarly demonstrated that male sex was a greater risk factor for intestinal parasite infection [25]. These studies suggest that boys, unlike girls, tend to have more contact with soil while playing and more direct contact with other children, which could favor the transmission of these infectious agents.

The prevalence in children with dogs was lower than in those without pets, but this was not statistically significant, which differs from other studies that have significantly linked the presence of dogs in the home with an increased prevalence of parasites in infants [26,27]. In children from both groups, the prevalence of *Blastocystis* spp. was the highest, followed by *G. duodenalis*, which is consistent with other national and international reports [9,10,28,29]. From a quantitative standpoint, the prevalence of *Blastocystis, G. duodenalis*, and *Entamoeba histolytica/dispar* was higher in children without dogs, which could indicate a predominant non-zoonotic mode of transmission. However, it is well known that in households with children living with dogs, which are a reservoir of intestinal zoonotic diseases, it is important to maintain the animals in optimal health [25].

A recent study carried out in Guantanamo province, Cuba, revealed that dog ownership in rural areas from three rural councils did not seem to be an important risk factor for intestinal parasitic infection amongst children living in the same household as the dog. However, the study does not rule out dog faeces as a potential source of exposure of children to intestinal parasites in the wider environment, regardless of dog ownership [30].

In conclusion, adopting a holistic approach, following the One Health principle, to combat these parasites is essential to addressing the health deficiencies that perpetuate these infections. It is important to promote educational activities focusing particularly on hygiene habits and proper sanitation in children from different communities and to prevent intestinal parasitic diseases from domestic animals.

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