Research Article

Gastrointestinal Parasites in Dog Feces in Puebla City, Mexico

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Abstract | The aim of the study was to determine the gastrointestinal parasitosis in pet dogs from an urban area in Puebla city, Mexico; as well as their associated factors. Between the months of November 2017 and May 2018, 250 samples of fresh stool from privately owned dogs were collected, regardless of sex, age, breed or zootechnical function. Likewise, data were obtained from the owner and the animal. The samples were processed by direct examination and the technique of Willis and Malloy modified by Basnuevo. The prevalence of enteric parasites was 19.6%. The identified parasites were *Ancylostoma* spp (6%), *Toxocara canis* (4.4%), *Cystoisospora* spp (4%), *Dipylidium caninum* (3.6%), *Strongyloides* spp (2%), *Uncinaria stenocephala* (1.6%), *Physaloptera* sp (0.4%) and *Trichuris vulpis* (0.4%). Of the parasitized animals 61.2% were males, 38.8% were females, 16.3% were puppies (up to 6 months old), 28.5% were young dogs (7 months to 2 years old), 55.1% were dogs over 2 years of age and 69.4% were purebred dogs; 71.4% had received antiparasitic treatment in the last three months, and 75.5% did not show digestive clinical signs in the last week. The dog's diet and the location of the dog when moored at home established a statistically significant association with the presence of parasites ($p < 0.05$). The 75% (6/8) of the parasitic genera detected were zoonotically important. Based on the high incidence of gastrointestinal parasites in pets, periodic medical examinations should be carried out in pets to prevent and control enteric parasites. Moreover, an adequate handling of feces is critical to prevent the spread of parasites.

Keywords | Endoparasites, Dogs, Puebla, Zoonoses, Prevalence

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INTRODUCTION

Gastrointestinal parasitic diseases are considered the main factor affecting the health of housed pets, especially in dogs (Sudan et al., 2015). Gastrointestinal parasites can generate subclinical diseases or chronic cases that impact animal's health and could cause death; in addition, some of these parasites represent a potential risk for the human population, mainly in places where dogs do not receive adequate medical attention (Encalada-Mena et al., 2011). The main source of contamination is the fecal matter of dogs disseminated in the environment. Hence, the most vulnerable population is children who are exposed to areas where dogs and cats defecate

and those who own domestic animals that do not receive adequate veterinary care (Camaño et al., 2010).

Canine intestinal parasites have a global distribution, their prevalence varies according to regions, times of year, cultural patterns and diagnostic techniques (Llanos et al., 2010). Mexico, due to its geographic diversity and uneven economic development, presents variable frequencies of parasitic diseases in the different regions (Chávez et al., 2012). In the State of Mexico, a frequency of 39.3% of *Toxocara* sp was reported in feces of pet dogs (Romero et al., 2011). In Zacatecas, were detected *Toxocara canis* (59.6%) and *Dipylidium caninum* (30.7%) (Chávez et al., 2012). In Mexico city, were identified *Cryptosporidium* sp (11.5%), *Toxocara canis* (6%) and *Ancylostoma* sp (3.8%) (Martínez-Barbosa et al., 2015). In Tabasco, were detected *Ancylostoma caninum* (15.9%), *Cystoisospora* sp (6.3%) and *Toxocara canis* (2.3%) (Torres-Chablé et al., 2015).

Some of these parasites represent a potential risk for the human population, mainly in places where dogs do not receive adequate medical attention (Encalada-Mena et al., 2011). The main source of contamination are the feces of dogs disseminated in the environment. Therefore, the most vulnerable population is children who are exposed to areas where dogs and cats defecate and those who own domestic animals that do not receive adequate veterinary care (Camaño et al., 2010). Simple procedures to break the fecal-oral route, such as hand washing, regular deworming of pets, and supervision of interaction between young children and companion animals, may reduce the likelihood of infection with zoonotic parasites (Robertson et al., 2000).

The main aim of the study was to determine the prevalence of gastrointestinal parasitosis in pet dogs in the conurbated municipalities in Puebla, Mexico, and their association with biological factors (sex, age group and breed) and zootechnical factors (zootechnical function, veterinary care habits and walking habits). The particular aim was to determine the diversity of gastrointestinal parasites found in dogs during the survey.

MATERIAL AND METHODS

Study area

This investigation was carried out in homes, streets, public parks from an urban area in Puebla city, in central Mexico, and in the recreational center for families, the "Ecoparque Metropolitano de Puebla". Puebla city has an area of 544.65 square kilometers with 1,576,259 inhabitants, it is located at coordinates 19° 02´ 38´´ N and 98° 11´ 50´´ W and has an elevation of 2137 m. The climate is sub humid temperate with rains in summer and the average annual temperature is 17°C (Instituto Nacional de Estadística y Geografía México, 2017).

Study design

The descriptive, observational, cross-sectional, and prospective study was carried out in the range between the months of November 2017 and May 2018.

Collection of fecal samples

Two hundred fifty samples of fresh feces were collected from pet dogs disregarding sex, age or breed, through convenience sampling, and were kept at 4°C to be processed in a period not greater than 48 hours. All the pet owners agreed to participate in the study and signed an informed consent document.

Questionnaire

Information of the owner and the dog were obtained through a questionnaire and registered on a data sheet. The questions were grouped into 3 sections. The first section collected contact details of the owner. The second section was designed to collect data from dwelling where dog lived. The last section of the questionnaire collected data of the dog, this included questions relating to the biological factors (sex, age group and breed), and zootechnical factors (zootechnical function, veterinary care habits and walking habits).

Parasitological procedures

Fecal samples were first macroscopically assessed for the detection of blood, mucus and potential parasitic forms. Afterwards, direct examination was accomplished by using distilled water and lugol (Serrano, 2010); likewise, fecal samples were examined with a flotation technique (Willis-Malloy Modified by Basnuevo) using a high-density solution (sodium chloride, sugar and formaldehyde) (Vázquez et al., 2012). After this procedure, samples were microscopically examined in search for eggs, cysts, oocysts and larvae. A dog was classified as parasite if at least one of these elements was present in its stool sample.

Statistical analysis

A database was constructed and analyzed using IBM-SPSS Statistics (Statistical Package for the Social Science) for the Windows version 23. Measures of central tendency and dispersion were calculated for quantitative variables while absolute and relative frequency distributions were constructed for qualitative variables. The chi-squared test was used to check any statistical significance in the prevalence of gastroenteric parasites with each variable. The associations were considered statistically significant at $p < 0.05$.

RESULTS

The prevalence of gastrointestinal parasitosis was 19.6%

(49/250). The majority of fecal samples from pet dogs were obtained in the months of February (43.2%) and March (28.8%); the number of positive samples per month followed the same distribution, since most corresponded to such months (27 positive samples in February and 19 in March).

The most frequently detected parasite was *Ancylostoma* spp (6%) (Table 1) and multiple parasitosis, caused by *Ancylostoma* spp, *Cystoisospora* spp, *Dipylidium caninum*, *Strongyloides* spp, *Uncinaria stenocephala* and *Toxocara canis,* was present in 12.24% of the parasitized animals (Table 2). No statistically significant association ($p > 0.05$) was found between higher prevalence of gastrointestinal parasites and sex, age group, breed or zootechnical function (Table 3).

Table 1: Number of cases and prevalence of each parasite.

Parasite	n	Prevalence
Ancylostoma spp	15	6%
Cystoisospora spp	10	4%
Dipylidium caninum	9	3.6%
Physaloptera sp	1	0.4%
Strongyloides spp	5	2%
Toxocara canis	11	4.4%
Trichuris vulpis	1	0.4%
Uncinaria stenocephala	4	1.6%

Regarding veterinary care habits, 71.4% of the dogs that resulted with gastrointestinal parasitosis had been dewormed in the last 3 months before the study, while 87.8% they had consultation with the veterinarian in the last 6 months. The statistical analysis demonstrated no significant association was found between veterinary care habits and the presence of parasites in feces ($p > 0.05$).

Parasitosis were not associated either with the spot where owners walk their dog: street 15.6% (5/32), park 22.4% (13/58), street and park 20.3% (31/152), nor with the form of control of the dogs during the walk: on a leash 17.3% (20/115), without a leash 22.2% (8/36), on a leash and without a leash 22.5% (21/93).

On average 3.14 ± 1.42 SD persons living with the sourced dogs per house. The total number of people involved in the care of dogs was 786: children (0 to 9 years old) 8.1%, teenagers (10 to 19 years old) 11%, adults (20 to 59 years old) 73.9% and older adults (60 years of age or older) 7.5%, while 151 persons lived with parasitized animals (20 children, 13 teenagers, 103 adults and 15 older adults). The 17.6% (44/250) of sampled dogs lived with one or more children and 26.5% (13/49) of parasitized dogs lived with one or more children inside the house.

DISCUSSION

The registered prevalence of 19.6% of gastrointestinal parasites during this study, figures similar to the prevalence that reported in Mexico city in 2008, of 20% (Martínez-Barbosa et al., 2011) and in 2015, of 21.3% (Martínez-Barbosa et al., 2015). However, compared to the prevalence obtained in other studies conducted in that same city, but in different years: 40.8% in 1998 (Martínez-Barbosa et al., 1998) and 63.36% in 2009 (Romero et al., 2009) and in other cities, such as Mérida, Yucatán (37.36%) (Rodríguez-Vivas et al., 2001); Escárcega, Campeche (55.92%) (Encalada-Mena et al., 2011); and Zacatecas and Guadalupe, Zacatecas (54.69%) (Chávez et al., 2012); the registered prevalence found in this study, remains low.

The prevalence was evaluated, mainly, in late winter and early spring. In general, low temperatures during the winter season delays the hatching of the eggs and immobilizes some larval stages that, when remaining in a dormant state, need favorable conditions to complete the cycle. In the summer the hatching of the eggs accelerates, although the extreme temperatures produce their desiccation and the destruction of certain larval forms (Giraldo et al., 2005).

Although, the prevalence of parasitized males was slightly higher than that of the females analyzed, this association was not significant ($p > 0.05$), which suggests that regardless of sex, the animals are exposed to similar risk conditions matching the results reported by Echeverry et al. (2012) and Romero et al. (2009).

Numerically, the age group with the highest prevalence of gastrointestinal parasites corresponded to the puppies (up to 6 months of age) with 34.78% (8/23); those with the lowest prevalence were juvenile dogs, from more than 6 months of age to 2 years, with 15.73% (14/89). One factor that could influence the high percentage of parasitism in puppies is the fact that immunity begins to manifest itself after the fifth week of age as in the case of *T. canis*; moreover, due to transplacental and transmammary parasitic transmission the puppy can become infected from before birth or from the moment when it begins to feed on the mother (Giraldo et al., 2005).

Therefore, the finding of age (puppies) as an indicator of risk could be explained by lower immunity, by less deworming or by the particular fact of living in more polluted environments (Betii et al., 2007). We did not find a significant association in this study between the age variable and the presence of parasites ($p > 0.05$). Our results are consistent with those reported by Cazorla and Morales (2013) and Romero et al. (2009). Nonetheless, our results contrast those reported by different studies (Trillo-Altamirano et

Table 2: Associations of identified gastroenteric parasites (monoparasitism, biparasitism and polyparasitism). The number and percentage of cases per parasite or parasites detected are shown.

Associations	Parasite(s)	n (%)	Total
Monoparasitism	*Ancylostoma* spp	12 (4.8)	17.2 %
	Cystoisospora spp	9 (3.6)	
	Dipylidium caninum	4 (1.6)	
	Physaloptera sp	1 (0.4)	
	Strongyloides spp	3 (1.2)	
	Toxocara canis	10 (4)	
	Trichuris vulpis	1 (0.4)	
	Uncinaria stenocephala	3 (1.2)	
Biparasitism	*Ancylostoma* spp and *Cystoisospora* spp	1 (0.4)	2%
	Ancylostoma spp and *Dipylidium caninum*	1 (0.4)	
	Dipylidium caninum and *Strongyloides* spp	2 (0.8)	
	Dipylidium caninum and *Uncinaria stenocephala*	1 (0.4)	
Polyparasitism	*Ancylostoma* spp, *Dipylidium caninum* and *Toxocara canis*	1 (0.4)	0.4%
	Positives	49 (19.6)	19.6%
	Negatives	201 (80.4)	80.4%
	Total	250 (100)	100%

Table 3: Cross tables and Chi-squared test of independence of qualitative variables obtained by each sampled dog (n=250).

		Gastrointestinal parasites		Total (%)	p-value
		Negative (%)	Positive (%)		
Sex	Female	90 (44.8)	19 (38.8)	109 (43.6)	0.448
	Male	111 (55.2)	30 (61.2)	141 (56.4)	
Age group	Puppies (up to 6 months old)	15 (7.7)	8 (16.3)	23 (9.2)	0.122
	Young dogs (7 months to 2 years old)	75 (37.3)	14 (28.5)	89 (35.6)	
	Adult dogs (over 2 years of age)	111 (55.2)	27 (55.1)	138 (55.2)	
Breed	Breed dogs	140 (69.7)	34 (69.4)	174 (69.6)	0.971
	Mixed-breed dogs	61 (30.3)	15 (30.6)	76 (30.4)	
Zootechnical function	Company	164 (81.6)	44 (89.8)	208 (83.2)	0.575
	Security	9 (4.5)	1 (2)	10 (4)	
	Recreation	13 (6.5)	3 (6.1)	16 (6.4)	
	Therapy	5 (2.5)	0 (0)	5 (2)	
	Other	10 (5)	1 (2)	11 (4.4)	

al., 2003; Cazorla and Morales, 2013; Romero et al., 2011; Martínez-Barbosa et al., 2015) where the highest rates of parasitism were registered in dogs under 2 years old.

The 71.4% of parasitized animals had been dewormed previous the survey. This finding could be attributed to the anthelmintic resistance. Otherwise, anthelminthic treatment does not always result in a complete elimination of parasites (Torres-Chablé et al., 2015). Another reason for this finding might be due to the inconclusive nature of the figures, result of the uncertainty that owners demonstrated while filling the survey.

The type of walk did not have a significant association with the presence of parasites in the feces of the sampled dogs. In contrast, Betii et al. (2007) found an association between higher prevalence of intestinal parasites and the control form of dogs in the street: 53.1% (17/32) of dogs with free walking or simple visual control had parasitosis and only 7.6% (1/13) of the dogs that walked on a leash was parasitized. Consequently, the containment with the neck and the strap could be a protective factor because it allows the walker to reduce the dog's access to more contaminated places where it can become infected (Betii et al., 2007).

The 75.5% of the parasitized dogs did not show digestive clinical signs in the last week before the sample was taken, which demonstrates a subclinical course of the disease. This is one of the factors that increases the risk of transmitting the disease to humans; as the owners are not aware of their pet's health condition, the parasite egg load present in the feces increases (Pumidonming et al., 2016), resulting in an important risk factor for children. Hence, children represent the most vulnerable group, since they often play on the ground and due to the common incidence of geophagia (Chávez et al., 2012), biting their nails and being barefoot (Mex-Álvarez et al., 2018).

The most common parasitic association was *Dipylidium caninum* and *Strongyloides* spp; this association is of great importance, because it reaffirms the zoonotic potential of these animals, which become disseminators of parasite eggs to the environment (Hernández et al., 2007). Consequently, the inadequate management of the feces can become a risk factor for people, due to the presence of parasites of zoonotic character in the feces of dogs, increasing the likelihood of human infection (González and Giraldo, 2015).

The 79.59% of the dogs with gastrointestinal parasites were eliminating some parasitic form of at least one zoonotic genus, constituting a potential risk for the public health in general and especially, for the infantile population. It is recommended that dog owners perform periodic controls through veterinary supervision, considering the prevention, diagnosis and therapeutic control of gastrointestinal parasites.

Likewise, people who visit public parks with their dogs must have an adequate handling of excreta to avoid the propagation and contagion of canine parasitosis. In public parks, the permanence of the eggs of helminthes can be up to years because they resist cold and dry conditions; therefore, even though the stool disintegrates, there is a risk that the park soils are infested (Mex-Álvarez et al., 2018).

The identification of species of *Ancylostoma*, *Cystoisospora*, *Physaloptera* and *Strongyloides* was not carried out in the studied feces; such identification will be necessary in the future and especially in those shared with the human, which will allow to estimate the risk factors and preventive measures (Martínez-Barbosa et al., 2015).

As parasitic diseases are often in urban zones in Puebla city, an overall, in Mexico, preventive measures are necessary to contain and reduce the prevalence of gastrointestinal parasites. The great potential gastrointestinal parasites present to infect humans (especially children) through feces ingestion, represents a high risk for public health. The findings obtained in this study provide general information for veterinarians and human health professionals regarding the prevalence of different parasitic diseases and could potentially be used to create awareness in the population.

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CONFLICT OF INTEREST

The authors confirm that there is no conflict of interests.

AUTHORS CONTRIBUTION

Ana Alejandra Contreras-Flores: design, sampling, laboratory work and writing the document. Salvador Romero-Castañón: design and writing the document. Valeria Magali Rocha-Rocha: statistical analysis.

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