



Original

Diagnosis of *Toxocara Canis* and *Dipylidium caninum*, and Associated Risk Factors in Ecuador

Blanca Jeaneth Villavicencio *, Rafael Alfonso Garzón Jarrín **, Karen Alexandra Solís-Constante *, Jenny Piedad Lozada- Ortiz *, Jorge Ricardo Guerrero-López *, Juan Ramón García-Díaz ***

*Faculty of Agricultural Sciences, Veterinary Medicine Degree, Technical University of Ambato, Campus Querochaca 180601, Cevallos, Ecuador.

**Faculty of Agricultural Sciences and Natural Resources, The Technical University of Cotopaxi, Cotopaxi, Ecuador. Av. Simón Rodríguez s/n Barrio El Ejido Sector San Felipe. Latacunga - Ecuador.

***The Marta Abreu Central University of Las Villas. Faculty of Agricultural Sciences. Department of Veterinary Medicine and Zootechnia. Center for Agricultural Research (CIAP), Carretera a Camajuaní Km. 5 ½. Santa Clara. PC 54830, Santa Clara, Villa Clara, Cuba.

Correspondence: juanramon@uclv.edu.cu

Received: January 2025; Accepted: January 2025; Published: March 2025

ABSTRACT

Background: To prevent and control *T. canis* and *D. caninum*, it is essential to understand appropriate diagnostic methods and the risk factors associated with both parasitic infections.

Aim. To evaluate direct stool examination as a diagnostic test for infestation by *T. canis* and *D. caninum*, as well as the risk factors associated with these parasitic infections in Quero Canton, Tungurahua Province, Ecuador. **Methods:** Between May and June 2023, stool samples were collected from 263 dogs, and direct stool examination was assessed as a diagnostic test. The association between infestation by *T. canis* and *D. caninum* and factors such as the dog's sex, age, and supervision during walks on the streets was analyzed. **Results:** Direct stool examination for *T. canis* diagnosis showed 100% sensitivity and specificity. For *D. caninum*, sensitivity was 50% and specificity was 96.55%, with a positive predictive value of 10.00%. Infestation by *T. canis* was significantly associated ($P < 0.001$) with the dog's age and the way it roamed the streets. Infestation with *D. caninum* was not associated ($P > 0.05$) with these factors. **Conclusions:** Direct stool examination has limited value for diagnosing *D. caninum*, while the dog's age and the way it roams the streets are risk factors for infestation by *T. canis*.

Keywords: specificity, parasitic infestation, dogs, sensitivity, predictive value (Source: AIMS).

INTRODUCTION

Citations (APA) Villavicencio-Villavicencio, B.J., Garzón-Jarrín, R.A., Solís-Constante, K.A., Lozada-Ortiz, J.P., Guerrero-López, J.R., & García-Díaz, J.R. (2025). Diagnosis of *Toxocara Canis* and *Dipylidium caninum*, and Associated Risk Factors in Ecuador *Journal of Animal Prod.*, 37. <https://apm.reduc.edu.cu/index.php/rpa/article/view/e168>



©The author(s), the Journal of Animal Production, 2020. This article is distributed under the terms of the international license Attribution-NonCommercial 4.0 (<https://creativecommons.org/licenses/by-nc/4.0/>), assumed by collections of open access scientific journals, recommended by the Declaration of Budapest, which may be consulted at Budapest Open Access Initiative's definition of Open Access.

Toxocara canis can infest dogs, causing anorexia, diarrhea, anemia, and decreased appetite. Meanwhile, when *Dipylidium caninum* parasitizes canines, it reduces nutrient absorption and conversion, leading to diarrhea and, in cases of severe infection, intestinal obstruction (Tull *et al.*, 2020; Drake *et al.*, 2022). Both parasites can result in significant mortality rates (Morandi *et al.*, 2020).

T. canis and *D. caninum* are zoonotic parasites, as they can cause diseases in humans, primarily in children who frequently interact with infected dogs (Sarmiento-Rubiano *et al.*, 2018; Rostami *et al.*, 2020). Diagnosis is typically performed using fecal flotation, but there is no consensus on the best method (Creedy *et al.*, 2019). Cestodes are difficult to diagnose using this technique, so direct stool examination is recommended instead (Zajac *et al.*, 2021).

Several risk factors contribute to infestation by *T. canis* and *D. caninum*, including the time of year, breed, diet, defecation locations, and unrestricted dog management (Aziz *et al.*, 2019). Additionally, lifestyle, living environment, unsupervised roaming, age, and the socioeconomic conditions of each region also play a role (Tull *et al.*, 2020).

For the successful treatment, control, and prevention of infestation by *T. canis* and *D. caninum*, scientific information on diagnostic methods and associated risk factors specific to the environmental and socioeconomic conditions of each territory is essential.

The aim of this study was to evaluate direct stool examination as a diagnostic test for *T. canis* and *D. caninum* infestation, along with the risk factors associated with these parasitic infections in Quero Canton, Tungurahua Province, Ecuador.

MATERIALS AND METHODS

Location and Duration

This study was conducted between May and June 2023 in the Matriz-Quero parish, an urban area in Quero Canton, Tungurahua Province, Ecuador. The study site is located at 1° 22' 45" S and 78° 36' 25" W, at an average altitude of 3,038 meters above sea level, covering an area of 179 km². The average temperature in the study area ranges between 12 and 18°C (INAMHI, 2023).

Quero Canton has a total population of 19,084 inhabitants, with a population density of 110.49 inhabitants/km². There are approximately 9,077 dogs, 72.55% of them in urban areas. In the urban zone, 62.8% of the 1,001 households have dogs, and 53.25% of homes have more than one. The ratio is 2.10 dogs per inhabitant (CPV-Mascotas, Ecuador, 2022).

Study Design

The performance of direct stool examination as a diagnostic test for infestation by *T. canis* and *D. caninum* was evaluated against the *Sugar Sheather* technique, considered the reference or "gold standard" test (Rousseau *et al.*, 2022).

For this analysis, a descriptive observational study was conducted (Argimon Pallás & Jiménez Villa, 2004), employing a randomized design in which each dog was diagnosed for parasitic

infestation using both tests. This approach allows for estimating all performance indicators of these diagnostic methods.

The association between *T. canis* and *D. caninum* infestation with the dog's sex, age, and supervision during walks on the streets was assessed.

Animals

A total of 263 domestic dogs were selected, regardless of sex or age, representing the canine population of the study area.

Sample Size Calculation

To determine the total dog population, their age, sex, and whether they roamed the streets alone or under owner supervision, a survey was designed for dog-owning residents of the Matriz-Quero parish.

Through the survey, data on the total dog population, their age, sex, and roaming habits were gathered. This area has a total of 832 dogs, from which the sample size was calculated as follows:

$$n = \frac{N * Z^2 * p * q}{e^2 * (N - 1) + Z^2 * p * q}$$

Where:

n= Sample size

N= Overall population size

Z= Statistical parameter (95%= 1,96 confidence level).

e= error (5%)

p= likelihood of event occurrence

q= unlikelihood of event occurrence

Sample Collection

Each dog owner received a sample collection kit, which contained a numbered container and tongue depressors inside a Ziploc bag. The 263 fecal samples were collected fresh from participating households between 6:00 and 7:00 a.m. They were preserved with 5% saline-formalin and transported to the laboratory at the Veterinary Teaching Hospital of the Technical University of Ambato.

Coprological Methods

Direct stool examination and the *Sugar Sheather* flotation concentration technique were performed following the procedures described by Zajac *et al.* (2021).

Statistical analysis

All statistical processing was carried out using the Epidat 3.1 package (2005). Concordance between the diagnosis of *T. canis* and *D. caninum* infestation using direct stool examination and the *Sugar Sheather* technique was analyzed. The Kappa index was calculated using the concordance and consistency module.

The performance of direct stool examination as a diagnostic test for *T. canis* and *D. caninum* infestation was evaluated against the *Sugar Sheather* technique. A cross-sectional analytical observational study was conducted to determine the association between *T. canis* and *D. caninum* infestation and factors such as the dog's sex, age, and supervision during walks, using contingency table analysis.

RESULTS AND DISCUSSION

Table 1 shows that 71 dogs were diagnosed with *T. canis* and 10 with *D. caninum*, with prevalences of 26.95% and 1.20%, respectively.

Table 1. Positive cases and prevalence of infestation by *T. canis* and *D. caninum* in Quero Canton, Ambato, Ecuador

Parasite	Population	Diagnosed cases	Positive n and (%)	Prevalence (%)
<i>T. canis</i>	832	263	71 (26.99)	8.53
<i>D. caninum</i>			10 (3.80)	1.20

The prevalence of *T. canis* in this study was higher than that found in canine fecal samples from the Albergue Asociación Protectora de Animales Chuquisaca shelter in Sucre, Bolivia, where a prevalence of 17% was reported (Calani, 2019). This difference may be due to variations in edaphoclimatic conditions; the fecal samples in the cited study were processed individually using the Faust Technique and included only 123 dogs.

The prevalence of *T. canis* in this study is lower than the global average values reported by Rostami *et al.* (2020), which was 11.1%, and lower than regional averages in the Eastern Mediterranean (19.2%), Africa (18.5%), Southeast Asia (11.9%), North America (11.1%), South America (10.9%), and Europe (10.8%). However, it was higher than that reported for the Western Pacific, which was 6.4%.

Nevertheless, the prevalence found in this study falls within the range published for South America, which varies between 7.6% and 14.6% (Rostami *et al.*, 2020). The variability is attributed to differences in breed, climatic conditions, animal ownership, and socioeconomic factors.

In this study, *T. canis* had a higher prevalence than *D. caninum*, which contrasts with the results published by Naupay *et al.* (2019). In Retes, Huaral District, Lima Province, Peru, *D. caninum* was found to be the most frequent parasite (12.8%), followed by *T. canis* (10.6%). The discrepancy between studies can be explained by differences in climate, the age of sampled dogs, and research conditions.

The direct stool examination and the *Sugar Sheather* test showed a very high concordance for diagnosing *T. canis* [Kappa = 1.0000; (95% CI: 1.0000–1.0000); P = 0.0000]. In contrast, for *D. caninum* infestation, concordance was poor [Kappa = 0.1761; (95% CI: -0.1273–0.4759); P = 0.0000].

The lack of concordance in diagnostic results for *D. caninum* may be explained by the fact that this parasite’s eggs are very heavy and do not float in the solution used for the *Sugar Sheather* technique. Nevertheless, this remains the reference or “gold standard” test for diagnosing gastrointestinal parasitosis (Rousseau *et al.*, 2022).

Therefore, it is necessary to calculate the basic indicators of the diagnostic value of direct stool examination for gastrointestinal parasitosis, in comparison to the *Sheather Sugar* technique.

The sensitivity of direct stool examination for diagnosing *T. canis* and *D. caninum* infestation is shown in Table 2. Based on these values, this technique has the ability to detect 100% and 50% of animals that are truly parasitized, respectively. In other words, if the disease is present, this is the probability that the diagnosis will be positive (Bravo-Grau & Cruz, 2015; Díaz *et al.*, 2018).

Table 2. Basic statistical indicators for evaluating the performance of direct stool examination as a diagnostic test for infestation by *T. canis* and *D. caninum*

Indicators (%)	<i>T. canis</i>		<i>D. caninum</i>	
	Value	CI (95%)	Value	CI (95%)
Sensitivity	100.00	99.30 -100.00	50.00	0.00 -100.00
Specificity	100.00	99.74 -100.00	96.55	94.15 - 98.96
Validity index	100.00	99.81 - 100.00	96.20	93.70 - 98.70
Positive predictive value	100.00	99.30 - 100.00	10.00	0.00 - 33.59
Negative predictive value	100.00	99.74 -100.00	99.60	98.63 - 100.00
Prevalence	27.00	21.44 - 32.55	0.76	0.00 -2.00
Youden index	1.00	1.00 -1.00	0.47	0.23 - 1.16

Specificity indicates that direct stool examination can correctly identify as parasite-free 100.00% and 96.55% of animals that are truly free of *T. canis* and *D. caninum*, respectively (Bravo-Grau & Cruz, 2015; Díaz *et al.*, 2018).

According to this study, direct stool examination has high sensitivity and specificity for diagnosing *T. canis* infestation, confirming its effectiveness and utility as a diagnostic test for this parasitosis. Conversely, for *D. caninum* diagnosis, although it has high specificity, its sensitivity is low.

The results of this investigation confirm that direct stool examination, while useful for diagnosing gastrointestinal parasitosis in dogs, has low sensitivity for diagnosing *D. caninum*, which is its main disadvantage. This is mainly due to the small quantity of stool analyzed and the presence of excessive debris (Zajac *et al.*, 2021). According to these authors, even if parasites are not observed under the microscope, parasitic infestation cannot be ruled out.

The low sensitivity of direct stool examination for detecting *D. caninum* compromises the accuracy of its diagnosis and also underestimates the true prevalence of the disease, as shown in Table 2. This corroborates previous findings that when *D. caninum* diagnosis relies solely on direct stool examination, its prevalence is low and fluctuates between 0% and 39.1% (Rabbani *et al.*, 2020).

To compensate for the lack of sensitivity of coprological methods, the sample size can be increased, and sampling can be repeated on the same individuals for three consecutive days (Portokalidou *et al.*, 2019).

Sensitivity and specificity are intrinsic indicators of a diagnostic test. However, in clinical practice, more important than knowing these indicators is understanding and interpreting the probability that an animal, for which a positive or negative result has been obtained (sensitivity and specificity), is actually diseased or free of the disease (Bravo-Grau & Cruz, 2015; Díaz *et al.*, 2018).

In this regard, the diagnosis of *T. canis* infestation via direct stool examination yielded positive and negative predictive values (Table 2), indicating that dogs diagnosed as infected or healthy have a 100% conditional probability of actually being so.

For *D. caninum* infestation (Table 2), the negative predictive value indicates that dogs diagnosed as free of the parasite have a 100% conditional probability of actually being parasite-free. In contrast, the positive predictive value suggests that an animal has only a 10% probability of truly being infected, which is due to the low prevalence of this parasitosis in the study (Table 2).

According to the results of this research, a positive result for *D. caninum* infestation obtained via direct stool examination does not allow for a reliable confirmation of this parasitosis. This is because predictive values, despite being highly useful for clinical decision-making, have the limitation of depending heavily on the frequency of the disease within the studied population (Bravo-Grau & Cruz, 2015; Díaz *et al.*, 2018).

The validity index (Table 2) expresses that 100% and 96.56% of the dogs were correctly classified via direct stool examination as infected or not with *T. canis* and *D. caninum*, respectively.

Youden's Index (Table 2) shows the difference between the rate of true positives and false positives. It had values of 1.00 for *T. canis* and 0.47 for *D. caninum*, indicating that direct stool examination is a good diagnostic test for the former but not for the latter. The closer this indicator is to one, the better the diagnostic test.

Table 3, shows that *T. canis* infestation was not associated with the sex of the dogs ($P = 0.2796$), with 51% of the subjects being females and 49% males. This confirms that the parasite does not affect both sexes differently, as infection occurs through the ingestion of parasite eggs or transport hosts (Calani, 2019).

Table 3. Risk factors associated with *T. canis* and *D. caninum* infestation

Factor	PR	CI-95 %	χ^2	P value	PE	PNE
<i>T. canis</i>						
Sex (female)	1.2	0.83-1.85	1.16	0.2796	0.3	0.24
Age (< 1 year)	9.3	5.65-15.47	120.97	0.0000	0.7	0.07
Roaming without supervision	7.8	4.46-13.92	82.13	0.0000	0.5	0.07
<i>D. caninum</i>						
Sex (female)	1.9	0.50-7.29	0.97	0.3233	0.0	0.02
Age (< 1 year)	0.6	0.13-2.88	0.36	0.5430	0.0	0.04
Roaming without supervision	1.0	0.30-3.69	0.01	0.9157	0.0	0.03

The infestation of *T. canis* was significantly associated ($P = 0.0000$) with the age of the dogs (Table 3), 79% of infected dogs being less than one year old. This is because this parasite primarily affects dogs within this age group. It is common for puppies to be born already infected, as fetuses can acquire the parasite transplacentally (Zajac *et al.*, 2021; Muñoz-Caro *et al.*, 2023).

Trillo-Altamirano *et al.* found that age was the only factor associated with *T. canis* infestation. Dogs younger than one year had a tenfold higher risk of acquiring the infection, which they attributed to the fact that younger animals have more infection pathways (transplacental, lactogenic, or ingestion), placing them at higher risk and resulting in a greater parasite burden compared to adults.

Infestation with *T. canis* was significantly associated ($P = 0.0000$) with the way dogs roamed the streets (Table 3); 83.09% of dogs with this parasitosis wandered alone without supervision, while the remaining 16.91% were under their owners' supervision. These results corroborate findings that dogs that roam without supervision are six times more likely to contract nematode infections (Muñoz-Caro *et al.*, 2023).

Dogs that roam freely defecate outside the home, posing a transmission risk since their feces are not properly collected. Consequently, the eggs excreted in the feces, which are highly resistant in the environment, can infect other dogs (Muñoz-Caro *et al.*, 2023).

For every infected dog older than one year diagnosed with *T. canis*, 9.35 (95% CI: 5.65 - 15.47) younger dogs were diagnosed with the same infestation. Similarly, *T. canis* infected 7.88 (95%

CI: 4.46 - 13.92) dogs that roamed without supervision compared to those accompanied by their owners (Table 3).

These findings further indicate that dogs younger than one year and those that roam without supervision have 9.35 and 7.88-time higher probabilities of acquiring this parasitosis, emphasizing the importance of eliminating these risk factors to reduce infestation rates.

The findings of this research corroborate those published by Rostami *et al.* (2020), who concluded that young dogs (< 1 year old), stray dogs, rural dogs, and male dogs had a significantly higher infection prevalence ($P < 0.001$) compared to older, domestic, urban, or female dogs.

Infestation with *D. caninum* was not associated with sex ($P = 0.3233$) or age ($P = 0.5430$) of the dogs. Additionally, it was not linked to the way dogs roamed the streets ($P = 0.9157$). Therefore, these factors do not constitute risks for this parasitosis (Table 3).

The results regarding the association between sex and the presence of this parasite are contradictory and inconclusive, suggesting that *D. caninum* infestation is not influenced by sex. Instead, its prevalence depends on the proportion of males and females included in the study.

The infestation of *D. caninum* across age groups is consistent with other studies. Olave-Leyva *et al.* (2019) did not find significant differences in positive cases based on age. The lack of association between age and infestation may be due to the fact that this parasitosis is transmitted by fleas, which can efficiently infest dogs of any age (Zajac *et al.*, 2021).

It is more common for *D. caninum* to affect dogs older than one year, as they typically have more freedom compared to puppies. Additionally, adult male dogs, which have greater contact with stray dogs, tend to be more susceptible to infection (Martínez-Barbabosa *et al.*, 2014).

Research has demonstrated that the main risk factors for gastrointestinal parasitic infections in dogs include lifestyle, habitat, and diet. Other factors that predispose dogs to parasitic infections include roaming the streets without owner supervision, age, and the socioeconomic conditions of a given area (Tull *et al.*, 2020).

Dogs living in urban areas with high dog density relative to surface area and population have a significantly greater risk ($p < 0.05$) of gastrointestinal parasitosis than those living in more isolated environments (Tull *et al.*, 2020). However, no significant differences were found in parasitic infestation rates between dogs that did not have access to the streets and those that did, as long as they were supervised by their owners (Othman & Abuseir, 2021).

The literature on the association between dog sex and gastrointestinal parasitic infestation is contradictory. One study found no significant differences between males and females (Othman & Abuseir, 2021), while another reported that male dogs were more likely to acquire gastrointestinal parasites than females (Ziam *et al.*, 2022). This discrepancy may be explained by the fact that male dogs tend to roam more frequently than females.

CONCLUSIONS

Direct stool examination for diagnosing *T. canis* infestation showed 100% sensitivity and specificity. For *D. caninum*, sensitivity was 50%, specificity was 96.55%, and the positive predictive value was 10.00%.

Infestation with *T. canis* was not associated ($P = 0.2796$) with the sex of the dogs but was significantly linked ($P = 0.0000$) to both the age of the dog and the way it roamed the streets, identifying these as risk factors for this parasitosis. Infestation with *D. caninum* was not associated ($P > 0.05$) with these factors and does not pose a significant risk for infestation by this parasite.

REFERENCES

- Argimon Pallás, J., M. A., & Jiménez Villa, J. (2004). Clasificación de los tipos de estudio. *Métodos de Investigación Clínica y Epidemiológica*, Tercera Edición, Elsevier España; pp 29–32. <https://doi.org/10.1016/b978-84-8174-709-6.50004-x>
- Aziz, A. A., Hassan, A. A., Elmahallawy, E. K., Elshahawy, I. S., & Almuzaini, A. M. (2019). Prevalence and associated risk factors of T. infection in dogs in northern and southern Egypt. *Veterinary Parasitology: Regional Studies and Reports*, 17, 100305. <https://doi.org/10.1016/j.vprsr.2019.100305>
- Bravo-Grau, S., & Cruz, J.P. (2015). Estudios de exactitud diagnóstica: Herramientas para su Interpretación. *Revista Chilena de Radiología*; 21 (4): 158-164. <https://doi.org/10.4067/S0717-93082015000400007>
- Calani, Y. (2019). Incidencia de *T. canis* en materia fecal de canes del albergue Asociación protectora de animales Chuquisaca. *Revista Bio Scientia*, 2(4), 51–59. <http://revistas.usfx.bo/index.php/bs/article/view/328>
- Censo Ecuador, (2022). VIII Censo de Población y VII de Vivienda. Hogares por tenencia y número de perros y gatos por hogar, según provincia y área de residencia. Instituto Nacional de Estadística y Censos (INEC) - Componente de Metodología y Análisis – CPV 2022. https://www.censoecuador.gob.ec > 2024/05 > 20... 2022_CPV_Mascotas.xlsx
- Creevy, K. E., Grady, J., Little, S. E., Moore, G. E., Strickler, B. G., Thompson, S., & Webb, J. A. (2019). 2019 AAHA Canine Life Stage Guidelines. *Journal of the American Animal Hospital Association*, 55, 267–290. <https://doi.org/10.5326/JAAHA-MS-6999>
- Díaz, A., Beltrán, J. P., & Cueva, Joana E. (2018). ¿Son suficientes los indicadores del rendimiento de una prueba o test diagnóstico para evaluar su desempeño?. *Revista Cubana de Medicina General Integral*. 2018;34(3): 95-109. <https://www.medigraphic.com/pdfs/revcubmedgenint/cmi-2018/cmi183k.pdf>

- Drake, J., Sweet, S., Baxendale, K., Hegarty, E., Horr, S., Friis, H., Goddu, T., Ryan, W., & von Samson-Himmelstjerna, G. (2022). Detection of Giardia and helminths in Western Europe at local K9 (canine) sites (DOGWALKS Study). *Parasites & Vectors*, 15(1), 311. <https://doi.org/10.1186/s13071-022-05440-2>
- EPIDAT VER. 3.1. (2005). [Internet]. Available at: [https://www.sergas.es/Saude-publica/Epidat-3-1-descargar-Epidat-3-1-\(espanol\)?idioma=es](https://www.sergas.es/Saude-publica/Epidat-3-1-descargar-Epidat-3-1-(espanol)?idioma=es)
- (INAMHI, 2023). Instituto Nacional de Meteorología e Hidrografía. Datos meteorológicos de la estación meteorológica de Chalpatán, Carchi, Ecuador. [Internet] Disponible en: <http://www.inamhi.gob.ec>.
- Martínez-Barbabosa, I., Gutiérrez Quiroz, M., Ruiz González, L. A., Fernández Presas, A. M., Gutiérrez Cárdenas, E. M., Aguilar Venegas, J. M., Shea, M., & Gaona, E. (2014). Dipilidiasis: Una zoonosis poco estudiada. *Revista Latinoamericana de Patología Clínica y Medicina de Laboratorio*, 61(2), 102–107. www.medigraphic.com/patologiaclinicawww.medigraphic.org.mx
- Morandi, B., Greenwood, S. J., Conboy, G. A., Galuppi, R., Poglayen, G., & VanLeeuwen, J. A. (2020). Endoparasites in dogs and cats diagnosed at the Veterinary Teaching Hospital (VTH) of the University of Prince Edward Island between 2000 and 2017. A large-scale retrospective study. *Preventive Veterinary Medicine*, 175, 104878. <https://doi.org/10.1016/j.prevetmed.2019.104878>
- Muñoz-Caro, T., Sáez, D., & Aravena, C. (2023). Determinación de parásitos intestinales en perros con dueño de la ciudad de Talca, Chile, y su asociación con variables epidemiológicas. *Revista de Investigaciones Veterinarias Del Perú*, 34(2), e23590. <https://doi.org/10.15381/rivep.v34i2.23590>
- Naupay, Asucena., Castro, Julia., & Tello, M. (2019). Prevalencia de parásitos intestinales con riesgo zoonótico en Canis lupus familiaris de la localidad de Retes, Lima, Perú. *Revista de Investigaciones Veterinarias del Perú*, 30(1): 320-329 <http://dx.doi.org/10.15381/rivep.v30i1.15766>
- Olave-leyva, J., García-reyna, P., Martínez-juárez, V., Luqueño-mejía, C. & Avila-castillo, R. (2019). Prevalencia de helmintos gastrointestinales en perros procedentes del servicio de Salud de Tulancingo. *Abanico Veterinario*. 9(1), 1–10. <http://dx.doi.org/10.21929/abavet2019.930>
- Othman, R. A., & Abuseir, S. (2021). The prevalence of gastrointestinal parasites in Native dogs in Palestine. *Iranian Journal of Parasitology*, 16(3), 435. doi: 10.18502/ijpa.v16i3.7097 <http://dx.doi.org/10.18502/ijpa.v16i3.7097>
- Portokalidou, S., Gkentzi, D., Stamouli, V., Varvarigou, A., Marangos, M., & Spiliopoulou, I. (2019). *Dipylidium caninum* infection in children: clinical presentation and therapeutic

- challenges. *The Pediatric infectious disease journal*, 38 (7): 157–9. <http://dx.doi.org/10.1097/INF.0000000000002235>
- Rabbani, I.A.R, Mareta, F.J., Hastutiek P., & Lastuti, N.D.R. (2020). Zoonotic and other gastrointestinal parasites in cats in Lumajang, East Java, Indonesia. *Infectious Disease Reports*, 12(suppl 1): 8747. <http://dx.doi.org/10.4081/idr.2020.8747>
- Rostami, A., Riahi, S. M., Hofmann, A., Ma, G., Wang, T., Behniafar, H., ... & Gasser, R. B. (2020). Global prevalence of *Toxocara* infection in dogs. *Advances in Parasitology*, 109, 561-583. <https://doi.org/10.1016/bs.apar.2020.01.017>
- Rousseau Julieta., Castro, A., Novo1, T., & Maia, Carla. (2022). *Dipylidium caninum* in the twenty-first century: epidemiological studies and reported cases in companion animals and humans. *Parasites & Vectors* (2022) 15:131. <https://doi.org/10.1186/s13071-022-05243-5>
- Sarmiento-Rubiano, LA., Delgado, L., Ruiz, J. P., Sarmiento, M. C., & Becerra, J. (2018). Intestinal parasites in dogs and cats with owners of Barranquilla, Colombia. *Revista de Investigaciones Veterinarias del Peru* 29(4):1403-1410. <https://doi.org/10.15381/rivep.v29i4.15348>.
- Trillo-Altamirano, M.D.P., Carrasco, A.J., & Cabrera, R. (2003). Prevalencia de helmintos enteroparásitos zoonóticos y factores asociados en *Canis familiaris* en una zona urbana de la ciudad de Ica, Perú. *Parasitología latinoamericana*, 58(3-4), 136-141. <http://dx.doi.org/10.4067/S0717-77122003000300009>
- Tull, A., Moks, E., Laurimaa, L., Keis, M., & Süld, K. (2020). Endoparasite infection hotspots in Estonian urban areas. *Journal of Helminthology*, 94. E104. <https://doi.org/10.1017/S0022149X19000920>
- Zajac, A.M., Conboy, G., Little, S.E., & Reichard, M.V., 2021. *Veterinary Clinical Parasitology*, 9th ed. Wiley, New York. https://books.google.es/books?hl=es&lr=&id=4_QIEAAAQBAJ&oi=fnd&pg=PR9&dq=24.
- Ziam, H., Kelanemer, R., Belala, R., Medrouh, B., Khater, H. F., Djerbal, M., & Kernif, T. (2022). Prevalence and risk factors associated with gastrointestinal parasites of pet dogs in North-Central Algeria. *Comparative Immunology, Microbiology and Infectious Diseases*, 86, 101817. <https://doi.org/10.1016/j.cimid.2022.101817>

AUTHOR CONTRIBUTION STATEMENT

Research conception and design: BJVV; data analysis and interpretation: RAGJ, KASC, JPLO, JRGL; redaction of the manuscript: JRGD.

CONFLICT OF INTEREST STATEMENT

The authors state there are no conflicts of interest whatsoever.