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Prevalence of parasites in dog´s feces of Gomez Palacio, Durango, Mexico

Prevalencia de parásitos en heces fecales de perros de Gómez Palacio, Durango, México

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ABSTRACT

The aim of the present study was to estimate the prevalence of parasites and identify the ones with the zoonotic potential present in the feces of household's dogs and stray dogs in Gomez Palacio, Durango, Mexico. Fifty fecal samples from household dogs and 50 fecal samples from stray dogs were collected and analyzed by sucrose flotation and McMaster techniques. The statistical analyzes showed a significant difference between households and stray dogs (p= 0.021). The highest prevalence was obtained by stray dogs with 22% (11/50), while household's dogs got a majority of 6% (3/50). The parasites of morphologically identified household dogs corresponded to *Cystoisospora canis* (6%) and *Trichuris vulpis* (4%), while in stray dogs parasites corresponded to *Ancylostoma* spp. (12%), *Cystoisospora canis* (10%), *Toxocara* spp. (4%), *Trichuris vulpis* (4%), and *Taenia* spp. (2%). The Chi-square (X^2) analysis showed that the prevalence of parasites in stray dogs according to age presented a significant difference (p= 0.002); 100% of the puppies were parasitized. In Gomez Palacio, parasites with zoonotic potential are present in the feces of households and stray dogs, representing a risk of infection for the human population.
Keywords: stray dogs, household dogs, zoonosis, parasitism, public health.

RESUMEN

El objetivo del presente estudio fue estimar la prevalencia e identificar los parásitos con potencial zoonótico presentes en las heces fecales de perros domiciliarios y callejeros de Gómez Palacio, Durango, México. Se colectaron 50 muestras de heces fecales de perros domiciliarios, así como 50 muestras de heces fecales de perros callejeros. Las muestras se analizaron mediante las técnicas de flotación por sacarosa y de McMaster. Los análisis estadísticos mostraron diferencia significativa entre las prevalencias de perros domiciliarios y callejeros (p= 0.021). La mayor prevalencia la obtuvieron los perros callejeros con 22% (11/50), mientras que los perros domiciliarios obtuvieron una prevalencia del 6% (3/50). Los parásitos de perros domiciliarios identificados morfológicamente correspondieron a *Cystoisospora canis* (6%) y *Trichuris vulpis* (4%), mientras que los parásitos de perros callejeros correspondieron a *Ancylostoma* spp. (12%), *Cystoisospora canis* (10%), *Toxocara* spp. (4%), *Trichuris vulpis* (4%) y *Taenia* spp. (2%). El análisis de Chi-cuadrada (X^2) mostró que la prevalencia de parásitos en perros callejeros presentó diferencia significativa entre edades (p= 0.002), el 100% de los cachorros resultó parasitado. En Gómez Palacio se encuentran parásitos con potencial zoonótico presentes en las heces de perros domiciliarios y callejeros lo que representa un riesgo de infección para la población humana.
Palabras clave: perros callejeros, perros domiciliarios, zoonosis, parasitismo, salud pública.

INTRODUCTION

The dog (*Canis lupus familiaris*) has been in close contact with humans since its domestication process. It currently plays an important role in our lives, since it is not only a companion animal, but also helps us in different activities, performing rescues, serving as a guide for blind people, participating in the detection of drugs and explosives (Macpherson *et al*., 2013) and even the influence of dogs is used in the treatment of patients with pathological shyness, emotional disorders, lack of sociability and autism (Zapata *et al*., 2015). This close interaction between humans and dogs has resulted in the possible acquisition of zoonotic diseases (Macpherson *et al*., 2013).

Dogs are related to 60 zoonoses, among which those of parasitic origin stand out (Hernández *et al*., 2019). Through feces, dogs can transmit zoonotic diseases to humans (Johnson *et al*., 2015) when the latter have contact with contaminated food, objects, water, air or soil (Desachy, 2016). Different studies conducted in Mexico and worldwide show that the parasite genera with the highest prevalence are *Toxocara* spp. and *Ancylostoma* spp. (Rodríguez-Vivas *et al*., 2001; Romero-Núñez *et al*., 2011; Solarte-Paredes *et al*., 2013; Kaminsky *et al.,* 2014; Vega *et al.,* 2014; González *et al*. 2015; Huerto *et al*., 2015; Delgado-Fernández, 2017; Peña *et al*., 2017; Plúas-Hurtado & Sánchez- Hernández, 2021). In turn, the most reported zoonotic parasite species are *Ancylostoma caninum* and *Toxocara canis* (Encalada-Mena *et al*., 2011; Vélez-Hernández *et al*., 2014; Idika *et al*., 2017; Sarmiento-Rubiano *et al*., 2018; Lara-Reyes *et al*., 2019; Olave-Leyva *et al*., 2019; Silva *et al*., 2020). Other parasites reported in dogs in Latin America are *Ascaris lumbricoides* (Acosta-Jurado *et al.*, 2017), *Cystoisospora* spp. (Gorman *et al*., 2006), *Dypylidium caninum* (López *et al.,* 2006; Cisneros *et al*., 2020), *Echinococcus granulosus* (Chuiquisana *et al*., 2014), *Spirocerca lupi* (Rodríguez-Vivas *et al*., 2019), *Strongyloides* spp. (Llanos *et al*., 2010; Diaz-Anaya *et al*., 2015) and *Taenia* spp. (Fernández-Campos & Cantó-Alarcón, 2002; Luzio *et al*., 2017), among others.

Canine fecal waste represents an important public health problem, due to the risk of transmission of zoonotic risk parasites; since not only people who have pets are exposed to contracting a disease, but all people are. In Mexico City, it is estimated that at least five tons of feces from stray dogs end up being sprayed daily in the environment, as well as from dogs of irresponsible owners (Zúñiga-Carraco & Caro-Lozano, 2020), who do not have the culture or precaution to pick up their biological waste.

The purpose of this research was to estimate the prevalence of parasites present in the feces of household and stray dogs in Gómez Palacio, Durango, Mexico, through a descriptive epidemiological study; as well as to identify those with zoonotic potential.

MATERIAL AND METHODS

Study site

The study was conducted in the municipality of Gómez Palacio, Durango, Mexico, which is located at coordinates 25°32'8.16" and 25°53'16.8" North Latitude and 103°41'24" and 103° 19'8.4" West Longitude, altitude between 1100 and 1800 m a.s.l. It has an average temperature range of 18-22°C and an annual rainfall of 100-400 mm; it has a very dry semi-warm climate (BS0hw), with rainfall in summer (INEGI, 2010).

Collection and analysis of fecal samples

Fifty fecal samples were collected from household dogs. Contact with dog owners was made at a Veterinary Clinic in Gómez Palacio municipality, Durango; as well as at the Faculty of Biological Sciences of the Universidad Juárez del Estado de Durango (UJED) during the months of August to November 2016. A fecal sample was taken in plastic jars given to the owners that were asked for fresh samples and the upper portion to avoid contamination with soil and to be transported in coolers at a temperature of approximately 4°C for later analysis. A survey was made to each owner to find out the sex, age, health, grooming and data about the nutrition, condition and general health of their pets. Prior to the survey, owners were asked for their consent and the data obtained were handled confidentially.

A collection of 50 fecal samples from stray dogs was also performed in five neighborhoods (Carlos Herrera, 5 de mayo, La Feria subdivisions, Hamburgo and Benito Juárez) of Gómez Palacio, Durango, during the months of August to October 2017. Samples were taken in plastic jars with 5% formalin, waited for dogs to defecate in the streets, proceeded to take the sample from the top and then transported to the Faculty of Biological Sciences of the UJED to perform the corresponding analyses. Age classification was done by dentition in three categories: puppies (under 6 months of age), young (6 months to 2 years of age) and adults (older than 2 years of age) (Malloy & Embil, 1978). The sucrose flotation method was used to analyze the fecal samples (Dryden *et al*., 2005) and the McMaster technique was used to quantify the parasite load (Cruz-Reyes *et al*., 2001). A total of 100 fecal samples were analyzed. This number was chosen based on the literature and because there are no official publications on the number of stray dogs in Gómez Palacio, Durango.

Data analysis

The Test of Independence (Contingency Tables 2x2 and rxc) with significance level of $p< 0.05$ was used in the PASW Statistics 18 program.

RESULTS

Prevalence of parasites in household and stray dogs

This study showed that, in the Gómez Palacio city, Durango, *Cystoisospora canis* was the most prevalent parasite in household dogs, followed by *Trichuris vulpis*. In stray dogs, *Ancylostoma* spp. was the most prevalent parasite, followed by *Cystosospora canis*, *Toxocara* spp, *Trichuris vulpis* and finally *Taenia* spp. Only one parasite with zoonotic potential was found in household dogs: *Trichuris vulpis*, while four parasites with zoonotic potential were found in stray dogs: *Ancylostoma* spp, *Taenia* spp, *Toxocara* spp. and *Trichuris vulpis*. Table 1 shows the frequency and prevalence of each.

Prevalence in household and stray dogs based on sex and age

Regarding prevalence by age in household dogs, the highest prevalence was obtained in dogs under 6 months of age (12.5%) and according to sex, males obtained a prevalence (8.33%). In stray dogs, the highest prevalence was obtained in dogs under 6 months of age (100%) and according to sex, very similar results were obtained for females (25%) and males (20.5%) (Table 2).

Table 1. Frequency and prevalence of parasite eggs and oocysts found in feces of household and stray dogs in Gómez Palacio city, Durango

HOUSEHOLD DOGS		
Parasite	Frequency	Prevalence
Cystoisospora canis	3	6.00
Trichuris vulpis	2	4.00
STRAY DOGS		
Parasite	Frequency	Prevalence
Ancylostoma spp.	6	12.00
Cystoisospora canis	5	10.00
Taenia spp.	1	2.00
Toxocara spp.	2	4.00
Trichuris vulpis	2	4.00

Prevalence of parasites in feces of stray dogs by neighborhood

In stray dogs, neighborhoods with the highest prevalence of parasites in feces were La Feria subdivisions and 5 de mayo, with 30% and 28.57%, respectively (Table 3). In La Feria subdivisions, *Toxocara* spp. and *Taenia* spp. parasites were found, which have zoonotic potential; in addition to being the neighborhood with the highest prevalence of intestinal parasites; while in 5 de mayo neighborhood the greatest variability of parasites

was found, with *Cystoisospora canis*, *Ancylostoma* spp. In the Hamburgo neighborhood, only the parasite *Ancylostoma* spp. was found, and finally, in the Carlos Herrera neighborhood, *Cystoisospora canis* and *Trichuris vulpis* were found.

In the case of household dogs, the Hamburgo neighborhood had the highest prevalence of parasites in feces with 25% and only *Cystoisospora canis* was found; while in the La Feria neighborhood with 11.11% and Miravalle with 10% prevalence, the same parasite (*Trichuris vulpis*), which has zoonotic potential, was found.

A significant difference was found between the prevalence of parasites in the feces of household dogs and stray dogs (p=0.021). Six percent of the household dogs were parasitized, while 22% of the stray dogs were parasitized.

Table 2. Prevalence in household and stray dogs in Gómez Palacio, Durango, according to sex and age variables

HOUSEHOLD DOGS			
Variable	Total	Positive to parasites	Prevalence
Age			
< 6 months	8	1	12.50
6 months to 2 years	14	0	0.00
> 2 years	28	2	7.14
Sex			
Females	26	1	3.84
Males	24	2	8.33

STRAY DOGS			
Variable	Total	Positive to parasites	Prevalence
Age			
< 6 months	3	3	100.00
6 months to 2 years	2	1	50.00
> 2 years	45	7	15.55
Sex			
Female	16	4	25.00
Males	34	7	20.50

Regarding the prevalence of household and stray dogs by sex, no significant differences were found (p>0.05).

When analyzing the parasitic infection prevalence in household dogs by age class, no significant differences were found (p=0.459); however, in stray dogs significant differences were found (p=0.002), 100% of puppies were parasitized, 50% of juveniles and 15.6% of adults.

Table 3. Prevalence of parasites in stray dogs by sampling site.

Neighborhood	Total n= 50	Parasite-positive samples	Prevalence
Carlos Herrera	n= 11	2	18.18
5 de mayo	n= 14	4	28.57
La Feria Fraccionamiento	n= 10	3	30.00
Hamburgo	n= 10	2	20.00
Benito Juárez	n= 5	0	0

**Prevalence was obtained taking into account parasite positive samples and the total number of samples per neighborhood.

DISCUSSION

The prevalence of parasites in feces found in this study for household dogs (6%) differs from that found by Ruvalcaba *et al*. (2012) in Zacatecas and by Rodríguez-Vivas *et al*. (2011) in Yucatán (94.7% and 80%, respectively). These differences could be due to the fact that the study conducted in Zacatecas covered the four seasons of the year and different diagnostic techniques were used; in addition to the fact that both investigations were conducted in rural areas, where there is a lesser culture of disease prevention in animals and dogs generally have access to the street and coexist with stray dogs and other animals; in contrast to the present work in which the dogs are from an urban area and have more limited access to public areas. Regarding the prevalence of parasites for stray dogs (22%) is similar to results found by Trasviña-Muñoz *et al*. (2017) in Baja California Norte and García-Hinojosa *et al.* (2018) in Chihuahua (21.5% and 25% respectively), this could be because their studies conducted in urban areas where there is more prevention in the care of pets, and differs from that reported by Alvarado-Esquivel *et al.* (2015) in Veracruz (98%). These differences could be due to the fact that the study site was a dog shelter, where there is greater spread of parasites due to proximity, cleanliness, nutritional conditions, among other factors.

With respect to the prevalence based on sex and age in stray and household dogs, the highest prevalence in both cases was in dogs under 6 months of age (100% and 12.5% respectively) and according to sex, females had a higher prevalence of stray dogs with 25% and in the case of house dogs, males had the highest prevalence with 8.33%. It

differs to Rodríguez-Vivas *et al.* (2011), Ruvalcaba *et al*. (2012), Alvarado- Esquivel *et al.* (2015), Trasviña-Muñoz *et al*. (2017) and García- Hinojosa *et al*. (2018), because none evaluated prevalence based on sex and age but very similar to what was obtained by Plúas- Hurtado & Sánchez- Hernández, (2021) who obtained prevalences of 46.9 % of parasitosis in dogs aged 0-24 months. This could be due to the fact that puppy dogs are more susceptible to parasites due to feeding problems, developing immune system, among others.

Cystoisospora canis was the most prevalent parasite in domiciliary dogs (6%), and was also found in stray dogs (10%) in the present work, which differs from Sierra-Cifuentes *et al.* (2015) in Colombia where a prevalence of 4.4% was obtained for this parasite; this may be because the study was conducted in a canine welfare center where its inhabitants at some period of the year have a preventive antiparasitic control that could have avoided the presence and parasite spread.

Another parasite found in household and stray dogs was *Trichuris vulpis*, with a prevalence of 4% in this work, which differs from that mentioned by Torres-Chablé *et al*. (2015), in Tabasco (0.3%) with household dogs; while Medina-Pinto *et al*. (2018) in Yucatán and Vélez-Hernández *et al.* (2014) in Oaxaca (1% and 1.1%, respectively) in stray dogs: on the other hand, high prevalences are reported by Rodríguez-Vivas *et al*. (2011) in Yucatán (25.4%) with household dogs and Alvarado-Esquivel *et al.* (2015) in Veracruz (18.8%) with stray dogs. In the case of the low prevalences reported in Yucatán and Oaxaca, it should be noted that both works were carried out in areas with the presence of domiciliary dogs, which could explain the low values reported; however, in the case of Oaxaca, high values were presented in the general prevalence and in the other parasites found. This could be explained because the prepatency period of *Trichuris vulpis* is relatively long, approximately three months; in addition, egg shedding is not constant (Birchard *et al*., 2006), so it is recommended to repeat the analysis of several different stool samples (Galán *et al*., 2019). This could also explain the low prevalences reported in Tabasco and in the present study.
Regarding the high prevalences reported in Yucatan and Veracruz, authors mention that both studies were conducted in rural areas, which could influence the results; in addition to other factors such as humidity and temperature that could have favored egg development at the time of the study. In house dogs in Italy, La Torre *et al*. (2018) reported similar results to the present work (5.5%); while in stray dogs, Sierra-Cifuentes *et al*. (2015) reported higher results (16.2%) in Colombia. Human infections with Trichuris spp. are usually accidental by ingesting embryonated eggs in contaminated food and water or by geophagy (Rodríguez-Vivas *et al.,* 2001).

On the other hand, the most prevalent parasite in stray dogs was *Ancylostoma* spp. (12%), which is very similar to other works in some Mexican states, where this parasite has also been reported as the most prevalent, as in Medina-Pinto *et al*. (2018) in Yucatan (10%), but lower than that reported by Alvarado-Esquivel *et al*. (2015) in Veracruz (88.1%). The difference found could be attributed to the fact that in the research conducted in Veracruz, most of the dogs were of rural origin; while in the study conducted in Yucatan dogs corresponded to urban origin. Prevalences ranging from 0.8% to 62.5% are reported in other countries (Johnson *et al*., 2015; Sierra-Cifuentes *et al*., 2015; Idika *et al*., 2017; Kidima, 2019; Silva *et al*. 2020; Sulieman *et al*. 2020).

Statistical analyses showed significant difference between the frequencies of domiciliary and stray dogs parasitized (p=0.021). Household dogs showed a prevalence of 6%, while stray dogs showed a prevalence of 22%. In a study conducted in Medina-Pinto *et al*. (2017) found that feces collected in parks where stray dogs were observed were more likely (p=0.046), to be positive for parasite eggs than in parks where owned dogs were observed. These differences may be due to the fact that stray dogs do not have preventive health management and that they have free access to areas where there are high rates of parasite egg and larval contamination, which can cause infections and re-infections. To determine these factors more precisely, it is proposed that risk factor analyses be carried out in future studies.

The parasite *Toxocara* spp. was found in stray dogs with a prevalence of 4% in this work, similar to some works in Mexico where it has been reported in prevalence ranges from 0.23% to 59.6% (Ruvalcaba *et al*., 2012; Torres-Chablé *et al*., 2015; Hernández *et al.*, 2019). In Africa, Johnson *et al*. (2015), have reported it with a prevalence of 5.8% for domiciliary dogs, while in Portugal Silva *et al*. (2020) reported it with a prevalence of 29% for stray dogs. The low prevalence in household dogs may be due to the fact that their owners comply with the responsibility of supplying dewormers to their pets, and in the case of stray dogs the prevalences tend to be higher, due to several environmental and anthropic factors to which they are exposed and that propitiate unfavorable environments for the reproduction and propagation of parasites.

Taenia spp. was found with a prevalence of 2% for stray dogs in this work, similar to that reported in our country by Trasviña-Muñoz *et al*. (2017) in Baja California Norte, where they reported prevalences of 3.9%; while in Hidalgo, Olave-Leyva *et al*. (2019), report it with prevalences of 16%. These differences may be due to the high temperatures and low humidity that occur in Baja California Norte, compared to Hidalgo, factors that intervene with the presence and development of this parasite. In Oklahoma it has been reported with a percentage of 0.47% (Nagamori *et al*., 2020) in household dogs, while in stray dogs in Colombia and Sudan prevalences of 4.4% and 6.7% are reported, respectively (Sierra-

Cifuentes *et al*., 2015; Sulieman *et al*., 2020).This could be due to the fact that in the areas of Colombia and Sudan where the studies were conducted there was a high presence and spread of the parasite; in addition to the fact that perhaps the canine hosts reviewed were susceptible to infection. In other studies that have been conducted in the world, this parasite has not been reported (Johnson *et al*., 2015; Idika *et al*., 2017; La Torre *et al*., 2018; Kidima, 2019; Silva *et al*., 2020), this may be due to the techniques that were used to rescue the parasites from feces, also due to the different environmental, geographical and sanitary conditions, among others.

The results obtained in the present work coincide with those reported by Idika *et al*. (2017) in Nigeria, where no significant difference was found between frequency and sex of dogs ($p > 0.05$), but by age group, which coincides in this work for stray dogs ($p=0.002$), where the highest percentages of parasites were obtained in dogs younger than 6 months of age. In Mexico there are similar reports, where Encalada-Mena *et al*. (2011) in Campeche, Rodríguez-Vivas *et al*. (2011) in Yucatán and Olave-Leyva *et al*. (2019) in Hidalgo report that the age factor had significant difference with respect to the prevalence of parasites; these studies report the highest prevalences of parasites in the younger age categories. This could be because younger dogs are more susceptible to parasitic infections from before birth.
In four of the five neighborhoods sampled, parasites were found that may present a zoonotic risk for the people living in them. These colonies have semi-urban areas where dogs find food, water and territory, i.e., favorable conditions for their survival. These places are generally used as garbage dumps and sanitary conditions are inefficient; therefore, dogs and humans are exposed to high levels of contamination with intestinal parasites.

The low prevalences reported in the present study for both household and stray dogs may be due to the environmental conditions of Gómez Palacio city, Durango, since it is a desert area that records maximum temperatures from April to September with a range of 41-44°C (Servicio Meteorológico Nacional, 2020). This factor could prevent the development of parasites in certain seasons of the year, although there are many factors that can influence; for example, the sensitivity and specificity of the flotation techniques used to concentrate parasite eggs, the methodology used, the sample size, the amount of larval eggs ingested by the dogs, the biological cycles of the parasites and, although the eggs can survive in the environment, if favorable environmental conditions are not present, infective larvae do not develop and therefore, the prevalences decrease.

CONCLUSIONS

The parasites found in feces of household and stray dogs were: *Ancylostoma* spp, *Taenia* spp, *Toxocara* spp, *Trichuris vulpis* and *Cystoisospora canis*; the first four of which are zoonotic in nature, posing a risk to public health in Gómez Palacio municipality, Durango. A significant difference was found between prevalences of intestinal parasites for household and stray dogs. Stray dogs had a higher prevalence than household ones. In stray dogs, a significant difference was found in relation to age class; all puppies were parasitized. No significant difference was found between parasitism and sex of stray and house dogs.

It is suggested to continue with more extensive studies on the prevalence of parasites in feces of household animals in urban areas, both in those animals with owners and those in street conditions.

CITED LITERATURE

ACOSTA-JURADO DC, Castro-Jay LI, Pérez-García J. 2017. Parásitos gastrointestinales zoonóticos asociados con hábitos de higiene y convivencia en propietarios de caninos. *Revista Biosalud*. 16(2):34-43. ISSN 1657-9550 (Impreso) ISSN 2462-960X (En línea). http://doi.org/10.17151/biosa.2017.16.2.4

ALVARADO-ESQUIVEL C, Romero-Salas D, Aguilar-Domínguez M, Cruz-Romero A, Ibarra-Priego N, Pérez-de-León AA. 2015. Epidemiological assessment of intestinal parasitic infections in dogs at animal shelter in Veracruz, Mexico. *Asian Pacific Journal Of Tropical Biomedicine*. 5(1):34-39. ISSN:2221-1691. http://doi.org/10.1016/S2221-1691(15)30167-2

BIRCHARD SJ, Sherding RG. 2006. Saunders manual of small animal practice. Tercera ed. St. Louis, Missouri, USA. *Elsevier Health Sciences*. Pp. 2032. ISBN-13:978-0-7216-0422-0, ISBN-10: 0-7216-0422-6.

CISNEROS S, Nuntón J, Alfaro R. 2020. Asociación significativa entre el endoparásitismo intestinal con la edad y la presencia de ectoparásitos en *Canis familiaris* (Linnaeus). *Revista Manglar*. 17(1):27-32. ISSN: 1816-7667. http://dx.doi.org/10.17268/manglar.2020.005

CHUQUISANA J, Chávez A, Casas E. 2014. Determinación de *Echinococcus granulosus* en perros del cono norte de Lima. *Revista de investigación veterinaria de Perú*. 11(2): 24-29. http://doi.org/10.15381/rivep.v11i2.7055

CRUZ-REYES A, Camargo-Camargo B. 2001. Glosario de términos en parasitología y ciencias afines. Plaza y Valdés: México, D. F. Pp. 345. ISBN: 968-856-878-3.

DELGADO-FERNANDEZ P. 2017. Prevalencia de parásitos con potencial zoonótico en perros callejeros de la ciudad de Ciego de Ávila. *Revista médica electrónica de Ciego de Ávila*. 23(2). ISSN: 1029-3035.
http://www.revmediciego.sld.cu/index.php/mediciego/article/view/630/1129

DESACHY F. 2006. Las zoonosis: transmisión de las enfermedades de los animales al ser humano. Barcelona: De Vecchi. Pp. 176. ISBN: 978-843-153-3564.

DÍAZ-ANAYA AM, Pulido-Medellín MO, Giraldo-Forero JC. 2015. Nemátodos con potencial zoonótico en parques públicos de la ciudad de Tunja, Colombia. *Salud publica México.* 57(2):170-176. ISSN: 0036-3634.
https://saludpublica.mx/index.php/spm/article/view/7413

DRYDEN MW, Payne PA, Ridley RK, Smith VT. 2005. Comparison of Common Fecal Flotation Techniques for the Recovery of Parasite Eggs and Oocysts. *Veterinary Therapeutics.* 6(1):15-28.
http://vetlab.com/Dryden%20Comparison%20of%20Flotation%20Methods.pdf

ENCALADA-MENA L, Duarte-Ubaldo E, Vargaz-Magaña J, García-Ramírez M, Medina-Hernández R. 2011. Prevalence of gastroenteric parasites of dogs in the city of Escarcega, Campeche, Mexico. *Universidad y Ciencia*. 27(2):209-217. ISSN: 0186-2979.
https://www.redalyc.org/src/inicio/ArtPdfRed.jsp?iCve=15421447010

FERNÁNDEZ-CAMPOS F, Cantó-Alarcón GJ. 2002. Frecuencia de helmintos en intestinos de perros sin dueño sacrificados en la ciudad de Querétaro, Querétaro, México. *Revista Veterinaria México*. 33:247-253. ISSN 0301-5092.
www.Redalyc.org/articulo.oa?id=42333304

GALÁN A, Pineda CM, Mesa I. 2019. Medicina interna en pequeños animales: Manuales clínicos de veterinaria. Barcelona, España: Gea Consultoría Editorial S. L. Pp. 376. ISBN: 978-84-9113-355-1, eISBN: 978-84-9113-594-4.

GARCÍA-HINOJOSA GA, Ávila-Huerta SA, Nevárez-Moorillón GV, Rodríguez-Zapién JF, Hernández-Castaños MR, Adame-Gallegos JR. 2018. Identification of parasites in dogs housed in temporary homes in Chihuahua, Chihuahua, Mexico. *Salud Pública de México*. 60(1):107-108. https://doi.org/10.21149/8937

GONZALEZ GA, Alfaro K, Trejos J. 2015. Parásitos intestinales de perros callejeros: Riesgo a la salud publica en San Ramon, Costa Rica. *Revista Biocenosis.* 29:1-2 https://revistas.uned.ac.cr/index.php/biocenosis/article/view/896

GORMAN T, Soto A, Alcaino H. 2006. Parasitismo gastrointestinal en perros de comunas de Santiago de diferente nivel socioeconómico. *Revista Parasitología latinoamericana*. 61(3):126-132. ISSN: 0717-7712. http://dx.doi.org/10.4067/S0717-77122006000200005

HERNÁNDEZ EA, Martínez J, Beltrán-Rico A, Hernández R, González B, Pérez L. 2019. Zoonotic parasites in dog feces from Leon, Mexico. *Acta Universitaria. 29,* e2113. ISSN: 2007-9621. http://doi.org/10.15174/au.2019.2113

HUERTO-MEDINA E. Fonseca-Livias A. Dámaso-Mata. 2015. Prevalencia de enteroparásitos zoonóticos en perros (*canis familiaris*) y el nivel de cultura ambiental orientado a mascotas en Huánuco. *Ágora Revista Científica*. 02(02): 233-239. https://www.revistaagora.com/index.php/cieUMA/article/view/33/33

IDIKA IK, Onuorah EC, Obi CF, Umeakuana PU, Nwosu CO, Onah DN, Chiejina SN. 2017. Prevalence of gastrointestinal helminth infections of dog in Enugu State, South Eastern Nigeria. *Parasite epidemiology and control*. 2(3):97-104. https://doi.org/10.1016/j.parepi.2017.05.004

INEGI (Instituto Nacional de Estadística y Geografía). 2010. Prontuario de información geográfica municipal de los Estados Unidos Mexicanos, Gómez Palacio, Durango. https://www.inegi.org.mx/contenidos/app/mexicocifras/datos_geograficos/10/10007.pdf

JOHNSON JA, Gakuya D, Mbuthia Pg, Mande J, Maingi N. 2015. Prevalence of gastrointestinal helminths and management practices for dogs in the Greater Accra region of Ghana. *Elsevier*. (1):1-11. ISSN: 2405-8440. http://dx.doi.org/10.1016/j.heliyon.2015.e00023

KAMINSKY R, Groothusen CM, Zúñiga AM, Contreras M, Ferrera AM, Henríquez KC. 2014. Infección por *Toxocara canis* en perros y riesgo de toxocariasis humana, Honduras. *Revista Médica Hondureña*. 82(2):60-57. ISSN: 0375-1112. http://www.colegiomedico.hn/RMH/html/revista.html

KIDIMA W. 2019. Prevalence of Zoonotic Parasites in Stray Dogs in Rural Communities, Tanzania. *Tanzania Journal of Science.* 45(1):93-100. ISSN: 0856-1761, e-ISSN 2507-7961. http://journals.udsm.ac.tz/index.php/tjs

LARA-REYES E, Figueroa-Ochoa JM, Quijano-Hernández IA, Del-Àngel-Caraza J, Barbosa-Mireles MA, Victoria-Mora JM, Beltrán-León T. 2019. Frecuencia de parásitos gastrointestinales de perros en parques públicos de dos municipios vecinos del Estado de México. *NOVA*. 17(32):75-81. http://www.scielo.org.co/pdf/nova/v17n32/1794-2470-nova-17-32-75.pdf

LA TORRE F, Di Cesare A, Simonato G, Cassini R, Traversa D, Frangipane di Regalbono A. 2018. Prevalence of zoonotic helminths in Italian house dogs. *The Journal of Infection in Developing Countries*. 12(8):666-672. https://doi.org/10.3855/jidc.9865

LLANOS M, Condori M, Ibáñez T, Loza-Murguía M. 2010. Parasitosis entérica en canidos (*Canis familiaris*) en el área urbana de Coroico, Nor Tungas Departamento de La Paz, Bolivia. *Journal of the Selva Andina Research Society*. 1(1):37-49 ISSN: 2072-9294. http://www.scielo.org.bo/scielo.php?script=sci_arttext&pid=S2072-92942010000100005

LÓPEZ J, Abarca K, Paredes P, Inzunza E. 2006. Parásitos intestinales en caninos y felinos con cuadros digestivos en Santiago, Chile. Consideraciones en salud pública. *Revista médica de Chile*. 134:193-200. ISSN: 0034-9887. http://dx.doi.org/10.4067/S0034-98872006000200009

LUZIO A, Diaz P, Luzio P, Fernández I. 2017. Formas parasitarias gastroentéricas de importancia zoonótica, en heces de perros, recolectadas en plazas de armas de las capitales provinciales de la Región del Bio Bio, Chile. *REDVET Revista electrónica de veterinaria.* 18(9):1-10. ISSN 1695-7504. http://www.veterinaria.org/revistas/redvet/n090917.html

MACPHERSON CNI, Meslin FX, Wandeler AI. 2013. Dogs, zoonoses and public health. Boston: CAB International. Pp. 277. ISBN: 13: 978-1-84593-835-2.

MALLOY W, Embil J. 1978. Prevalence of Toxocara spp and other parasites in dogs and cats in Halifax, Nova Scotia. *Canadian Journal of Comparative Medicine.* 42(1):29-31. https://www.mendeley.com/catalogue/8dd5dd56-2c17-3ffe-82f9-a82d8d0638f3/

MEDINA-PINTO RA, Rodríguez-Vivas RI, Bolio-González ME. 2018. Zoonotic intestinal nematodes in dogs from public parks in Yucatan, Mexico. *Revista Biomedica.* 38(1):105-110. https://doi.org/10.7705/biomedica.v38i0.3595

NAGAMORI Y, Payton ME, Looper E, Apple H, Johnson EM. 2020. Retrospective survey of endoparasitism identified in feces of client-owned dogs in North America from 2007 through 2018. *Veterinary Parasitology: Regional Studies and Reports.* https://doi.org/10.1016/j.vetpar.2020.109137

OLAVE-LEYVA J, García-Reyna P, Martínez-Juárez V, Figueroa-Castillo J, Luqueño-Mejía C, Avila-Castillo M. 2019. Prevalencia de helmintos gastrointestinales en perros procedentes del servicio de Salud de Tulancingo, Hidalgo. *Abanico Veterinario*. 9(1):1-10. ISSN 2448-6132. http://dx.doi.org/10.21929/abavet2019.930

PEÑA I, Vidal F, Del Toro A, Hernández A, Zapata M. 2017. Zoonosis parasitaria causada por perros y gatos, aspectos a considerar en salud pública de Cuba. *Revista electrónica de veterinaria.* 18(10):1-11. ISSN:1695-7504.
http://www.veterinaria.org/revistas/redvet/n101017.html

PLÙAS-HURTADO M. Sánchez-Hernández CA. 2021. Prevalencia de parásitos intestinales zoonóticos de origen canino (*Canis lupus familiaris*) en parroquias urbanas de Guayaquil- Ecuador, 2020. *Boletín de Malariologia y Salud Ambiental*. LXI (2):195-203. ISSN: 1690- 4648.
http://iaes.edu.ve/iaespro/ojs/index.php/bmsa/article/view/297/371

RODRÍGUEZ-VIVAS RI, Cob-Galera L, Domínguez-Alpizar JL. 2001. Frecuencia de parásitos gastrointestinales en animales domésticos diagnosticados en Yucatán, México. *Revista Biomédica*. 12:19-25. ISSN: 2007-8447.
https://doi.org/10.32776/revbiomed.v12i1.253

RODRÍGUEZ-VIVAS RI, Gutiérrez-Ruiz E, Bolio-González M, Ruiz-Piña H, Ortega-Pacheco A, Reyes-Novelo E, Manrique-Saide P, Aranda-Cirerol F, Lugo-Pérez J. 2011. An Epidemiological Study of Intestinal Parasites of Dogs from Yucatan, Mexico, and Their Risk to Public Health. *Vector-borne and zoonotic diseases*. 11(8):1141-1144. ISSN: 1530-3667. https://doi.org/10.1089/vbz.2010.0232

RODRIGUEZ-VIVAS RI, Cordero LG, Trinidad-Martínez L, Ojeda-Chi M. 2019. *Spirocerca lupi* en perros de Yucatán, México: Reporte de caso y estudio retrospectivo. *Revista MVZ Córdoba.* 24(1):7145-7150. ISSN-L: 0122- 0268.
https://doi.org/10.21897/rmvz.1253

ROMERO-NÚÑEZ C, Mendoza-Martínez GD, Bustamante LP, Crosby-Galván MM, Ramírez-Duran N. 2011. Presencia y viabilidad de *Toxocara spp*. en suelos de parques públicos, jardines de casas y heces de perros en Nezahualcóyotl, México. *Revista científica.* XXI(3):195-201. ISSN: 0798-2259.
https://www.redalyc.org/articulo.oa?id=9591823

RUVALCABA F, García M, Escobedo J, Ruvalcaba M. 2012. Detección de parasitosis gastroentéricas en canideos en la zona conurbada Zacatecas-Guadalupe, México. *Revista Electrónica de Veterinaria*. 13(10):1-15. ISSN: 1695-7504.
https://www.redalyc.org/articulo.oa?id=636/63624631008

SARMIENTO-RUBIANO LA, Delgado L, Ruiz JP, Sarmiento MC, Becerra J. 2018. Parásitos intestinales en perros y gatos con dueño de la ciudad de Barranquilla, Colombia. *Revista de investigación veterinaria del Perú.* 29(4):1403-1410. ISSN:1609-9117. https://doi.org/10.15381/rivep.v29i4.15348

SERVICIO METEREOLÓGICO NACIONAL. 2020. Estaciones climatológicas. Estación: 10169, C. B. T. A. 101 Gómez Palacio, Durango. https://smn.conagua.gob.mx/tools/RESOURCES/Estadistica/10169.pdf

SIERRA-CIFUENTES V, Jiménez-Aguilar JD, Alzate A, Cardona-Arias JA, Ríos-Osorio LA. 2015. Prevalencia de parásitos intestinales en perros de dos centros de bienestar animal de Medellín y el oriente antioqueño (Colombia), 2014. *Revista de Medicina Veterinaria*. 30:55-66. ISSN: 0122-9354. https://dx.doi.org/10.19052/mv.3609

SILVA V, Silva J, Gonçalves M, Brandão C, Brito NV. 2020. Epidemiological survey on intestinal helminths of stray dogs in Guimarães, Portugal. *Journal of Parasitic Diseases*: *Official Organ of the Indian Society for Parasitology*. 1-8. https://doi.org/10.1007/s12639-020-01252-2

SOLARTE-PAREDES LD, Castañeda-Salazar R, Pulido-Villamartín AP. 2013. Parásitos gastrointestinales en perros callejeros del centro de zoonosis de Bogotá D.C., Colombia. *Revista Neotropical Helminthology*. 7(1):83-93. ISSN: 2218-6425. ISSN: 1995-1043. https://doi.org/10.24039/rnh201371951

SULIEMAN Y, Zakaria MA, Pengsakul T. 2020. Prevalence of intestinal helminth parasites of stray dogs in Shendi area, Sudan. *Annals of Parasitology*. 66 (1): 115–118. https://dx.doi.org/10.17420/ap6601.246

TORRES-CHABLÉ OM, García-Herrera RA, Hernández-Hernández M, Peralta-Torres JA, Ojeda-Robertos NF, John B., Blitvich BJ, Baak-Baak CM, García-Rejón JE, Machain-Wiliams CI. 2015. Prevalence of gastrointestinal parasites in domestic dogs in Tabasco, southeastern Mexico. *Revista Brasileira de Parasitologia Veterinária*. 24(4):432-437. ISSN 1984-2961. http://dx.doi.org/10.1590/S1984-29612015077

TRASVIÑA-MUÑOZ E, López-Valencia G, Álvarez CP, Cueto-González SA, MongeNavarro FJ, Tinoco-Gracia L, Núñez-Castro K, Pérez-Ortiz P, Medina-Basulto, GE,Tamayo-Sosa AR, Gómez-Gómez D. 2017. Prevalence and distribution of intestinal parasites in stray dogs in the northwest area of Mexico. *Austral Journal of Veterinary Sciences*. 49(2):105-111. ISSN: 0719-8000. https://doi.org/10.4067/S0719-81322017000200105

VEGA S, Serrano-Martínez E, Grandez R, Pilco M, Quispe M. 2014. Parásitos gastrointestinales en cachorros caninos provenientes de la venta comercial en el Cercado de Lima. *Revista salud y tecnología veterinaria*. 2:71-77. ISSN: 2312-3907. https://doi.org/10.20453/stv.v2i2.2242

VÉLEZ-HERNÁNDEZ L, Reyes-Barrera K, Rojas-Almaráz D, Calderón-Oropeza M, Cruz-Vázquez J, Arcos-García J. 2014. Riesgo potencial de parásitos zoonóticos presentes en heces caninas en Puerto Escondido, Oaxaca. *Salud Pública de México*. 56(6):625-630. http://dx.doi.org/10.21149/spm.v56i6.7389

ZAPATA RM, Soriano E, González AJ, Márquez VV, López MDM. 2015. Educación y Salud En Una Sociedad Globalizada. España: Universidad de Almería. Pp. 598. ISBN: 978-84-16027-82-8.

ZÚÑIGA-CARRASCO IR, Caro-Lozano J. 2020. Heces caninas: un riesgo permanente y sin control para la salud pública. *Revista Latinoamericana de Infectología Pediátrica*. 33 (2):74-77. https://dx.doi.org/10.35366/94417