Prevalence of Intestinal Parasites with Zoonotic Potential in Canids in Mexico City

Camilo Romero¹, Germán Eduardo Mendoza², Miguel Angel Pineda¹, Nadyeli Nava³,
Linda Guilliana Bautista¹ & Rafael Heredia⁴

ABSTRACT

Background: In Mexico City, there are 1.2 million dogs of which 10% are strays, which produce about 182 tons of feces per year. Among the intestinal parasites with zoonotic risk from dogs are Ancylostoma, Toxocara, Giardia and Dipylidium. These pathogens can be found in standard human environments, such as water, soil, food, parks, and contamination from dog feces, and represent a high risk to persons. Therefore it is important to promote prophylactic measures, which are based on hygiene, having pet deworming programs and control of stray dogs. The objective was identifying Toxocara spp., Giardia spp., Dipylidium caninum, Ancylostoma spp. and Coccidia in canids from the downtown area of Mexico City.

Materials, Methods & Results: The study was conducted in Mexico City. A total of 1603 pet feces were collected and were classified according to gender and age (young animals < 1 year and adults > 1.1 years). Microscopic diagnosis of parasites was achieved using the flotation technique of Willis. The proportion of contamination was considered as the percentage of positive samples out of all collected samples. The number of parasite eggs in each sample was counted, and eggs were then identified by structure and morphometry, to provide an additional measure of the degree of parasitization (number of eggs g⁻¹ feces). Prevalence was analyzed using the Chi-square (χ²) test to compare age groups and gender, while the average number of parasites per gram of feces was analyzed using a “t” test with a confidence level of P < 0.05. The results showed that 13.10% (210) of the dogs were positive for some type of gastrointestinal parasite (Toxocara spp., Coccidia, Ancylostoma spp., Giardia spp., Dipylidium caninum) of which 115 (13.18%) were males and 95 (12.99%) females, with no gender difference (χ² = 0.013, P = 0.99). Giardia spp. was found in 25 young animals (6.9%) and 50 adults (4.0 %) whereas Toxocara spp. was less common (3.3% of young animals and 3.7% of adults).

Discussion: The results of this study show lower prevalence rates than other reports from around the world. In our study, only 30 dogs were positive out of 1603 samples. Our sampling revealed a higher prevalence in males, but with a much lower incidence of A. caninum. The low incidence of A. caninum can be attributed to the fact that most pet dogs have been subjected to a deworming program. Several studies agree that dogs aged less than 5 months are more susceptible to this protozoan, because Giardia spp. can complete its life cycle by this age, and some dogs do not undergo an adequate deworming program. We observed the same effect of age, but the prevalence in Peru was four times greater than that in Mexico (4.0%). Several studies have shown that the soil of public parks presents an important source of infection of this zoonotic parasite and has a significant impact on public health. In most studies the prevalence varies between males and females, being higher in males, and appearing more frequently in younger animals. This information should be taken into account in the prevention and control of these zoonotic parasites, involving implementing deworming programs and avoiding fecal contamination of soil, water and food, encouraging responsible pet ownership, implementing the control of street animals and thus reducing the impact of this zoonotic problem. The parasite burden in the feces of dogs in the downtown area of Mexico City can be considered low but remains a potential risk factor for humans.

Keywords: canine, parasites, risk factor, zoonosis, fecal examination.
INTRODUCTION

In large cities many inhabitants live in close proximity to one another, and in some cases live with pets such as cats and dogs. These may be considered loyal friends and companions, but although they provide substantial benefits such as emotional development, socialization and physiologic wellbeing [24], dogs also act as reservoirs of a large number of parasitic zoonoses such as toxoplasmosis [30], giardiasis [33], toxocariosis [12] and anquilostomiasis [1]. This is important because parasitic eggs can enter the body in various ways, such as via the skin mucosa, and digestive and respiratory tracts [16] and the human may host over 100 different types of parasites. It has been estimated that 85% of the adult population has at least one form of parasite living in their bodies [7].

In Mexico City, there are 1.2 million dogs of which 10% are strays, which produce about 182 tons of feces per year [31]. Among the intestinal parasites with zoonotic risk from dogs are Ankylostoma, Toxocara, Giardia and Dipylidium [8]. These pathogens can be found in standard human environments, such as water, soil, food, parks, and contamination from dog feces [18], and represent a high risk to immunosuppressed persons, children, seniors and pet owners [27]. However, these zoonoses are not considered a public health problem because they do not cause epidemiological emergencies [26]. Therefore it is important to promote prophylactic measures, which are based on hygiene, hand washing as well as washing fruits and vegetables, proper cooking of meat products [15,23], having pet deworming programs and control of stray dogs. The objective was identifying these parasites.

MATERIALS AND METHODS

The study was conducted in Mexico City. According to the guidelines of the Autonomous University of the State of Mexico, where the study was carried out not will require approval of the Ethics Committee, since we worked with stool samples are to make management in dogs. Samples of dog feces were collected, and were classified by gender and age (juvenile animals < 1 year and adults > 1.1 years) for the purposes of a cross-sectional descriptive study. The sample size was 1603 excreta determined by equation: where: = 1.96 (with 95% confidence, gl > 120); = sampling error; = estimated proportion of presence and = estimated proportion of absence (100-). An a priori prevalence of 21.2% obtained in a study in dogs of the City of Mexico was used [19], along with a 10% sampling error.

Samples were collected with the necessary measures for health and safety of the staff, and placed in bottles labeled for subsequent microscopic diagnosis using the flotation technique of Willis. The bottles were filled with water and were shaken to dissolve the fecal matter. The resulting solution was filtered in beakers, and the filtrate was washed twice with running water and centrifuged at 800 x g for 4 min. The last centrifugation of the sample was performed with zinc sulfate solution (33%), and a sample from the supernatant of each tube was grabbed with a bacteriological loop for observation under the microscope Olympus ® model CX21FS1 with objectives 10x and 40x. The proportion of contamination was considered as the percentage of positive samples out of all collected samples [13]. The number of parasite eggs in each sample was counted, and eggs were then identified by structure and morphometry [4], to provide an additional measure of the degree of parasitization (number of eggs g⁻¹ feces).

All dogs that had at least one fecal parasite egg were considered positive. Prevalence was defined as the percentage of positive fecal samples for any kind of parasite and specific prevalence as the percentage of positive samples for a given parasite.

The Chi-square ($\chi^2$) was used to compare the prevalence of helminthes in different age groups and gender. The difference in concentration of eggs per gram of feces according to gender and age was analyzed via a “r” test for each type of parasite [14].

RESULTS

Among the 1603 sampled dogs (731 females and 872 males), there were 210 positive dogs (13.10%). Among the positives, 13.18% were male and 12.99% female, indicating no difference in prevalence according to gender ($P = 0.99$). In terms of age, 15.55% of young dogs and 12.38% of adults were positive, with no difference according to age ($P = 0.11$) [Table 1].

There were some differences in the prevalence of different parasites (Table 2). Toxocara spp. was uncommon (3.3% of young and 3.7% of adult peoples.
dogs) with no difference according to age ($P = 0.69$) or gender ($P = 0.19$). Those animals most affected by *Giardia* were adults (4.0%) compared with the young (6.9%), with a significant difference according to age ($P = 0.02$), and males showed a higher prevalence ($P = 0.019$) than females (6.0 vs. 3.5%). In the case of *Dipylidium caninum*, there were no differences between age groups ($P = 0.26$), with 1.6% of young animals and 0.96% of adults infected; however, there was a higher prevalence in males (1.7%) than in females (0.5%) ($P = 0.022$). The presence of *Ancylostoma* spp. was similar ($P = 0.26$) in both age groups (young 2.5%, adults 0.16%) but males showed a higher prevalence (2.5%) than females (1.2%) ($P = 0.042$). In the case of *Coccidia* there was no difference ($P = 0.06$) between age groups (young 1.6% vs. adult 1.52%), but there was a tendency ($P = 0.06$) for a higher prevalence in males (2.1%) than in females (1.0%).

Data on the number of parasites per gram of feces according to age and gender are presented in Table 3. *Giardia* spp. accounted for the highest number of eggs, but with no differences between age groups ($P = 0.46$) or gender ($P = 0.20$). The number of eggs of *Toxocara* spp. did not differ between age groups ($P = 0.44$) or gender ($P = 0.51$). In the case of *Dipylidium caninum* there was a tendency ($P = 0.09$) for more eggs in young animals than in adults (15.0 vs. 9.33) and a higher prevalence ($P = 0.06$) in females than in males (12.31 vs. 5.75). In the case of *Ancylostoma* there were no differences between age groups ($P = 0.14$) or gender ($P = 0.73$); the same was true for *Coccidia* (age $P = 0.57$; gender $P = 0.07$).

### Table 1. The overall prevalence of parasites in dogs by age; young animals <1 year and adults> 1.1 years and gender; male-female, from Mexico City.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Animals tested</th>
<th>Positive (%)</th>
<th>$\chi^2$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>872</td>
<td>115 (13.18)</td>
<td>0.013</td>
<td>0.99</td>
</tr>
<tr>
<td>Female</td>
<td>731</td>
<td>95 (12.99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>360</td>
<td>56 (15.55)</td>
<td>2.45</td>
<td>0.11</td>
</tr>
<tr>
<td>Adult</td>
<td>1243</td>
<td>154 (12.38)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1603</td>
<td>210 (13.10)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\chi^2$: Chi-square shows the degree of association, (*) it means $P = < 0.05$, and if there is association between positive and males or females, young or adult.

### Table 2. Prevalence of *Toxocara*, *Giardia*, *Dipylidium*, *Ancylostoma*, and *Coccidia* according to age and gender.

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Age</th>
<th>Positive (%)</th>
<th>$\chi^2$ ($P$)</th>
<th>Gender</th>
<th>Positive (%)</th>
<th>$\chi^2$ ($P$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Toxocara</em></td>
<td>Young</td>
<td>12 (3.3)</td>
<td>0.15</td>
<td>Female</td>
<td>37 (4.24)</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>47 (3.7)</td>
<td>(0.69)</td>
<td>Male</td>
<td>22 (3.0)</td>
<td>(0.19)</td>
</tr>
<tr>
<td><em>Giardia</em></td>
<td>Young</td>
<td>25 (6.9)</td>
<td>5.34</td>
<td>Female</td>
<td>31 (3.5)</td>
<td>5.41</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>50 (4.0)</td>
<td>(0.02)*</td>
<td>Male</td>
<td>44 (6.0)</td>
<td>(0.01)*</td>
</tr>
<tr>
<td><em>Dipylidium</em></td>
<td>Young</td>
<td>6 (1.6)</td>
<td>1.23</td>
<td>Female</td>
<td>5 (0.5)</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>12 (0.96)</td>
<td>(0.26)</td>
<td>Male</td>
<td>13 (1.7)</td>
<td>(0.02)*</td>
</tr>
<tr>
<td><em>Ancylostoma</em></td>
<td>Young</td>
<td>9 (2.5)</td>
<td>0.99</td>
<td>Female</td>
<td>11 (1.2)</td>
<td>3.87</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>21 (0.16)</td>
<td>(0.31)</td>
<td>Male</td>
<td>19 (2.5)</td>
<td>(0.04)*</td>
</tr>
<tr>
<td><em>Coccidia</em></td>
<td>Young</td>
<td>6 (1.6)</td>
<td>0.03</td>
<td>Female</td>
<td>9 (1.0)</td>
<td>3.46</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>19 (1.52)</td>
<td>(0.85)</td>
<td>Male</td>
<td>16 (2.1)</td>
<td>(0.06)</td>
</tr>
</tbody>
</table>

$\chi^2$: Chi-square shows the degree of association; (*) it means $P = < 0.05$, and if there is association between species and males or females, young or adult.

Table 3. Concentration of eggs per gram of feces of each parasite according to age and gender.

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Age</th>
<th>Gender</th>
<th>P</th>
<th></th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adult</td>
<td>Young</td>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Toxocara</td>
<td>12.11± 10.11</td>
<td>9.93 ± 5.72</td>
<td>0.44</td>
<td>12.31 ± 9.14</td>
<td>10.64 ± 9.74</td>
</tr>
<tr>
<td>Giardia</td>
<td>15.10 ± 9.37</td>
<td>16.92 ± 11.18</td>
<td>0.46</td>
<td>16.61 ± 9.72</td>
<td>13.93 ± 8.21</td>
</tr>
<tr>
<td>Dipylidium</td>
<td>9.33 ± 6.77</td>
<td>15.0 ± 2.55</td>
<td>0.09</td>
<td>12.31 ± 6.49</td>
<td>5.75 ± 1.50</td>
</tr>
<tr>
<td>Ancylostoma</td>
<td>8.81 ± 4.76</td>
<td>6.0 ± 3.93</td>
<td>0.14</td>
<td>7.54 ± 4.24</td>
<td>8.11 ± 4.79</td>
</tr>
<tr>
<td>Coccidia</td>
<td>7.11 ± 7.55</td>
<td>5.43 ± 3.15</td>
<td>0.57</td>
<td>3.90 ± 3.11</td>
<td>8.73 ± 7.65</td>
</tr>
</tbody>
</table>

(*) it means $P = < 0.05$, if there is significant difference between adult and young, females and males in number of eggs per gram of feces.

**DISCUSSION**

The results of this study show lower prevalence rates than other reports from around the world. Biu and collaborators reported that the most common parasite in dogs was *Ancylostoma caninum*, with 51.9% of dogs infected in a sample of 138 dogs [3]. A study from Ethiopia showed similar results, with the most frequent parasite being *Ancylostoma caninum* (78.89%) [32] and another study from Nepal reported 52.0% positivity for this same parasite [28]. In our study, only 30 dogs were positive (1.87%) out of 1603 samples.

In terms of gender, Biu and collaborators found that most affected dogs were males (57.1% vs. 52.5% of females) [3]. Our sampling revealed a higher prevalence in males, but with a much lower incidence of *A. caninum* (2.5% males and 1.2% females). Biu and cols. also reported higher rates of infection in young animals (54.0%) than in adults (30.0%) [3], contrary to the results found in the current study in which there was no difference between age groups. The low incidence of *A. caninum* can be attributed to the fact that most pet dogs have been subjected to a deworming program.

The prevalence of zoonotic parasites in other countries is higher than that found in the current study. In the province of Cordoba, Spain, 71.3% of samples from domestic dogs (n = 1800) were infected with some type of intestinal parasite [20], a much higher rate than in our study (13.10%, n = 1603). In Iran 71.7% of animals were found to be infected with zoonotic parasites obtained from intestinal samples at necropsy, with *Ancylostoma caninum* being the most frequent parasite with a prevalence of 22.4% [34], followed by 31.83% protozoa, and 15.77% tapeworms, the most prevalent of which was *Dipylidium caninum* [28], with a higher prevalence than in our study (1.2%). The Iranian study also reported higher rates of *Toxocara canis* (17.72%) and *Toxascaris leonina* (14.94%) than our study (3.7%). In another study from China the most abundant parasite was *Toxocara canis* (45.2%) [6]. In South Africa *Toxocara canis* was detected in 36% of samples [21], a higher rate than observed in our study (3.7%).

The most frequent parasite in dogs varies between regions. In South Africa *Ancylostoma caninum* was found in 88% [21], of the samples (n = 164) collected from feces, necropsy and blood, and *Dipylidium caninum* was present in 39% of the dogs (higher than in our study: 1.12%). Minnaar and Krecek stated that there are many zoonotic helminths in dogs belonging to low-income people because they may not be able to afford to carry out biosecurity measures for their animals, such as deworming [21].

A study performed in Lima, Peru, reported *Giardia* spp. in 16.7% of fecal samples from domestic dogs [29], with younger animals showing the highest rate of infection. We observed the same effect of age, but the prevalence in Peru was four times greater than that in Mexico (4.0%). Batchelor and collaborators also found a higher prevalence of the same parasite in young animals (8.4%) compared with adults [2]. Dado and collaborators reported a 19.4% prevalence of *Giardia* spp. [9]. Several studies agree that dogs aged less than 5 months are more susceptible to this protozoan, because *Giardia* spp. can complete its life cycle by this age, and some dogs do not undergo an adequate deworming program. Several studies have shown that the soil of public parks presents an important source of infection of this zoonotic parasite and has a significant impact on public health [20]. A study conducted in Brazil reported a prevalence of *Giardia* spp. of 16.9% in dogs, with a significant difference between owned and stray dogs [17].
Coccidia was present at a lower prevalence (1.52%) than in most studies. A study in Pakistan reported a prevalence of 18% in domestic dogs, and was associated with the misuse of dewormers, geographical conditions or lack of knowledge of the owners about this parasite [22]. In a breeding unit in South Africa, Penzhorn and collaborators reported a prevalence of coccidiosis of 26% in German Shepherd dogs and 51.7% in their litters [25]. Buehl and collaborators reported a prevalence of coccidiosis in dogs of 8.7% [5]. In most studies the prevalence varies between males and females, being higher in males, and appearing more frequently in younger animals. This information should be taken into account in the prevention and control of these zoonotic parasites, involving implementing de-worming programs and avoiding fecal contamination of soil, water and food, encouraging responsible pet ownership, implementing the control of street animals and thus reducing the impact of this zoonotic problem.

The results of this study indicate that the prevalence of the parasites Toxocara spp., Giardia spp., Dipylidium caninum, Ancylostoma spp., and Coccidia in canids in the downtown area of Mexico City is low. With the exception of Toxocara, the feces from males had a higher prevalence of gastrointestinal parasites than those from females.

REFERENCES