Prevalence and Risk Factors of *Giardia* Spp. from Free Living and Owned Dogs in Tunja-Boyacá, Colombia

M. O. Pulido-Medellín¹, J. C. Giraldo-Forero² & G. I. Chavarro-Tulcán³

¹Gidimevetz, Pedagogical and Technological University of Colombia, Tunja – Boyacá, Colombia; ²Gipamt, INCCA University of Colombia, Bogotá, Colombia

Summary


*Giardia* spp. is a zoonotic protozoan that causes acute gastroenteritis in humans and other animal species across the world (Bouzid et al., 2015). The overall global prevalence of canine giardiasis ranges from 5% to 100% and depends on many factors including age, living conditions, animal density, nutritional and immune status, and diagnostic method (Scaramozzino et al., 2009).

The parasite can spread easily through the faecal-oral route (Munoz & Mayer, 2016) and can be usually acquired via water, food, or direct contact (Caccio &

**Key words**: dogs, *Giardia* spp., prevalence, risk factors

**INTRODUCTION**

*Giardia* spp. is a zoonotic protozoan that causes acute gastroenteritis in humans and other animal species across the world (Bouzid *et al.*, 2015). The overall global prevalence of canine giardiasis ranges from 5% to 100% and depends on many factors including age, living conditions, animal density, nutritional and immune status, and diagnostic method (Scaramozzino *et al.*, 2009).

The parasite can spread easily through the faecal-oral route (Munoz & Mayer, 2016) and can be usually acquired via water, food, or direct contact (Caccio &
Prevalence and risk factors of *Giardia* spp. from free living and owned dogs in Tunja-Bayacá, Colombia

Ryan, 2008). Public health concern is significant due to the risk from companion animals (Thompson *et al*., 2008). This risk depends on prevalence rates and excretion patterns. Assemblages A and B pose a greater risk to public health because they infect dogs, humans, and other mammals (Caccio *et al*., 2005).

Previous studies have identified risk factors. In the United States, researchers found that prevalence in dogs was highest in the Mountain region and in puppies ≤0.5 years of age and lower for dogs of mixed breed compared to purebred dogs. Additionally, infection risk was by 25–30% greater in sexually intact dogs than in spayed or neutered dogs (Mohamed *et al*.; 2013).

In Romania the prevalence was significantly higher in kennel dogs (50%; 13/26), shelter dogs (47.7%; 74/155) and shepherd dogs (40.5%; 17/42) than in household dogs from urban areas (34.1%; 15/44) or rural areas (16.8%; 25/149) (Mircean *et al*., 2012). In China, the overall infection rate of *G. duodenalis* was 14.3% (134/940) with the highest infection rate (17.3%) observed in dogs from shelters (Qi *et al*., 2016).

To date, *Giardia* spp. prevalence studies of domestic dogs in urban areas of Colombia are scarce. In Ibague a prevalence of 14.28% was found (17/119 dogs) (Rodríguez *et al*., 2014). In Medellín, the prevalence found was 8.8% (Sierra-Cifuentes *et al*., 2015). In Cartagena and Sincelejo the prevalence was 6.4% (Arroyo-Salgado *et al*., 2014). In Boyacá, a study found a prevalence of 11% in children. Most infected children had contact with cats, pigs or dogs and researchers concluded that these animals can act as reservoirs and source of contamination of water and transmission vehicles (Rodríguez-Sáenz, 2015).

The aim of this study was to determine the prevalence of *Giardia* spp. infecting dogs in free living and in household conditions from Tunja (Colombia) by Ritchie concentration method and to identify risk factors (age, sex, living condition, body condition, type of hair and consistency of stool) associated with infection.

**MATERIALS AND METHODS**

This study was conducted in accordance with the Resolution 8430/1993 from the Colombian Ministry of Health and Social Protection and the law 84/1989, which set standards for animal welfare during research. Permission was obtained from the dogs’ owners before collecting faecal samples. The field studies excluded endangered or protected species.

**Study design**

A cross-sectional study was carried out to address the stated objectives. The target population consisted of dogs in Tunja city in the Boyacá region of Colombia. Tunja is located in the Eastern Range with an area about 119.1 km² and a population of approximately 195,496. Rural areas, consisting primarily of houses, gardens, and farms, surrounded the city. Temperatures averaged 11.7 °C and precipitation averaged 644.6 mm (Rojas *et al*., 2010).

**Sample collection**

The study population consisted of 200 dogs. The database collected information on gender, approximate age, body condition, hair condition and consistency of stool. Faecal samples were collected from 100 stray dogs and 100 owned dogs using a convenient sampling method. At the time of collection, samples were placed in zip-lock bags, labelled with the name of each dog, and stored in ice packs in a

---

338 BJVM, 22, No 3
cooler. They were then stored for a short time (1–2 days) at 4 °C prior to microscopy.

*Sample analysis and microscopy*

All samples were processed using a qualitative centrifugation concentration technique, with formol and ether as the concentration media. Researchers examined samples using bright-field microscopy or tripled and double blind with a 40× objective. Each observed cyst was identified by its morphological characteristics.

*Statistical analysis of data*

Frequency, prevalence and a 95% confidence interval of *Giardia* spp. infection were established. These parameters were determined by living conditions (stray dogs, owned dogs), sex (male, female), age (≤6 months; >6 ≤12 months; >12≤24 months; >24≤36 months, and >37 months), body condition score (7, 5, 3, 1), hair condition (shiny, normal, abnormal), consistency of stool (dry, normal, soft, mild diarrhoea, diarrhoea), and the difference between categories was analysed using the chi-square test. Risk factors were analyzed by logistic regression analysis. Risk was expressed as an odds ratio (OR) with 95% confidence interval. Descriptive epidemiology and risk factors were calculated using EpiInfo software. A P value of <0.05 was statistically significant.

**RESULTS**

The overall prevalence for gastrointestinal parasites in our study was 39%. Prevalence rates in *Giardia* spp. positive dogs are shown in Table 1. *Giardia* cysts were detected by microscopy in 38 of 100 stray dogs and 40 of 100 owned dogs. Researchers used standards set by The Global Nutrition Committee (WSAVA) to classify body condition (BCS), five being ideal, and three and one being less than ideal.

Risk for *Giardia* spp. infection calculated through odds ratios are presented in Table 2.

**DISCUSSION**

The overall prevalence range of *Giardia* spp. was 39%, similar to results obtained in Serbia: 45.5% (Sommer et al., 2017), France: 41% (109/266) (Grellet et al., 2014), Canada: 38% (Uehlinger et al., 2013) Spain: 33% (Gil et al., 2017) and Romania: 34.6% (Mircena et al., 2012) but higher than those recorded in Trinidad and Tobago: 25% (Mark-Carew et al., 2013), Portugal: 15.5% (Neves et al., 2014), Italy: 3.8% (Riggio et al., 2013) and the United States – 0.44% (Mohamed et al., 2013).

*Giardia* spp. cysts were detected by microscopy in 38 stray dogs and 40 owned dogs. The infection rate in stray dogs (38%) and owned dogs (40%) were similar, contrary to other studies which found a higher prevalence in stray dogs than in owned dogs (Mark-Carew et al., 2013; Qi et al., 2016,).

This similarity could possibly be attributed to high population density (Uehlinger et al., 2013) and the exposure of stray and owned dogs to common factors including poor hygiene, lack of access to clean water, or environmental contamination (Campbell et al., 2016). Previous studies have demonstrated that soil contamination in gardens and public grounds by infectious parasites significantly increases the risk of infection (Rodríguez-Vivas, 2011). *Giardia* spp. is known to be a highly infective protozoan, insensitive to
Prevalence and risk factors of *Giardia* spp. from free living and owned dogs in Tunja-Bayacá, Colombia

Table 1. *Giardia* spp. positive prevalence rates and corresponding 95% confidence interval (95% CI) by living conditions, sex, age, body condition, hair condition and stool consistency

<table>
<thead>
<tr>
<th>Factor</th>
<th>Stray dogs</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number</td>
<td>Prevalence (95% CI)</td>
<td>P value</td>
<td>number</td>
<td>Prevalence (95% CI)</td>
<td>P value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>positive/</td>
<td>examined</td>
<td></td>
<td>positive/</td>
<td>examined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>14/25</td>
<td>56 (36-75)</td>
<td>0.05</td>
<td>17/55</td>
<td>31 (18-42)</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24/75</td>
<td>32 (22-42)</td>
<td></td>
<td>23/45</td>
<td>51 (37-65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38/100</td>
<td>38 (29-47)</td>
<td>0.88</td>
<td>40/100</td>
<td>40 (32-47)</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Age (months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤6</td>
<td>13/38</td>
<td>34 (19-49)</td>
<td></td>
<td>10/25</td>
<td>40 (21-59)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;6 ≤12</td>
<td>6/14</td>
<td>43 (18-68)</td>
<td>0.68</td>
<td>4/22</td>
<td>18 (2-33)</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>&gt;12 ≤24</td>
<td>7/16</td>
<td>44 (20-68)</td>
<td></td>
<td>4/13</td>
<td>31 (7-55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;24 ≤36</td>
<td>6/12</td>
<td>50 (46-54)</td>
<td></td>
<td>5/8</td>
<td>63 (30-96)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;36</td>
<td>6/20</td>
<td>30 (10-50)</td>
<td></td>
<td>17/32</td>
<td>53 (36-70)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCS</td>
<td>5</td>
<td>19/45</td>
<td>42 (28-56)</td>
<td>0.49</td>
<td>38/95</td>
<td>40 (30-49)</td>
<td>0.66</td>
</tr>
<tr>
<td>3</td>
<td>18/51</td>
<td>35 (22-48)</td>
<td></td>
<td>2/5</td>
<td>40 (0-82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0/4</td>
<td>0</td>
<td></td>
<td>0/0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shiny</td>
<td>0/0</td>
<td>0</td>
<td></td>
<td>5/11</td>
<td>45 (30-60)</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>17/34</td>
<td>50 (34-66)</td>
<td>0.11</td>
<td>31/78</td>
<td>40 (28-51)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>21/64</td>
<td>33 (21-44)</td>
<td></td>
<td>3/9</td>
<td>33 (3-63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency of stool</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>2/6</td>
<td>33 (0-70)</td>
<td></td>
<td>1/6</td>
<td>17 (0-47)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>10/17</td>
<td>59 (33-85)</td>
<td>0.09</td>
<td>21/43</td>
<td>49 (34-64)</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Soft</td>
<td>24/71</td>
<td>34 (45-23)</td>
<td></td>
<td>1/48</td>
<td>2 (0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild diarrhoea</td>
<td>2/6</td>
<td>33 (0-70)</td>
<td></td>
<td>0/0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>0/0</td>
<td>0</td>
<td></td>
<td>2/3</td>
<td>67 (14-100)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Risk factors for *Giardia* spp infection following analysis by flotation technique in dogs from Tunja - Colombia obtained by logistic regression analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio (OR)</th>
<th>95% CI for OR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living condition</td>
<td>0.6</td>
<td>0.2–1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Sex</td>
<td>0.9</td>
<td>0.5–1.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Age</td>
<td>1.1</td>
<td>0.9–1.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Body condition score</td>
<td>1.2</td>
<td>0.5–2.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Hair condition</td>
<td>1.1</td>
<td>0.4–2.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Consistency of stool</td>
<td>1.8</td>
<td>0.8–3.7</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Living conditions (stray dogs, owned dogs), sex (male, female), age (≤6 months; >6 ≤12 months; >12 ≤24 months; >24 ≤36 months, and >37 months), body condition score (7, 5, 3, 1), hair condition (shiny, normal, abnormal), consistency of stool (dry, normal, soft, mild diarrhoea, diarrhoea).
a number of disinfectants, and capable of zoonotic transmission (Nguyen et al., 2016).

Sex did not show any influence on the prevalence of *Giardia* spp. in our study (*P*=0.05 for stray dogs and *P*=0.06 for owned dogs; OR=0.9) in agreement with some previous studies (Riggio et al., 2013; Sotelo et al., 2013; Alarcón et al., 2015; Sierra-Cifuentes et al., 2015; Sommer et al., 2017).

Similar to other Colombian studies (Alarcón et al., 2015; Sierra-Cifuentes et al., 2015), no statistically significant differences were found among age (*P*=0.68 for stray dogs and *P*=0.81 for owned dogs; OR=1.1), although studies in other countries identified age as a further risk factor, finding that puppies were twice more likely to be infected with *G. duodenalis* than adult dogs (Mark-Carew et al., 2013; Riggio et al., 2013; Sotelo et al., 2013; Qi et al., 2016).

Stool consistency (*P*=0.09 for stray dogs and *P*=0.17 for owned dogs; OR=1.8) was not either statistically significant, contrary to other studies where *G. duodenalis* cysts were found more frequently in diarrheic dogs (Riggio et al., 2013; Sotelo et al., 2013; Qi et al., 2016). The lack of several faecal samples from the same dog can lead to false-negative results in dogs with diarrhoea, due possibly to the fact that in symptomatic cases, dogs excrete a lower number of cysts (Jérez et al., 2017).

Hair condition (*P*=0.11, OR=0.88, OR=1.1) and body condition (*P*=0.49, OR=0.66, OR=1.2) were not significantly associated with prevalence of *Giardia* spp. infection, despite the known negative effects that parasites in general, have over canine nutrition (Hiepe et al., 2011) and the results in other studies in which poor body condition of dogs was associated with a higher prevalence of intestinal zoonotic parasites and a higher risk of infection (Rodríguez-Vivas, 2011).

Some factors may limit the accuracy of our epidemiological results. For example, this study is likely to underestimate *Giardia* spp. because diagnosis was based on the analysis of a single faecal sample per dog as *Giardia* spp. is known to be intermittently shed. Additionally, low parasitic burdens and inadequate sensitivities of the conventional diagnostic methods used could enhance this problem.

In summary, this study’s results indicate that stray and owned dogs contribute significantly to environmental contamination by *Giardia* spp. cysts in the city of Tunja. The zoonotic transmission must be confirmed in molecular epidemiological surveys studying isolates of human and animal origin.

We concluded that the prevalence of *Giardia* spp. in Tunja city was high, with no distinction between stray and owned dogs. We also found that the analysed variables (sex, age, hair condition, body condition and stool consistency) did not constitute risk factors for the acquisition of *Giardia* spp. We also concluded that high presence of *Giardia* spp. is detrimental to animal health and preventable through responsible pet care practices including deworming plans, parasitical diagnosis, and proper waste disposal.

REFERENCES


Arroyo-Salgado, B., Y. Buelvas-Montes, V. Villalba-Vizcaíno & O. Salomón-Arzuza, 2014. Genetic profiling of *Giardia intesti-


Paper received 12.07.2017; accepted for publication 21.09.2017

**Correspondence:**

Martín O. Pulido-Medellín
MScs in Biological Sciences
Pedagogical and Technological University of Colombia,
Central North Avenue
39-115 Tunja, Boyacá, Colombia,
phone: +57 310 337 5929,
fax: +57 87405626 ext. 2448;
e-mail: mopm@hotmail.com