Article

Not peer-reviewed version

Risk factors associated with intestinal parasites found in fecal samples from dogs and cats

Juliana Bruno Borges Souza , Zara Mariana de Assis Silva , Bruna Samara Alves-Ribeiro , Iago de Sá Moraes , Ana Vitória Alves-Sobrinho , Klaus Casaro Saturnino , Henrique Trevizoli Ferraz , Mônica Rodrigues Ferreira Machado , Isis Assis Braga , Dirceu Guilherme de Souza Ramos *

Posted Date: 20 June 2023

doi: 10.20944/preprints202306.1462.v1

Keywords: canine; feline; health; helminths; protozoa

Article

Risk Factors Associated with Intestinal Parasites Found in Fecal Samples from Dogs and Cats

Juliana Bruno Borges Souza [1], Zara Mariana de Assis Silva [2], Bruna Samara Alves-Ribeiro [3], Iago de Sá Moraes [4], Ana Vitória Alves-Sobrinho [5], Klaus Casaro Saturnino [6], Henrique Trevizoli Ferraz [7], Mônica Rodrigues Ferreira Machado [8], Ísis Assis Braga [9] and Dirceu Guilherme de Souza Ramos [10,*]

1 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; julianabbsouza@hotmail.com
2 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; zaram952@gmail.com
3 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; brsamaraalves@gmail.com
4 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; iago.moraes@discente.ufj.edu.br
5 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; anavitsobrinho@outlook.com
6 Laboratory of Veterinary Pathological Anatomy, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; klaus.sat@ufj.edu.br
7 Laboratory of Veterinary Anatomy, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; htferraz@ufj.edu.br
8 Laboratory of Biotechnology and Physiology in Fish, Institute of Biological Sciences, Federal University of Jataí, Jataí, Brazil; monica_rodrigues@ufj.edu.br
9 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; isisbraga@ufj.edu.br
10 Laboratory of Parasitology and Veterinary Clinical Analysis, Institute of Agricultural Sciences, Federal University of Jataí, Jataí, Brazil; dguilherme@ufj.edu.br
* Correspondence: dguilherme@ufj.edu.br

Simple Summary: Gastrointestinal diseases caused by parasites are frequently diagnosed in the clinical routine of dogs and cats. This study aimed to identify the main intestinal parasites obtained from fecal samples of dogs and cats in the municipality of Jataí, Brazil, and associate them with risk factors. The eggs, cysts, and oocysts were identified as those of *Ancylostoma* spp., *Toxocara* spp., *Trichuris vulpis*, *Dipylidium caninum*, *Giardia* spp., *Entamoeba* spp., *Cystoisospora* spp., and *Platynosomum fastosum*. Considering the results, the need for the implementation of preventive and control measures to reduce the occurrence of parasites in animals and the exposure of humans to pathogenic agents is evident.

Abstract: Gastrointestinal diseases caused by parasites are frequently diagnosed in the clinical routine of domestic animals, especially dogs and cats. In general, they trigger factors that can affect individual health due to zoonoses. Therefore, this study aims to identify the main intestinal parasites obtained from the fecal samples of dogs and cats in the municipality of Jata, Brazil, and their associated risk factors. Between October 2020 and March 2022, fecal samples were collected from 359 dogs and 55 cats through spontaneous defecation and subsequently subjected to coproparasitological analyses using the Willis fluctuation and Hoffman spontaneous sedimentation techniques. The following parasitic species were identified: *Ancylostoma*, *Toxocara*, *Trichuris vulpis*, *Dipylidium caninum; Giardia*, *Entamoeba*, *Cystoisospora,* and *Platynosomum fastosum*. The risk factors associated with parasitism include age, average income of owners, access to garbage, sewage, waste, outdated deworming, and contact with animals. The results demonstrate the need to establish public policies and implement preventive and control measures to reduce the occurrence of parasites in animals and the exposure of humans to pathogenic agents.

Keywords: canine; feline; health; helminths; protozoa

1. Introduction

The proximity between humans and domestic animals, particularly dogs and cats, has increased considerably. Pets act therapeutically in the lives of their guardians; however, their close coexistence facilitates the spread of zoonoses. The role of companion animals as disseminators of parasites with zoonotic potential has been increasingly studied [1,2]. Therefore, it is an important issue as it affects animal, human, and environmental health. Thus, it is important to take an interdisciplinary approach to reassess actions that can trigger the occurrence of parasites [3–6]. According to the World Health Organization (WHO, 2022) [7], approximately 24% of the world's population is infected with soil-transmitted helminthiases, with the highest rates of occurrence being in sub-Saharan Africa, the Americas, China, and East Asia.

Gastrointestinal parasites have been frequently reported in domestic dogs and cats. The helminths and protozoa frequently diagnosed in these species include *Ancylostoma* spp., *Toxocara* spp., *Trichuris* spp., *Dipylidium caninum*, *Strongyloides stercoralis*, *Giardia* spp., *Cystoisospora* spp., and *Cryptosporidium* spp. [8–15]. Usually, single infections or co-infections occur in the presence of more than one etiological agent. In dogs, the prevalence of single infections ranged from 20.5% to 62.2% and co-infections from 16.1% to 37.4%, whereas in cats, they ranged from 46.2% to 90.9% and 3.3% to 41.4%, respectively [8,9,11,15–17].

The occurrence of clinical signs depends on the parasite species and parasite load [18]. Therefore, enteric infections can be asymptomatic [19] or progress with the onset of moderate-to-severe gastrointestinal disorders, growth retardation, and anorexia and may lead to patient death [20,21]. The clinical signs of parasitism by *Ancylostoma* spp. directly correlate with pathogenicity. Parasites of this genus undergo haematophagy in the host intestine, resulting in intense blood loss [22], and dysentery is frequently observed [23]. Parasitism by *Toxocara* spp. is associated with a prevalence of diarrhea, vomiting, abdominal distension, constipation, cough, and nasal secretion [24,25]. Death in hatchlings is recurrent because liver and lung involvement may occur during larval migration. Entangled adults can lead to intestinal rupture and obstruction of the gallbladder and biliary and pancreatic ducts [26,27]. In humans, these parasites are responsible for the occurrence of cutaneous larva *migrans* (CML) and visceral larva *migrans* (VLM), respectively. CML consists of serpiginous linear papular lesions with an inflammatory aspect [28]. In VLM, involvement is due to parasitic migration during the biological cycle, and the clinical findings include hepatomegaly, eosinophilia, and multiple oval lesions in the liver and lungs [29]. Thus, for each parasitosis, clinical signs can vary depending on the biological and morphological characteristics of the etiological agent, host immune status, and environmental factors.

Considering the importance of veterinary medicine in maintaining unique health and the recognition of the role of dogs and cats in the spread of parasitic zoonoses, this study aimed to identify the main gastrointestinal parasites affecting domestic animals by statistically evaluating the coproparasitological results and observing the risk factors associated with the occurrence of these parasites in dogs and cats in the municipality of Jataí, Brazil.

2. Materials and Methods

2.1. Location and sampling

Between October 2020 and March 2022, fecal samples were collected from 359 dogs in the municipality of Jata, Goiás, Brazil. The collections were carried out in the owners' homes. The collections were distributed among 58 sectors and later separated into northern, western, eastern, central, and southern regions. All were carried out in the morning, with a single collection of each animal, through spontaneous defecation and sent to the Laboratory of Parasitology and Veterinary Clinical Analysis of the Federal University of Jataí. The sample calculation followed the design described by the following formula:

$$n = \frac{N * Z^2_{(1-\alpha)} * [p * (1-p)]}{(N-1) * d^2 + Z^2_{(1-\alpha)} * [p * (1-p)]} = \frac{33605 * 3{,}84 * [0{,}5 * (1-0{,}5)]}{(33604) * 0{,}0025 + 3{,}84 * [0{,}5 * (1-0{,}5)]} = 346$$

where N is the population size, which according to Assis et al. (2020) was 33,605 dogs in Jataí in 2018; Z(1-α) is the standard value of a normal distribution for a 95% confidence interval; p is an estimated proportion of 35% of parasitized animals (considering data from Martins et al. [30] who described an occurrence of parasitism of 34.41% in Mineiros, Goiás, adjacent municipality to Jataí); and d is required accuracy of 0.05 (5% maximum error).

2.2. Coproparasitological examination

After collection, the stool samples were subjected to coproparasitological analysis using two techniques for researching helminth eggs and protozoan oocysts: Willis fluctuation [31] and spontaneous sedimentation by Hoffman et al. [32], adapted according to Hoffmann [33].

For flotation, a hypersaturated NaCl solution (NaCl 35%) was added to the stool samples and subsequently filtered through a sieve and gauze to remove debris, subjecting it to spontaneous fluctuation due to the difference in density of eggs and oocysts. Finally, they were observed between the slide and coverslip (with the addition of a drop of Lugol's solution) using an optical microscope (Nikon Eclipse E200).

The sedimentation test was carried out with the addition of water to the sample, filtered through a sieve and gauze to remove debris, subjected to spontaneous sedimentation in a specific cup, and then observed between the slide and coverslip (with the addition of a drop of Lugol) using optical microscopy (Nikon Eclipse E200). Eggs and oocysts were identified according to the method of Zajac and Conboy [34].

2.3. Data analysis and interpretation

The overall prevalence of each parasite species was calculated according to Bush et al. [35], by multiplying the number of positive animals relative to the total number of samples by 100 (%). Parasite richness was also evaluated, which is the number of species found in a single host, as well as their variation in the sample.

Along with the collection of each sample, an epidemiological questionnaire was used to compare parasitism with possible risk factors using the following variables: defined race, age, host sex, average income of owners, street access, presence of basic sanitation (sewage collection and piped water), access to sewage, garbage, and waste, updated deworming, and presence of contacting animals (including synanthropic animals). Factors associated with parasitism were analyzed using the Chi-Square (X^2) test, considering a significant p-value < 0.05. Using the same test, the results of the two coproparasitological examinations were compared. The odds ratio (OR) was calculated to verify the level of risk associated with variables that correlated with parasitism.

Finally, we analyzed the spatial distribution of gastrointestinal parasites in dogs in the municipality of Jataí, Brazil.

2.4. Cats

Fecal samples were collected from 55 cats and subjected to the same coproparasitological analyses as previously described. As the "n" was small, the statistical analyzes were not feasible, so only the occurrence descriptions were weighted in this study.

2.5. Ethics Committee

The study was submitted for analysis by the Ethics in the Use of Animals Committee of the Federal University of Jataí for verification and monitoring of activities, having been approved by protocol 028/19.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 20 June 2023 doi:10.20944/preprints202306.1462.v1

3. Results

3.1. Prevalence and richness of parasites in dogs

The observed species richness ranged from 0–3 (having hosts parasitized by one, two, or three species of parasites). Eggs of Ancylostoma spp., Toxocara spp., Trichuris vulpis, D. caninum egg capsules, cysts of Giardia spp. and Entamoeba spp., and oocysts of Cystoisospora spp. were identified (Figure 1).

Figure 1. Eggs, cysts, and oocysts of intestinal parasites in fecal samples from dogs and cats in the municipality of Jataí, Brazil. (A) Egg of *Ancylostoma* spp. (bar 50 µm); (B) Egg of *Toxocara* spp. (bar 50 µm); (C) Egg of *Trichuris vulpis* (bar 50 µm); (D) *Dipylidium caninum* ovigerous capsules (bar 50 µm); (E) Egg of *Platynosomum fastosum* (bar 50 µm); (F) Cyst of *Giardia* spp. (bar 20 µm); (G) Oocyst of *Cystoisospora* spp. (bar 40 µm); (H) Cyst of *Entamoeba* spp. (bar 40 µm).

The most prevalent parasites were Ancylostoma spp. (29.53 %), followed by Toxocara spp. (7.52%), D. caninum (6.13%), Cystoisospora spp. (4.74%), Giardia spp. (3.34%), T. vulpis (1.67%), and Entamoeba spp. (0.84%). Data related to prevalence, absolute values, and confidence intervals are presented in Table 1.

Table 1. Prevalence of gastrointestinal parasites in dog feces samples (n=359) from Jataí, Brazil, submitted to coproparasitological examination between October 2020 and March 2022.

Species	Positives (n)	Prevalence (%)	Confidence Interval (%)*
Nematodes			
Ancylostoma spp.	106	29.53	25.04-34.44[a]
Toxocara spp.	27	7.52	5.22-10.72[b]
Trichuris vulpis	6	1.67	0.77-3.60[c]
Cestodes			
Dipylidium caninum	22	6.13	4.08-9.10[b]
Protozoa			
Giardia spp.	12	3.34	1.92-5.75[bc]
Cystoisospora spp.	17	4.74	2.98-7.45[bc]
Entamoeba spp.	3	0.84	0.28-2.43[c]

*Values with different letters differ at the 5% level of significance.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 20 June 2023 doi:10.20944/preprints202306.1462.v1

3.2. Risk factors

Risk factor analysis revealed that the following factors were associated with parasitism: age, average income of owners, access to garbage, sewage, waste, outdated deworming, and presence of contacting animals (including synanthropic animals). All p-values for the analyses are presented in Table 2.

Table 2. Associated risk factors and probability of occurrence of gastrointestinal parasites in fecal samples from dogs (n=359) from Jataí, Brazil, submitted to coproparasitological examination between October 2020 and March 2022.

Risk Variable	p-value*	*odds ratio***
Defined race		
No defined race	0.225	-
With defined race		-
Age		
Juvenile/Pup	0.005	0.134
Adult		2.167
Elderly		0.246
Host sex		
Male	0.605	-
Female		-
Average income of owner ***		
Until BRL 3,600.00	0.007	1.815
Bigger then BRL 3,600.00		0.551
Street access		
Yes	0.318	-
No		-
Basic home sanitation (sewage collection and piped water)	0.702	
Yes		-
No		-
Access to sewage, garbage and waste		
Yes	<0.001	1.171
No		0.854
Updated deworming		
Yes	<0.001	0.134
No		7.444
Presence of contacting animals (including synanthropic)	0.019	
Yes		4.241
No		0.236

* Considered signif; * Considered significant when p-value < 0.05; ** Calculated only for variables that obtained statistical significance; *** Reference value of approximately three minimum wages in Brazil (BRL) in the year 2023 (approximately US$ 728.97, June 2023).

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 20 June 2023 doi:10.20944/preprints202306.1462.v1

The *odds ratio* of the variables associated with the risk of gastrointestinal parasitism revealed the following probabilities: adult animals are 116.7% more likely to be parasitized than elderly or young animals/puppies; animals whose guardians have a family income of up to BRL 3,600.00 (approximately US$ 705.88 in August 2022) are 81.5% more likely to be parasitized than animals whose guardians have an average income above this amount; animals with access to garbage, waste, and sewage are 17.1% more likely to be parasitized than animals that do not have contact with these elements; animals with outdated deworming are 644.4% more likely to be parasitized than animals with updated prophylaxis; and finally, animals that have contact with other animals, including synanthropic animals (rodents and pigeons), are 324.1% more likely to be parasitized than animals that are not in this condition.

The other analyzed variables showed no differences and, therefore, were not associated with parasitism.

3.3. Comparison of techniques

In total, 95 samples were positive in both the sedimentation and fluctuation tests. Of the others, 31 samples were positive only for fluctuations and 27 were positive only for sedimentation. Despite this difference, when compared to the total number of parasites, the fluctuation technique had 82.89% sensitivity (126/152, confidence interval 76.91%– 88.88%) and the sedimentation technique had 79.61% sensitivity (121/152, confidence interval 72.65%– 85.59%), with no difference between them; thus, they complemented each other.

3.4. Spatial distribution

The analysis of the spatial distribution showed that only the southern sector of the municipality of Jataí had a difference in relation to the others, which were considered statistically equal. The confidence intervals of prevalence between the north (47.37%, confidence interval 24.45–71.14), west (31.67%, confidence interval 20.26–44.96), central (32.65%, confidence interval 19.95–47.54), and east (31.78%, confidence interval 23.87–40.56), intersect. The southern sector (65.69%, confidence interval 55.63–74.81), which despite having an intersection with the north, does not have an intersection with the others, is considered an area of greater exposure (Figure 2).

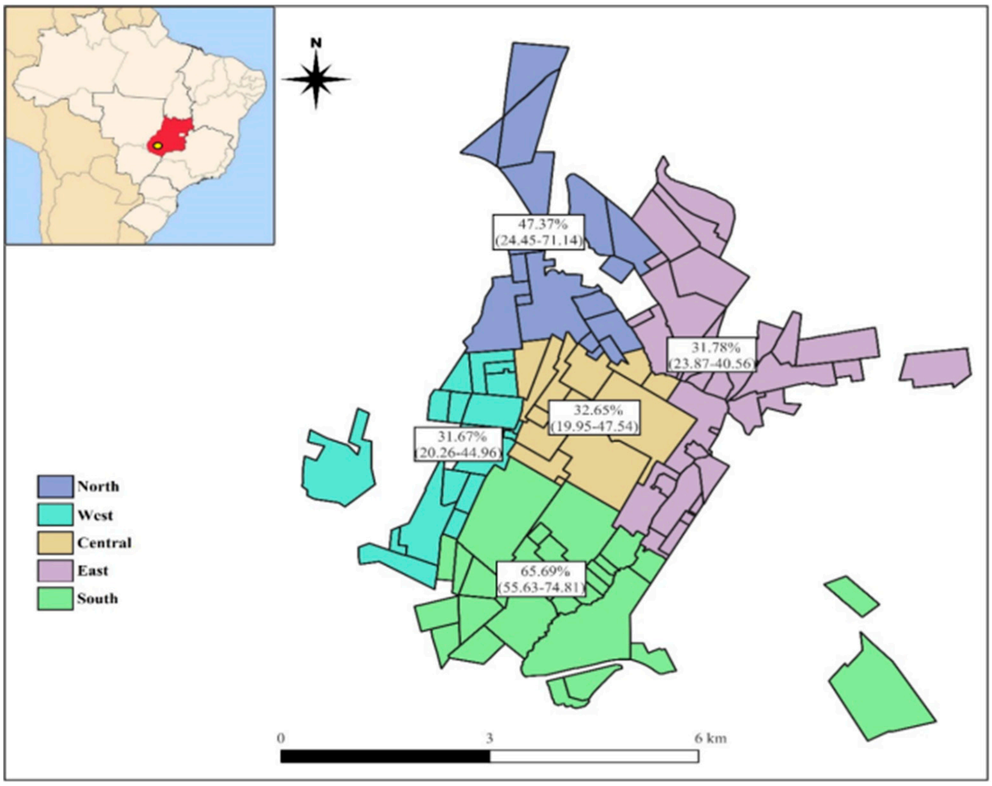

Figure 2. Map of the municipality of Jataí (highlighted in yellow in the upper left corner, location in Brazil), Goiás, with the prevalence and confidence intervals of the distribution of gastrointestinal parasites in dogs and cats.

3.5. Cats

Of the 55 animals sampled, 38 were positive for at least one gastrointestinal parasite species (69.09%). *Ancylostoma* spp. and *Toxocara* spp. eggs, *D. caninum* egg capsules, *P. fastosum* eggs, *Giardia* spp. cysts, and oocysts from *Cystoisospora* spp. were also found.

The most common parasites were *Ancylostoma* spp. (47.27%), followed by *Cystoisospora spp*. (29.09%), *D. caninum* (7.27%), *P. fastosum* (5.45%), *Toxocara* spp. (3.64%), and *Giardia* spp. (3.64%). Data related to frequencies, absolute values, and confidence intervals are presented in Table 3.

Table 3. Frequency of gastrointestinal parasites in fecal samples from cats (n=55) from Jataí, Goiás, Brazil, submitted to coproparasitological examination between October 2020 and March 2022.

Species	Positives (n)	Frequency (%)	Confidence Interval (%)
Nematodes			
Ancylostoma spp.	26	47.27	33.65-61.20
Toxocara spp.	2	3.64	0.44-12.53
Cestodes			
Dipylidium caninum	4	7.27	2.02-17.59
Flukes			
Platynosomum fastosum	3	5.45	1.14-15.12
Protozoa			
Giardia spp.	2	3.64	0.44-12.53
Cystoisospora spp.	16	29.09	17.23-42.90

4. Discussion

According to Guimarães et al. [36], *Ancylostoma* is most commonly diagnosed in domestic animals in Brazil, mainly dogs. In the present study, this genus was the most prevalent parasite in dogs and cats, with a prevalence of 29.53% and 47.27%, respectively *Ancylostoma* spp. is the genus that has high prevalence rates in all Brazilian regions, in addition to emphasizing the relevance of its zoonotic potential [37]. The high prevalence in Brazil is related to environmental conditions, mainly in tropical areas, with temperatures between 25 and 30 °C. These factors favor the permanence and development of the parasite in the environment, making it a risk factor for infection in animals and humans. In addition, the non-restriction of animals unaccompanied by their guardians, and even stray animals, are factors described by Ribeiro et al. [38] and Prestes et al. [39] as contributors to the spread of parasites in the environment.

In infected animals, symptoms vary according to the parasite load and nutritional and immunological status of the host. The main factors included dysentery, apathy, and weight loss. The most severe symptoms occur mainly in infants and may lead to the formation of intestinal ulcers and intussusception, resulting in death [40]. Parasitized animals often contaminate the environments in which they are located; therefore, humans are often exposed to parasitism, especially in places where temperature and humidity are favorable for the development of larvae, emphasizing housing as a possible risk factor. The frequency with which animals frequently contaminate public places, such as squares and parks, is an important factor in the transmission of CML. CML is a zoonosis that occurs in humans and is transmitted through infective larvae that penetrate percutaneously, with larval migration close to the affected site, as well as the occurrence of inflammatory reactions. The lesions occur on the skin and exhibit both serpiginous and pruritic characteristics [29,41].

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 20 June 2023 doi:10.20944/preprints202306.1462.v1

The genus *Toxocara* spp. is the second most frequently reported parasite in domestic and wild canines and felids. It is important to public health because of its transmission between animals and humans and is therefore characterized as a zoonosis. The prevalence in cats was 3.64%, which was within the expected range, and similar occurrences have been reported previously [42]. When released into the environment, eggs are resistant to environmental factors and are viable for long periods in soil. Thus, the environment in which infected animals are introduced and the environments they frequently encounter correspond to a high-risk factor, resulting in damage to their unique health, to which humans and other animals are exposed daily. The ideal temperature for the eggs to develop varies from 15 to 30 °C, similar to that found in Jataí, (19.9 and 31.3 °C [43]), making it favorable for the development of eggs in the environment and resulting in high prevalence of infections.

Dogs and cats infected with *Toxocara* can be asymptomatic. However, under high parasitic loads, symptoms such as vomiting, abdominal cramps, and anorexia evolve [18]. Diarrhea, developmental delay, and the expulsion of adult worms during emesis are also common [27]. In severe cases, pneumonia, intestinal obstruction, intestinal perforation with subsequent peritonitis, or death can occur [18,44]. This study emphasizes the importance of infection by *Toxocara* spp., as most of the animals evaluated have access to the street, including the unaccompanied, free access to contaminated public places, increasing the probability of new infections and offering risks to humans through exposure to pathogens, where infection can occur accidentally [45–47].

Trichuris vulpis is the most common parasite of the Trichuridae family reported in wild dogs and canids. Infection occurs through the oral route through the ingestion of water or soil contaminated with embryonated parasite eggs. Eggs deposited in the environment take an average of 9–10 days to embryonate at higher temperatures; therefore, the environment in this municipality is favorable for them to develop and infect other animals [39,48]. Intense infections can result in diarrhea, anemia, anorexia, lesions in the intestinal mucosa, colic, abdominal distensions, and rectal prolapse in puppies. Therefore, it is important to emphasize that feces are properly disposed of in the environment to reduce new infections [48–52].

The prevalence of *D. caninum* was 6.13% and 7.27% for dogs and cats, respectively. Compared with other parasites in dogs and cats, *D. caninum* does not show high prevalence [53,54]. Domestic and wild canids and felines are definitive hosts, in addition to having zoonotic potential and infecting humans. Infection occurs through the oral route in domestic and wild canids and felids, as well as in humans when the intermediate host was ingested (*Ctenocephalides* spp. and *Trichodectes canis*), containing the cysticercoid larva in their organism [27,39]. In general, infections are mild and asymptomatic, resulting only in itching in the anal region because the proglottids actively leave this region. Abdominal cramps, nausea, reduced appetite, diarrhea, inflammation, and intestinal obstruction may occur [55].

PPlatynosum fastosum has domestic and wild felids as definitive hosts, with great relevance in veterinary medicine, as it parasitizes the bile ducts and gallbladders of cats. Terrestrial mollusks of the genus *Subulina*, isopods, and lizards are intermediate hosts [56–58]. This study showed a prevalence of 5.45% in cats, which was consistent with most of the habits of the analyzed animals, which were mostly adults with a history of access to the street and hunting habits. The most common symptoms include apathy, anorexia, vomiting, diarrhea, mucus, lethargy, lack of appetite, and hair development changes. In severe cases, anemia, ascites, and bile duct thickening may occur, resulting in jaundice and cirrhosis, which can lead to death. Due to the characteristics of infected animals, diagnosis can be challenging, requiring attention during clinical care because of the patient's history, which can demonstrate habits that favor the transmission of pathogenic agents [59–61].

The low prevalence (3.34%) of *Giardia* spp. in dogs was because parasitized animals do not eliminate cysts continuously [62]. This protozoan has a wide variety of hosts and is frequently reported in dogs, cats, and humans. Infection occurs orally through ingestion of infective cysts in contaminated water, food, or soil. The habit of some owners not collecting the feces of their animals deposited in the environment is an eminent risk factor, favoring the contamination of soil and water and their occurrence in humans [63–65]. Clinical signs depend on the nutritional and immunological

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 20 June 2023 doi:10.20944/preprints202306.1462.v1

factors of each host. According to reports by Ballweber et al. [66] and Fantinatti et al. [67], symptoms are commonly observed, mainly in puppies and children, with pasty stools or fetid diarrhea, stools with color changes, and the presence of mucus, vomiting, nausea, colic abdominal pain, flatulence, fever, and constipation. In severe cases, damage caused to the intestinal mucosa by trophozoites results in inflammation, changes in bile and intestinal microbiota, intestinal dysfunction, pain in the xiphoid region, delay in the development of puppies and children, chronic gastroenteritis, weight loss, dehydration and even result in the death of the animal [68,69].

Unlike *Giardia* spp., *Cystoisospora* spp. is not considered a zoonotic agent [70]. Infection also occurs through the fecal-oral route and in places with precarious sanitary measures, frequently found in this study, that offer ideal temperature and humidity conditions, which increase the risk of infection. In general, the infection is not very pathogenic, is commonly asymptomatic, and self-limiting [26,27]. Dubey and Almeria [71] observed that clinical signs occur in heavily parasitized adults or puppies, including dysentery, fever, vomiting, developmental delay, weight loss, anorexia, and colic abs. It is commonly reported in overcrowded environments and places with poor sanitation [72,73].

The genus *Entamoeba* has been reported in dogs, cats, cattle, horses, and humans. Transmission occurs orally after animals or humans ingest water or food contaminated with cysts [73,74]. The prevalence was 0.84% in dogs and was not diagnosed in cats, where infections are rare [75]. In most cases, animals and humans are asymptomatic; however, the main symptoms include diarrhea, abdominal cramps, flatulence, fever, vomiting, and weight loss. In rare severe cases, they can evolve and compromise other organs such as the liver, lungs, spleen, and brain, in addition to causing colitis and intestinal ulcers that can become necrotic, cause peritonitis, and result in death [76,77].

After collecting the stool samples, they were submitted to coproparasitological analysis, with the aim of looking for helminth eggs and protozoan oocysts. Two techniques were used, Floating and Spontaneous Sedimentation. During the analyses, 95 samples tested positive in both the fluctuation and sedimentation tests. Of the others, 31 samples were positive only for fluctuations and 27 were positive only for sedimentation. Despite this difference, when compared to the total number of parasites, the fluctuation technique had 82.89% sensitivity (126/152), with a confidence interval of 76.91%– 88.88%. The sedimentation technique had a sensitivity of 79.61% (121/152) with a confidence interval of 72.65%– 85.59%. Therefore, there was no difference between them and they complemented each other, similar to the results of Alencar et al. [78].

Adult animals were more susceptible than elderly or puppies. The prevalence of infection in adult dogs is approximately twice as high as that in puppies [79]. Magalhães et al. [13] in Minas Gerais, Brazil, demonstrated a similar prevalence in adult dogs in Minas Gerais, Brazil. However, some studies have shown that young animals are more susceptible [80–83]. This divergence in prevalence is related to the parasite species and host characteristics. Younger animals are more susceptible to infections because of transplacental and transmammary transmission, and the immaturity of the immune system is also a contributing factor [80]. For example, *Ancylostoma* spp. demonstrate a higher occurrence in adult animals because of their longer exposure to pathogenic agents, especially in situations where they have an active infection in the environment in which they are found [84].

Family finances of up to BRL 3,600.00 (approximately US$ 728.97 in June 2023) increase the risk of parasitism in animals, which can be explained by the Brazilian economic profile. According to the Inter-Union Department of Statistics and Socioeconomic Studies (DIEESE) [85], the minimum wage required for a family of four is BRL 6,298.91, which is equivalent to five nominal minimum wages. This estimate is based on basic needs such as food, housing, health, education, clothing, hygiene, transportation, leisure, and social security. Thus, for low-income owners, since their purchasing power is related to basic expenses, access to veterinarian support is less frequent or not at all. In addition, a high proportion of Brazilian families do not have basic sanitation conditions [86]. Nunes and Matos-Rocha [87] conducted a descriptive and cross-sectional in Maceió, Brazil, where they concluded that most parasites in adolescents are due to a lack of basic sanitation and the presence of pet feces in the environment.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 20 June 2023 doi:10.20944/preprints202306.1462.v1

Contact with synanthropic animals, such as pigeons and rodents, increases the susceptibility to new parasitic infections by 324.1%. According to Paramasvaran et al. [88] and Allen et al. [89], the expansion of urban centers has contributed to the approximation of different animal species, including synanthropic species. This constant rapprochement between humans and domestic animals with synanthropy favors the transmission of various pathogenic agents, including gastrointestinal parasites. They can act as intermediate and paratenic hosts for pathogens and can spread contaminants in the environment, water, and food. It is worth noting the importance of implementing preventive control and prophylactic measures aimed at eradicating synanthropic animals to reduce the spread of pathogens [90].

In general, Jatai has an equivalent risk of exposure to pathogens, emphasizing the importance of one-health, which is a proportional risk for all, including animals and humans (especially due to the prevalence of zoonotic pathogens). Sanitary problems in municipalities, such as the intense presence of animals in the streets without the supervision of guardians and vacant lots with relatively high amounts of garbage, are found in different parts of the world, especially in developing countries. These data of Jataí are important for understanding and establishing public policies and implementing preventive actions [91]. Balassiano et al. [82] identified factors that intensify the occurrence of gastrointestinal parasites in dogs, including the lack of concern regarding the owners, who neglect these diseases; inefficient intercommunication between veterinarians and the population; lack of government programs aimed at controlling these conditions; high number of infected animals, contributing to new infections in animals exposed to risk factors; environmental contamination, through the non-removal of feces in public places during walks; and stray animals.

4.1. Control and prevention

Several factors contribute to the spread of pathogenic agents in the environment, including dogs and cats, which contaminate the environment through feces excreted in public places. Implementing health education for owners is fundamental to reducing the transmission of parasites. It is recommended that feces be collected during walks and immediately in domestic environments. Dogs and cats should not have access to the streets, and their guardians are responsible for the physical and environmental hygiene of their animals. In addition, access to garbage, waste, and sewage, which pose risks to them, should be restricted. as they may be contaminated and exposed [92,93]. Population control of stray animals is also necessary to control parasites and owners should have access to veterinarians for guidance on the risks of zoonosis and health education [94–97].

Close contact among domestic animals, humans, and synanthropic animals is an important aspect to consider in the transmission of pathogenic agents. In the domestic environment, a balanced diet of animals with hygienic measures, garbage collection, and basic sanitation is important to control synanthropic animals and minimize the spread of pathogens [88–90].

In kennels and catteries, it is essential to isolate the contaminated areas, maintain continuous hygiene, use suitable products, and avoid the presence of animals. Additionally, sunlight during the day causes the environment to dry, preventing the development of eggs and larvae [98].

5. Conclusions

This study demonstrated a wide range of parasites in the coproparasitological analyses of dogs and cats in the municipality of Jataí, Goiás. In dogs, *Ancylostoma* spp., *Toxocara* spp., and *T. vulpis*; *D. caninum* egg capsules; cysts of *Giardia* spp. and *Entamoeba* spp.; and oocysts from *Cystoisospora* spp. were observed. In cats, eggs of *Ancylostoma* spp., *Toxocara* spp., *D. caninum* egg capsules, *P. fastosum* eggs, *Giardia* spp. cysts, and *Cystoisospora* spp. oocysts were observed. Risk factors related to parasitism included age, average income of owners, outdated deworming, presence of contacting and synanthropic animals, and access to garbage, sewage, and waste. Public policies to prevent and control measures and health education are vital for reducing the occurrence of parasites in animals and the exposure of humans to pathogenic agents.

Acknowledgments: We thank Neusa Bruno Borges Marques, Dirceu de Sousa Ramos, and Egon Bauer [*in memorian*] for all the support provided.

Funding: This research was funded by the Fundação de Amparo à Pesquisa do Estado de Goiás (grant number 202110267000513).

Institutional Review Board Statement: The animal study protocol was approved by the Ethics Committee on Animal Use (CEUA) - Jataí, of the Federal University of Jataí under protocol no. 028/19, approved on November 29, 2019 for studies involving animals.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Giumelli, R.D.; Santos, M.C.P. Convivência com animais de estimação: um estudo fenomenológico. *Rev. Abordagem Gestalt.* **2016**, 22, 49-58; DOI: 10.18065/RAG.2016v22n1.6.
2. Kajero, O.T.; Janousková, E.; Bakare, E.A.; Belizario, V.; Divina, B.; Alonte, A.J.; Manalo, S.M.; Paller, V.G.; Betson, M.; Prada J.M. Co-infection of intestinal helminths in humans and animals in the Philippines. *Trans. R. Soc. Trop. Med. Hyg.* **2022**, 116, 727–735; DOI: 10.1093/trstmh/trac002.
3. Capuano, D.M.; Rocha, G.M. Ocorrência de parasitas com potencial zoonótico em fezes de cães coletadas em áreas públicas do município de Ribeirão Preto, SP, Brasil. *Rev. Bras. Epidemiol.* **2006**, 9, 81-86; DOI: 10.1590/S1415-790X2006000100010.
4. Paoletti, B.; Traversa, D.; Lorio, R.; Berardinis, A.; Bartolini, R.; Salini, R.; Cesare, A. Zoonotic parasites in feces and fur of stray and private dogs from Italy. *Parasitol. Res.* **2015**, 114, 2135-2141; DOI: 10.1007/s00436-015-4402-6.
5. Bojar, H.; Kłapeć, T. Contamination of selected recreational areas in Lublin Province, Eastern Poland, by eggs of *Toxocara* spp., *Ancylostoma* spp. and *Trichuris* spp. *Ann. Agric. Environ. Med.* **2018**, 25, 460-463; DOI: 10.26444/aaem/92252.
6. Farias, D.B.; Guimarães, D.R.A.; Souza, M.A.A. Contaminação parasitológica do solo em parques públicos da cidade de Conceição da Barra, Espírito Santo, Brasil. *Health Bioscienc.* **2021**, 2, 143-154; DOI: 10.47456/hb.v2i1.34071.
7. Brasil, Ministério da Saúde. T*extbook of Guia Prático para o Controle das Geo-helmintíases*. Ministério da Saúde: Brasília, DF, Brazil, **2022**, 33 p.
8. Ferreira, J.I.G.S.; Pena, H.F.J.; Azevedo, S.S.; Labruna, M.B.; Gennari, S.M.. Occurrences of gastrointestinal parasites in fecal samples from domestic dogs in São Paulo, SP, Brazil. *Rev. Bras. Parasitol. Vet.* **2016**, 25, 435-440; DOI: 10.1590/S1984-29612016081.
9. Monteiro, M.F.; Ramos, R.A.N.; Calado, A.M.C.; Lima, V.F.S.; Ramos, I.C.N.; Tenório, R.F.L.; Faustino, M.A.G.; Alves, L.C.. Gastrointestinal parasites of cats in Brazil: frequency and zoonotic risk. *Rev. Bras. Parasitol. Vet.* **2016**, 25, 254-257. DOI: 10.1590/S1984-29612016019
10. Pumidonming, W.; Salman, D.; Gronsang, D.; Abdelbaset, A.E.; Sangkaeo, K.; Kawaso, S.; Igarashi, M. Prevalence of gastrointestinal helminth parasites of zoonotic significance in dogs and cats in lower Northern Thailand. *J. Vet. Med. Scienc.* **2017**, 78, 1779-1784; DOI: 10.1292/jvms.16-0293.
11. Pereira, P.F.; Barbosa, A.S.; Moura, A.P.P.; Vasconcellos, M.L.; Uchôa, C.M.A.; Bastos, O.M.P.; Amendoeira, M.R.R. Gastrointestinal parasites in stray and shelter cats in the municipality of Rio de Janeiro, Brazil. *Rev. Bras. Parasitol. Vet.* **2017**, 26, 383-388; DOI: 10.1590/S1984-29612017024.
12. Sauda, F.; Malandrucco, L.; De Liberato, C.; Perrucci S. Gastrointestinal parasites in shelter cats of central Italy. *Vet. Parasitol. Reg. Stud. Reports* **2019,** 18, e100321; DOI: 10.1016/j.vprsr.2019.10321.
13. Magalhães, V.F.; Oliveira, N.M.S.; Silva, B.C.M.; Marques, M.J.; Darcadia, H.P.; Nogueira, D.A. Prevalence of zoonotic intestinal parasites in domiciled dogs living in the urban area of Alfenas, State of Minas Gerais, Brazil. *Ann. Parasitol.* **2020**, 66, 521-531; DOI: 10.17420/ap6604.294.
14. Arruda, I.F.; Ramos, R.C.F.; Barbosa, A.S.; Abboud, L.C.S.; Reis, I.C.; Millar, P.R.; Amendoeira, M.R.R. Intestinal parasites and risk factors in dogs and cats from Rio de Janeiro, Brazil. *Vet. Parasitol. Reg. Stud. Reports* **2021**, 24, e100552; DOI: 10.1016/j.vprsr.2021.100552.
15. Kamani, J.; Massetti, L.; Olubade, T.; Balami, J.A.; Samdi, K.M.; Traub, R.J.; Colella, V.; González-Miguel, J. Canine gastrointestinal parasites as a potential source of zoonotic infections in Nigeria: A nationwide survey. Prev. Vet. Med. **2021**, 192, e105385; DOI: 10.1016/j.prevetmed.2021.105385.
16. Takeuchi-Storm, N.; Mejer, H.; Al-Sabi, M.N.S.; Olsen, C.S.; Thamsborg, S.M.; Enemark, H.L. Gastrointestinal parasites of cats in Denmark assessed by necropsy and concentration McMaster technique. *Vet. Parasitol.* **2015**, 214, 327-332; DOI: 10.1016/j.vetpar.2015.06.033.

17. Nagamori, Y.; Payton, M.E.; Duncan-Decocq, R.; Johnson, E.M. Fecal survey of parasites in free-roaming cats in northcentral Oklahoma, United States. *Vet. Parasitol. Reg. Stud. Reports* **2018**, 14, 50-53; DOI: 10.1016/j.vprsr.2018.08.008.
18. Taylor, M.A; Coop, R.L.; Wall, R.L. *Textbook of Veterinary Parasitology*. John Wiley & Sons: Hoboken, NJ, USA, **2016**, 1006 p..
19. Hackett, T.; Lappin, M.R. Prevalence of enteric pathogens in dogs of north-central Colorado. *J. Am. An. Hosp. Assoc.* **2003**, 39, 52-56; DOI: 10.5326/0390052.
20. Barutzki, D.; Schaper, R. Endoparasites in dogs and cats in Germany 1999-2002. *Parasitol. Res.* **2003**, 90, S148-150; DOI: 10.1007/s00436-003-0922-6.
21. Spinosa, H.S.; Górniak, S.L.; Bernardi, M.M. *Textbook of Farmacologia aplicada à medicina veterinária*. Guanabara Koogan: Rio de Janeiro, RJ, Brazil, **2022**, 1040 p.
22. Bowman, D.D. *Textbook of Georgis' Parasitology for Veterinarians*. Saunders: Philadelphia, PA, USA, **2020**, 2057 p.
23. Kopp, S.R.; Kotze, A.C.; McCarthy, J.S.; Coleman, G.T. High-level pyrantel resistance in the hookworm *Ancylostoma caninum*. *Vet. Parasitol.* **2007**, 143, 299-304; DOI: 10.1016/j.vetpar.2006.08.036.
24. Ashwath, M.L.; Robinson, D.R.; Katner, H.P. A presumptive case of toxocariasis associated with eosinophilic pleural effusion: case report and literature review. *Am. J. Trop. Med. Hyg.* **2004**, 71, 764.
25. Foreyt, W.J. *Textbook of Parasitologia veterinária: manual de referência*. Roca: São Paulo, SP, Brazil, **2009,** 238 p..
26. Urquhart, G.M.; Armour, J.; Duncan, J.L.; Dunn, A.M.; Jennings, F.W. *Textbook of Veterinary Parasitology*. Blackwell Publishing: Oxford, OX, UK, **1996**, 396 p.
27. Monteiro, S.G. *Textbook Parasitologia na Medicina Veterinária*. Roca: São Paulo, SP, Brazil, **2017**, 370p..
28. Felix, D.A.S.; Silva, C.X.; Gomes, J.S.; Dias, E.G.; Freitas, J.S.; Fernandes, L.E.S.; Mendes, T.M.; Farias, L.A. *Toxocara* spp., larva *migrans* visceral e saúde pública: Revisão. *Pubvet*, **2020**, 14, a719; DOI: 10.31533/pubvet.v14n12a719.1-8.
29. Rocha, M.J.; Weber, D.M.; Costa, J.P. Prevalence of larva *migrans* in soils of city parks in Redenção, Pará State, Brazil. *Rev. Pan-Amaz. Saude* **2019**, 10, e201901607; DOI: 10.5123/s2176-6223201901607.
30. Martins, A.P.; Duarte, R.B.; Silva, M.F.S.; Soares, J.M.; Braga, I.A.; Ramos, D.G.S. Occurrence of intestinal parasites in fecal samples of dogs and cats from Mineiros, Goiás. *Ars Vet.* **2022,** 38, 13-17; DOI: 10.15361/2175-0106.2022v38n1p13-17.
31. Willis, H. H. A simple levitation method for the detection of hookworm ova. *Med. J. Aust.* **1921**, 18, 375-376; DOI: 10.5694/j.1326-5377.1921.tb60654.x.
32. Hoffman, W.A.; Pons, J.A.; Janer, J.L. The sedimentation-concentration method in schistosomiasis mansoni. *PR. J. Public Health Trop. Med.* **1934**, 9, 283-289.
33. Hoffmann, R.P. *Textbook of Diagnóstico de Parasitismo Veterinário*. Sulina: Porto Alegre, RS, Brazil, **1987**, 156 p.
34. Zajac, A.M.; Conboy, G.A. *Textbook of Veterinary Clinical Parasitology*. Wiley-Blackwell: Oxford, OX, UK, **2012**, 368 p.
35. Bush, A.O.; Lafferty, K.D.; Lotz, J.M.; Shostak, A.W. Parasitology meets ecology on its own terms: Margolis et al. revisited. *J. Parasitol.* **1997**, 83, 575-583.
36. Guimarães, B.C.S.; Texeira, B.T.; Toledo, L.V.; Damasceno, L.S.; Almeida, M.E.W.C.; Martins, M.A.; Leite, N.S. Hookworm infection: Ancylostomiasis. *Braz. J. Surg. Clin. Res.* **2019**, 26, 84-88.
37. Santos, B.; Silva, A.N.F.; Mora, S.E.V.; Koslowski-Neto, V.A.; Justo, A.A.; Pantoja, J.C.F.; Schmidt, E.M.S.; Takahira, R.K. Epidemiological aspects of *Ancylostoma* spp. infection in naturally infected dogs from São Paulo state, Brazil. *Vet. Parasitol. Reg. Stud. Reports* **2020**, 22, e100452; DOI: 10.1016/j.vprsr.2020.100452..
38. Ribeiro, K.L.; Freitas, T.D.; Teixeira, M.C.; Araújo, F.A.P. Avaliação da ocorrência de formas parasitárias no solo de praças públicas no município de Esteio-RS. *Rev. Acad. Ciênc. Agrár. Amb.* **2013**, 11, 59-64.
39. Prestes, L.F.; Jeske, S.; Santos, C.B.; Gallo, M.C.; Villela, M.M. Contaminação do solo por geohelmintos em áreas públicas de recreação em municípios do sul do Rio Grande do Sul (RS), Brasil. *Rev. Patol. Trop.* **2015**, 44, 155-162; DOI: 10.5216/rpt.v44i2.36645.
40. Fortes, E. *Textbook of Parasitologia Veterinária*. Ícone: São Paulo, SP, Brazil, **2017,** 608 p.
41. Francisco, M.M.S.; Silva, R.C.; Figueiredo, D.L.V.; Souza, J.N.; Ramalho, P.C.D.; Caetano, A.L. Prevalência de ovos e larvas de *Ancylostoma* spp. e de *Toxocara* spp. em praças públicas da cidade de Anápolis-GO. *Ensaios Ciênc. C. Biol. Agrár. Saúde* **2008**, 12, 131-137.
42. Campos-Filho, P.C.; Barros, L.M.; Campos, J.O.; Braga, V.B.; Cazorla, I.M.; Albuquerque, G.R.; Carvalho, S.M.S. Parasitas zoonóticos em fezes de cães em praças públicas do município de Itabuna, Bahia, Brasil. *Rev. Bras. Parasitol. Vet.* **2008**, 17, 206-209; DOI: 10.1590/S1984-29612008000400007.
43. Rocha, J.R.R.; Mariano, Z.F.; Feltrin, J.C.; Silva, M.R.. O clima em cidade pequena: o sistema termodinâmico em Jataí (GO). *Rev. Bras. Climatol.* **2014**, 15, 205-228.
44. Dantas-Torres, F. *Toxocara* prevalence in dogs and cats in Brazil. *Adv. Parasitol.* **2020**, 109, 715-741; DOI: 10.1016/bs.apar.2020.01.028.

45. Figueiredo, S.D.P.; Taddei, J.A.A.C.; Menezes, J.J.C.; Novo, N.F.; Silva, E.O.M.; Cristóvão, H.L.G.; Cury, M.C.F.S. Clinical-epidemiological study of toxocariasis in a pediatric population. *J. Pediatr.* **2005**, 81, 126-132; DOI: 10.1590/S0021-75572005000300007.
46. Bradburya, R.S.; Hobbs, C.V. *Toxocara* seroprevalence in the USA and its impact for individuals and society. *Adv. Parasitol.* **2020**, 109, 317-339; DOI: 10.1016/bs.apar.2020.01.035.
47. Chidumayo, N.N. Prevalence of *Toxocara* in dogs and cats in Africa. *Adv. Parasitol.* **2020**, 109, 861-871; DOI: 10.1016/bs.apar.2020.01.032.
48. Ferraz, A.; Pires, B.S.; Barwaldt, E.T.; Santos, E.M.; Dallmann, P.R.J.; Castro, T.A.; Nobre, M.O.; Nizoli, L.C. *Trichuris vulpis* eggs in stool samples of dogs analyzed in the region of Pelotas, RS, between 2015 and 2018. *Rev. Acad. Ciênc. Anim.* **2020**, 18, e18004; DOI: 10.7213/2596-2868.2020.18004.
49. Acha, P.N; Szyfres, B. *Textbook of Zoonosis y enfermidades transmisibles comunes al hombre ya los animales - Volume 3*. Pan-American Health Organization: Washington, DC, USA, **2003**, 423 p.
50. Longo, C.E.M.; Santos, G.R.; Oliveira, J.L.S.; Neves, M.F. *Trichuris vulpis*. *Rev. Científ. Eletr. Med. Vet.* **2008**, 11, 1-6.
51. Rey, L. *Textbook of Parasitologia*. Guanabara Koogan: Rio de Janeiro, RJ, Brazil, **2013,** 888 p.
52. Ramos, D.G.S.; Zocco, B.K.A.; Torres, M.M.; Braga, I.A.; Pacheco, R.C.; Sinkoc, A.F. Helminths parasites of stray dogs (*Canis lupus familiaris*) from Cuiabá, Midwestern of Brazil. *Semina Ciênc. Agrar.* **2015**, 36, 889-894; DOI: 10.5433/1679-0359.2015v36n2p889.
53. Batista, S.P.; Silva, F.F.; Valêncio, B.A.; Carvalho, G.M.M.; Santos, A.; Costa, F.T.R.; Feitosa, T.F.; Vilela, V.L.R. Parasitos zoonóticos em solos de praças públicas no município de Sousa, Paraíba. *Rev. Bras. Ciênc. Vet.* **2019**, 26, 82-86; DOI: 10.4322/rbcv.2019.015.
54. Ferraz, A.; Evaristo, T.A.; Coelho, A.L.R.; Castro, T.A.; Mello, C.C.S.; Pappen, F.G.; Silva, S.S.; Nizoli, L.C. Presença de parasitos com potencial zoonótico na areia de praças de recreação de escolas municipais de educação infantil do munícipio de Pelotas, RS, Brasil. *Vet. Zootec.* **2019**, 26, 1-7.
55. Nelson, R.W.; Couto, C.G. T*extbook of Medicina interna de pequenos animais*. Guabara Koogan: Rio de Janeiro, RJ, Brazil, **2015,** 1512 p.
56. Ramos, D.G.S.; Santos, A.R.G.L.O.; Freitas, L.C.; Braga, I.A.; Silva, E.P.; Soares, L.M.C.; Antoniassi, N.A.B.; Furlan, F.H.; Pacheco, R.C. Feline platynosomiasis: analysis of the association of infection levels with pathological and biochemical findings. *Rev. Bras. Parasitol. Vet.* **2017**, 26, 54-59; DOI: 10.1590/S1984-29612017009.
57. Bielsa, L.M.; Greiner, E.C. Liver flukes (*Platynosomum concinnum*) in cats. *J. Am. Anim. Hosp. Assoc.* **1985**, 21, 269-274.
58. Ettinger, S.J.; Feldman, E.C. *Textbook of Tratado de medicina interna veterinária*. Manole: São Paulo, SP, Brazil, **1997**, 1828 p.
59. Campos, N.C.; Siqueira, D.F.; Perin, L.R.; Oliveira, L.C.; Campos, D.R.; Martins, I.V.F. Natural infection by *Platynosomum fastosum* in domestic feline in Alegre, Espírito Santo, Brazil and successful treatment with praziquantel. *Med. Vet. UFRPE*, **2018**, 12, 17-21; DOI: 10.26605/medvet-v12n1-2138.
60. Ferraz, A.; Lima, C.M.; Barwaldt, E.T.; Bierhals, E.S.; Chagas, B.C.; Salame, J.P.; Silva, A.B.; Nizoli, L.Q.; Nobre, M.O. Platinossomose em felino doméstico no município de Pelotas, RS, Brasil. *Vet. Zootec.* **2021**, 28, 1-8; DOI: 10.35172/rvz.2021.v28.540.
61. Salomão, M; Souza-Dantas, L.M.; Mendes-Almeida, F.; Branco, A.S.; Bastos, O.P.M.; Sterman, F.A.; Labarthe, N. Ultrasonography in hepatobiliary evaluation of domestic cats (*Felis catus*, L., 1758) infected by *Platynosomum* Looss, 1907. *Int. J. App. Res. Vet. Med.* **2005**, 3, 271-279.
62. Carrillo, M.R.G.G.; Lima, A.A.; Nicolato, R.L.C. Prevalênciade enteroparasitoses em escolares do bairro Morro de Santana no Municípiode Ouro Preto, MG. *Rev. Bras. Anál. Clín.* **2005**, 37, 191-193.
63. Sousa, M.C.; Morais, J.B.; Machado, J.E.; Poiares-Silva, J. Genotyping of *G. duodenalis* human isolates from Portugal by PCR-RFLP and sequencing. *J. Eukaryot. Microbiol.* **2006**, 53, 174-176; DOI: 10.1111/j.1550-7408.2006.00221.x.
64. Thompson, R.C.A.; Smith, A. Zoonotic enteric protozoa. *Vet. Parasitol.* **2011**, 182, 70-78; DOI: 0.1016/j.vetpar.2011.07.016.
65. Vieira, D.E.A.; Benetton, M.L.F.N. Environment factors associate with the occurrence of enteroparasitosis in patients assisted in the public health net in Manaus, state of Amazonas, Brazil. *Biosci. J.* **2013**, 29, 487-498.
66. Ballweber, L.R.; Xiao, L.; Bowman, D.D.; Kahn, G.; Cama, V.A. Giardiasis in dogs and cats: update on epidemiology and public health significance. *Trends Parasitol.* **2010**, 26, 180-189; DOI: 10.1016/j.pt.2010.02.00.
67. Fantinatti, M; Gonçalves-Pinto, M.; Lopes-Oliveira, L.A.P.; Cruz, A.M. Epidemiology of *Giardia duodenalis* assemblages in brazil: There is still a long way to go. *Mem. Inst. Oswaldo Cruz* **2020**, 115, e200431; DOI: 10.1590/0074-02760200431.
68. Gonçalves, L.A; Belizário, T.L.; Pimentel, J.B.; Penatti, M.P.A.; Pedroso, R.S. Prevalence of intestinal parasites in preschool children in the region of Uberlândia, Brazil. *Rev. Soc. Bras. Med. Trop.* **2011**, 44, 191-193; DOI: 10.1590/S0037-86822011005000022.

69. Pereira, M.G. *Textbook of Epidemiologia teoria e prática*. Guanabara Koogan: Rio de Janeiro, RJ, Brazil, **2012,** 616 p.
70. Rodrigues, A.N.; Menezes, R.C.A.A. Infecção natural de cães por espécies do gênero *Cystoisospora* (Apicomplexa: Cystoisosporinae) em dois sistemas de criação. *Clín. Vet.* **2003**, 42, 24-30.
71. Dubey, J.P.; Almeria, S. *Cystoisospora belli* infections in humans: the past 100 years. *Parasitol.* **2019**, 146, 1490-1527; DOI: 10.1017/S0031182019000957.
72. Funada, M.R.; Pena, H.F.J.; Soares, R.M.; Amaku, M.; Gennari, S.M. Frequency of gastrointestinal parasites in dogs and cats referred to a veterinary school hospital in the city of São Paulo. *Arq. Bras. Med. Vet. Zootec.* **2007**, 59, 1338-1340; DOI: 10.1590/S0102-09352007000500038.
73. Arbos, K.A.; Freitas, R.J.S; Stertz, S.C.; Carvalho, L.A. Organic vegetables safety: sanitary and nutritional aspects. *Ciênc. Tecnol. Alim.* **2010**, 30, 215-220; DOI: 10.1590/S0101-20612010000500033.
74. Shirley, D.T.; Farr, L.; Watanabe, K.; Moonah, S. A Review of the Global Burden, New Diagnostics, and Current Therapeutics for Amebiasis. *Open Forum Infect. Dis.* **2018**, 5, 1-9; DOI: 10.1093/ofid/ofy161.
75. Brener, B; Mattos, D.P.B.G.; Lisboa, L.; Arashiro, E.K.N.; Millar, P.R.; Sudré, A.P.; Duque, V. Frequência de enteroparasitas em amostras fecais de cães e gatos dos municípios do Rio de Janeiro e Niterói. *Rev. Bras. Ciênc. Vet.* **2005**, 12, 102-105; DOI: 10.4322/rbcv.2014.313.
76. Erdogrul, O.; Sener, H. The contamination of various fruit and vegetable with *Enterobius vermicularis*, *Ascaris* eggs, *Entamoeba histolyca cysts* and *Giardia* cysts. *Food Control* **2005**, 16, 559-562; DOI: 10.1016/j.foodcont.2004.06.016.
77. Castro, A.A.; Bacalhau, F.; Silva, F.F.; Avillez, C.; Batalheiro, J. *Entamoeba histolytica* como causa de diarreia crônica. *Rev. Bras. Med. Fam. Comunidade* **2019**, 14, e1917; DOI: 10.5712/rbmfc14(41)1917.
78. Alencar, F.P.; Queiroz, L.N.; Uchôa, S.K.S.; Moura, H.L. Enteroparasitas zoonóticos do gênero *Ancylostoma* spp. e *Toxocara* sp. em fezes de cães coletadas em locais públicos do 1° distrito da cidade de Rio Branco-AC. *Scientia Naturalis* **2020**, 2, 241-253.
79. Torres-Chablé, O.M.; García-Herrera, R.A.; Hernández-Hernández, M.; Peralta-Torres, J.A.; Ojeda-Robertos, N.F.; Blitvich, B.J.; Baak-Baak, C.M.; García-Rejón, J.E.; Machain-Williams, C.I. Prevalence of gastrointestinal parasites in domestic dogs in Tabasco, southeastern Mexico. *Rev. Bras. Parasitol. Vet.* **2015**, 24, 432-437; DOI: 10.1590/S1984-29612015077.
80. Oliveira-Sequeira, T.C.G.; Amarante, A.F.T.; Ferrari, T.B.; Nunes, L.C. Prevalence of intestinal parasites in dogs from São Paulo State, Brazil. *Vet. Parasitol.* **2002**, 103, 19-27; DOI: 10.1016/s0304-4017(01)00575-1.
81. Robertson, I.D.; Thompson, R.C. Enteric parasitic zoonoses of domesticated dogs and cats. *Microbes Infect.* **2002**, 4, 867-873; DOI: 10.1016/s1286-4579(02)01607-6.
82. Balassiano, B.C.C.; Campos, M.R.; Menezes, R.C.A.A.; Pereira, M.J.S. Factors associated with gastrointestinal parasite infection in dogs in Rio de Janeiro, Brazil. *Prev. Vet. Med.* **2009**, 91, 324-340; DOI: 10.1016/j.prevetmed.2009.05.030.
83. Ilić, T.; Nisavic, U.; Gajic, B.; Nenadovic, K.; Ristic, M.; Stanojevic, D.; Dimitrijevic, S. Prevalence of intestinal parasites in dogs from public shelters in Serbia. *Comp. Immunol. Microbiol. Infect. Dis.* **2021**, 76, e101653; DOI: 10.1016/j.cimid.2021.101653.
84. Ferreira, J.I.G.S.; Pena, H.F.J.; Azevedo, S.S.; Labruna, M.B.; Gennari, S.M. Occurrences of gastrointestinal parasites in fecal samples from domestic dogs in São Paulo, SP, Brazil. *Rev. Bras. Parasitol. Vet.* **2016**, 25, 435-440; DOI: 10.1590/S1984-29612016081.
85. Departamento Intersindical de Estatística e Estudos Socioeconômicos. *Anuário da saúde do trabalhador.* DIEESE: São Paulo, SP, Brazil, **2022**.
86. Couto, W.F.; Pereira, R.V.; Figueiredo, B.C.P.; Silva, A.C.; Gramigna, L.L.; Sana, D.E.M.; Gomes, R.S; Andrade, G.F.; Brant, J.F.A.C.; Breguez, G.S.; Silva, M.A.R.; Barbeitos, P.O.; Junior, L.C.P.; Reis, L.E.S.; Jayme, M.F.; Camargo, R.S.; Franco, M.N.; Amaral, M.S.; Nicolato, R.L.C.; Carneiro, C.M.; Reis, A.B. Relação entre parâmetros ambientais, econômicos e socioculturais na identificação de regiões de risco para ocorrência de parasitoses intestinais em uma área rural de ouro preto, MG. *Rev. Eletrôn. Farm.* **2007**, 4, 148-150.
87. Nunes, M.O.; Rocha, T.J.M. Fatores condicionantes para a ocorrência de parasitoses entéricas de adolescentes. *J. Health Biol. Sci.*, **2019**, 7, 265-270; DOI: 10.12662/2317-3076jhbs.v7i3.2244.p265-270.2019.
88. Paramasvaran, S.; Sani, R.A.; Hassan, L.; Kaur, H.; Krishnasamy, M.; Jeffery, J.; Raj. S.; Ghazali, S.M.; Hock, L.C.. Endo-parasite fauna of rodents caught in five wet markets in Kuala Lumpur and its potential zoonotic implications. *Trop. Biomed.* **2009**, 26, 67–72.
89. Allen, T.; Murray, K.A.; Zambrana-Torrelio, C.; Morse, S.S.; Rondinini, C.; Di-Marco, M.; Breit, N.; Olival, K.J.; Daszak, P. Global hotspots and correlates of emerging zoonotic diseases. *Nat. Commun.* **2017**, 8, 1124; DOI: 10.1038/s41467-017-00923-8.
90. Lima, V.F.S; Ramos, R.A.N.; Giannelli, A.; Andrade, W.W.A.; Torres-López, I.Y.; Ramos, I.C.N.; Rinaldi, L.; Cringoli, G.; Alves, L.C. Occurrence of zoonotic gastrointestinal parasites of rodents and the risk of human infection in different biomes of Brazil. *Braz. J. Vet. Med.* **2021**, 43, e113820; DOI: 10.29374/2527-2179.bjvm113820.

91. Oliveira-Arbex, A.P.; David, E.B.; Oliveira-Sequeira, T.C.G.; Katagiri, S.; Coradi, S.T.; Guimarães, S. Molecular identification of *Ancylostoma* species from dogs and an assessment of zoonotic risk in low-income households, São Paulo State, Brazil. *J. Helminthol.* **2017**, 91, 14–19; DOI: 10.1017/S0022149X15001145.
92. Heller, L.; Bastos, R.K.X.; Vieira, M.B.C.M.; Bevilacqua, P.D.; Brito, L.L.A.; Mota, S.M.M.; Oliveira, A.A.; Machado, P.M.; Salvador, D.P.; Cardoso, A.B. *Cryptosporidium* oocysts and *Giardia* cysts: environmental circulation and health risks. *Epidemiol. Serv. Saúde* **2004**, 13, 79-92; DOI: 10.5123/S1679-49742004000200002.
93. Mota, K.C.P.; Hernández, C.G.; Oliveira, K.R. Frequência de enteroparasitos em amostras de fezes de cães em um município do Pontal do Triângulo Mineiro, Minas Gerais, Brasil. *Rev. Patol. Trop.* **2014**, 43, 219-227; DOI: 10.5216/rpt.v43i2.31124.
94. Guimarães, A.M.; Alves, E.G.L.; Rezende, G.F.; Rodrigues, M.C. Ovos de *Toxocara* sp. e larvas de *Ancylostoma* sp. em praça pública de Lavras, MG. *Rev. Saúde Pública* **2005**, 39, 293-295; DOI: 10.1590/S0034-89102005000200022.
95. Macpherson, C.N.L. Human behaviour and the epidemiology of parasitic zoonoses. *Int. J. Parasitol.* **2005**, 35, 1319–1331; DOI: 10.1016/j.ijpara.2005.06.004.
96. Rodrigues, A.A.M.; Corrêa, R.S.; Souza, F.S.; Lisboa, R.S.; Pessoa, R.O. Ocorrência de parasitos zoonóticos em fezes de cães em áreas públicas em duas diferentes comunidades na Reserva Desenvolvimento Sustentável do Tupé, Amazonas. *Rev. Bras. Hig. Sanid. Anim.* **2014**, 8, 138-146; DOI: 10.5935/1981-2965.20140123.
97. Ramos, D.G.S.; Scheremeta, R.G.A.C.; Oliveira, A.C.S.; Sinkoc, A.L.; Pacheco, R.C. Survey of helminth parasites of cats from the metropolitan area of Cuiabá, Mato Grosso, Brazil. *Rev. Bras. Parasitol. Vet.* **2013**, 22, 201-206; DOI: 10.1590/S1984-29612013000200040.
98. Bricarello, P.A.; Magagnin, E.A.; Oliveira, T.; Silva, A.; Lima, L.M. Contamination by parasites of zoonotic importance in fecal samples from Florianópolis Beaches, Santa Catarina State, Brazil. *Braz. J. Vet. Res. Anim. Sci.* **2018**, 55, 1-10; DOI: 10.11606/issn.1678-4456.bjvras.2018.133259.