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Original article

PREVALENCE AND RISK FACTORS OF *GIARDIA* SPP. FROM FREE LIVING AND OWNED DOGS IN TUNJA-BOYACÁ, COLOMBIA

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Summary

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Giardia spp. is a zoonotic protozoan that causes acute gastroenteritis in humans and other animal species across the world. The aim of this study was to determine the prevalence of *Giardia* spp. in free living and owned dogs from Tunja - Colombia by Ritchie concentration method and to identify the risk factors (living condition, age, sex, stool consistency, body condition and hair condition) associated with infection. To address the objective a cross-sectional study was carried out. The study population consisted of 200 dogs. Faecal samples were collected from 100 stray dogs and 100 owned dogs using a convenient sampling method. Risk factors were analysed by logistic regression analysis. Risk was expressed as an odds ratio (OR) with 95% confidence interval. Descriptive epidemiology and risk factors were performed using EpiInfo software. A P value of <0.05 was statistically significant. The overall prevalence of *Giardia* spp. was 39%; cysts were detected by microscopy in 38 of 100 stray dogs and 40 of 100 owned dogs. It was 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 infection with *Giardia* spp.

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 &

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) (Rodriguez *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 indentify 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 ^{o}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

cooler. They were then stored for a short time (1–2 days) at 4 ^{o}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

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

Factor	Stray dogs			Owned dogs		
	number positive/ examined	Prevalence (95% CI)	P value	number positive/ examined	Prevalence (95% CI)	P value
	38/100	38 (29-47)	0.88	40/100	40 (32-47)	0.88
Sex						
Male	14/25	56 (36-75)	0.05	17/55	31 (18-42)	0.06
Female	24/75	32 (22-42)		23/45	51 (37-65)	
Age (months)						
≤6	13/38	34 (19-49)	0.68	10/25	40 (21-59)	0.81
>6 ≤12	6/14	43 (18-68)		4/22	18 (2-33)	
>12≤24	7/16	44 (20-68)		4/13	31 (7-55)	
>24≤36	6/12	50 (46-54)		5/8	63 (30-96)	
>36	6/20	30 (10-50)		17/32	53 (36-70)	
BCS						
5	19/45	42 (28-56)	0.49	38/95	40 (30-49)	0.66
3	18/51	35 (22-48)		2/5	40 (0-82)	
1	0/4	0		0/0	0	
Hair condition						
Shiny	0/0	0	0.11	5/11	45 (30-60)	0.88
Normal	17/34	50 (34-66)		31/78	40 (28-51)	
Abnormal	21/64	33 (21-44)		3/9	33 (3-63)	
Consistency of stool						
Dry	2/6	33 (0-70)	0.09	1/6	17 (0-47)	0.17
Normal	10/17	59 (33-85)		21/43	49 (34-64)	
Soft	24/71	34 (45-23)		1/48	2 (0-6)	
Mild diarrhoea	2/6	33 (0-70)		0/0	0	
Diarrhoea	0/0	0		2/3	67 (14-100)	

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

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

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 neither statistically significant, contrary to other studies where *G. duodenalis* cysts were found more frequently in diarrhoeic 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, P=0.88, OR=1.1) and body condition (P=0.49, P=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

Alarcón, Z., V. Juyo & J. Larrotta, 2015. Epidemiologic characterization of zoonotic gastrointestinal parasites in dogs with owner of the urban area of La Mesa, Cundinamarca. *Revista de Medicina Veterinaria y Zootecnia*, **62**, 20–36.

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

nalis by polimerase chain in human and dogs samples of Colombian Caribbean Coast. *Enfermedades Infecciosas y Microbiología Clínica*, **32**, 424–427.

Bouzid, M., K. Halai, D. Jeffreys & P. Hunter, 2015. The prevalence of Giardia infection in dogs and cats, a systematic review and meta-analysis of prevalence studies from stool samples. *Veterinary Parasitology*, **207**, 181–202.

Caccio, S., R. Thompson, J. Mclauchlin & H. Smith, H., 2005. Unravelling Cryptosporidium and Giardia epidemiology. *Trends in Parasitology*, **21**, 430–437.

Cacciò, S. & U. Ryan, 2008. Molecular epidemiology of giardiasis. *Molecular and Biochemical Parasitology*, **160**, 75–80.

Campbell, S., S. Nery, C. D'este, D. Gray, J. Mccarthy, R. Traub, R. Andrews, S. Llewellyn, A. Vallely, G. Williams, S. Amaral & A. Clements, 2016. Water, sanitation and hygiene related risk factors for soil-transmitted helminth and *Giardia duodenalis* infections in rural communities in Timor-Leste. *International Journal of Parasitology* **46**, 771–779.

Jerez, L., F. Núñez, L. Rojas, Y. Robau, I. Atencio & N. Müller, 2017. Prevalence of intestinal parasites and molecular characterization of *Giardia duodenalis* from dogs in La Habana, Cuba. *Veterinary Parasitology: Regional Studies and Reports*, **8**, 107–112.

Gil, H., L. Cano, A. De Lucio, B. Bailo, M. Hernández, G. Cardona, J. Fernández-Basterra, J. Aramburu-Aguirre, N. López-Molina & D. Carmena, 2017. Detection and molecular diversity of *Giardia duodenalis* and *Cryptosporidium* spp. in sheltered dogs and cats in Northern Spain. *Infection Genetics and Evolution* **50**, 62–69.

Grellet, A., S. Chastant-Maillard, C. Robin, A. Feugier, C. Boogaerts, C. Boucraut-Baralon, D. Grandjean & B. Polack, 2014. Risk factors of weaning diarrhea in puppies housed in breeding kennels. *Preventive Veterinary Medicine*, **117**, 260–265.

Hiepe, T., R. Lucius & B. Gottstein, 2011. El concepto de parasitismo. In: *Parasitología general: Con principios de inmunología, diagnóstico y lucha antiparasitaria*. Editorial Acribia S.A. p.19

Mark-Carew, M., A. Adesiyun, A. Basu, K. Georges, T. Pierre, S. Tilitz, S. Wadea, & H. Mohammed, 2013. Characterization of Giardia duodenalis infections in dogs in Trinidad and Tobago. *Veterinary Parasitology*, **196**, 199–202.

Mircean, V., A. Györke & V. Cozma, 2012. Prevalence and risk factors of *Giardia duodenalis* in dogs from Romania. *Veterinary Parasitology*, **184**, 325–329.

Mohamed, A., L. Glickman, J. Camp, E. Lund & G. Moore, 2013. Prevalence and risk factors for Giardia spp. infection in a large national sample of pet dogs visiting veterinary hospitals in the United States (2003–2009). *Veterinary Parasitology*, **195**, 35–41.

Munoz, J. & D. Mayer, 2016. *Toxoplasma gondii* and *Giardia duodenalis* infections in domestic dogs in New York City public parks. *Veterinary Journal*, **211**, 97–99.

Neves, D., L. Lobo, P. Simões & L. Cardoso, 2014. Frequency of intestinal parasites in pet dogs from an urban area (Greater Oporto, northern Portugal). *Veterinary Parasitology*, **200**, 295–298.

Nguyen, T., R. Traub, P. Pham, H. Nguyen, K. Nguyen, C. Phung & A. Dalsgaard, 2016. Prevalence and molecular characterization of *Cryptosporidum* spp. and *Giardia* spp. in environmental samples in Hanam province, V*ietnam Food and Waterborne Parasitology*, **3**, 13–20.

Qi, M., H. Dong, R. Wang, J. Li, J. Zhao, L. Zhang & J. Luo, 2016. Infection rate and genetic diversity of *Giardia duodenalis* in pet and stray dogs in Henan Province, China. *Parasitology International*, **65**, 159–162.

Riggio, F., R. Mannella, G. Ariti & S. Perrucci, 2013. Intestinal and lung parasites in owned dogs and cats from central

Italy. *Veterinary Parasitology*, **193**, 78–84.

Rodríguez, V., O. Espinosa, J. Carranza, S. Duque, A. Arévalo, J. Clavijo, D. Urrea & G. Vallejo, 2014. *Giardia duodenalis* genotypes found in the Instituto Colombiano de Bienestar Familiar day care centers and dogs in Ibagué, Colombia. *Biomédica*, **34**, 271–281.

Rodríguez-Sáenz, A., 2015. Risk factors for intestinal parasites in children enrolled in a school in the municipality of Soracá – Boyacá. *Revista Universidad y Salud*, **17**, 112–120.

Rodríguez-Vivas, R., E. Gutiérrez-Ruiz, M. Bolio-Gonzalez, H. Ruiz-Piña, A. Ortega-Pacheco, E. Reyes-Novelo, P. Manrique-Saide, F. Aranda-Cirerol & J. Lugo-Perez, 2011. An epidemiological study of intestinal parasites of dogs from Yucatan, Mexico, and their risk to public health. *Vector Borne Zoonotic Disease*, **11**, 1141–1144.

Rojas, E., B. Arce, A. Peña, F. Boshell & M. Ayarza, 2010. Quantization and interpolation of local trends in temperature and precipitation in the high Andean areas of Cundinamarca and Boyaca (Colombia). *Revista Corpoica - Ciencia y Tecnología Agropecuaria,* **11**, 173–182.

Scaramozzino, P., D. Di Cave, F. Berrilli, C. D'orazi, A. Spaziani, S. Mazzanti, F. Scholl & C. De Liberato, 2009. A study of the prevalence and genotypes of *Giardia duodenalis* infecting kennelled dogs. *Veterinary Journal*, **182**, 231–234.

Sierra-Cifuentes, V., J. Jiménez-Aguilar, A. Álzate-Eecheverri, J. Cardona-Arias & L. Ríos-Osorio, 2015. Prevalence of Intestinal Parasites in Dogs from Two Centers of Animal Welfare from Medellín and eastern Antioquia (Colombia), 2014. *Revista de Medicina Veterinaria*, **30**, 55–66.

Sommer, M., N. Zdravković, A. Vasić, F. Grimm & C. Silaghi, 2017. Gastrointestinal parasites in shelter dogs from Belgrade, Serbia. *Veterinary Parasitology: Regional Studies and Reports,* **7**, 54–57.

Sotelo, H., A. Chávez, E. Casas, R. Pinedo & N. Falcón, 2013. Giardiasis and Cryptosporidiosis in dogs of the western area of metropolitan Lima. *Revista de Investigaciones Veterinarias del Perú*, **24**, 353–359.

Thompson, A., 2000. Giardiasis as a re-emerging infectious disease and its zoonotic potential. *International Journal of Parasitology*, **30**, 1259–1267.

Thompson, R., C. Palmer & R. O'handley, 2008. The public health and clinical significance of *Giardia* and *Cryptosporidium* in domestic animals. *Veterinary Journal*, **177**, 18–25.

Uehlinger, F., S. Greenwood, J. Mcclure, G. Conboy, R. O'handley & H. Barkema, 2013. Zoonotic potential of *Giardia duodenalis* and *Cryptosporidium* spp. and prevalence of intestinal parasites in young dogs from different populations on Prince Edward Island, Canada. *Veterinary Parasitology*, **96**, 509–514.

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