Acta Scientific Veterinary Sciences (ISSN: 2582-3183)

Volume 6 Issue 3 March 2024

Research Article

Prevalence and Risk Factors for *Cryptosporidium* spp. In Domestic Cats Around Mexico

Camilo Romero Núñez[1], Laura Reyes Clímaco[1], Rafael Heredia Cárdenas[2]*, Linda Guiliana Bautista Gómez[3], Manuel Ricardo Sánchez Mora[4], Ariadna Flores Ortega[3] and Laura Miranda Contreras[1]

[1]*Hospital Veterinario DERMAVET, Ciudad de México, México*

[2]*Centro Integral Veterinario, CIVET, Estado de México, México*

[3]*Centro Universitario UAEM Amecameca, Universidad Autónoma del Estado de México, México*

[4]*Universidad Pedagógica de Colombia, Colombia*

***Corresponding Author:** Rafael Heredia Cárdenas, Centro Integral Veterinario, CIVET, Estado de México, México

DOI: 10.31080/ASVS.2024.06.0840

Received: January 16, 2024

Published: February 24, 2024

Abstract

The prevalence of *Cryptosporidium* spp. in cats varies between 1 and 74%, however, cat's role as transmitter agent of *Cryptosporidium* spp. is not clear. The objective of the current study was to evaluate the prevalence and risk factors of *Cryptosporidium* spp. in domestic cats around Mexico. 614 domestic cat stools around 31 States in Mexico, were collected. Cats of all breeds, both genres, sane and ill, and of all ages were included. The samples were analyzed with the cold modified Ziehl-Neelsen staining for the detection of oocysts of *Crypstosporidium* spp. in stool samples. The Chi-square test was used to determine the association between the variables and Odds Ratio was applied for determining risk factors with an alpha of $P \leq 0.05$. Of 614 evaluated samples, 319 (51.9%) were positive to *Cryptosporidium* spp. The fact of not bathing the cat was associated (Chi2 = 15.51, P = 0.001) to be positive to *Cryptosporidium* spp. and it was a risk factor (OR = 1.60, P = 0.003). Small size in felines was associated to the presence of *Cryptosporidium* spp. (Chi2 = 5.78 P = 0.05), whereas the medium-sized cats have low possibilities of presenting *Cryptosporidium* (OR = 0.68, P = 0.01). The kind of hair, the breed, body condition, hunting habits, access to the outside, and the consistency and findings in the stools, were not associated and were not risk factors. There exists a high prevalence (51.9%) of *Cryptosporidium* spp. in domestic cats around Mexico. The risk factor for the presence of the protozoan in stools was not to bathe the cat.

Keywords: Parasites; Cats; Prevalence; Risk Factors; Protozoan

Introduction

Owning domestic cats as pets, has increased in time. The owners now consider them as part of the family [1]. *Cryptosporidium* spp. is a protozoan belonging to the Apicomplexa phylum, it infects almost all vertebrate species [2], including humans, dogs and cats [3]. *Cryptosporidium* spp. oocysts are found in the gastrointestinal tract [4], and are eliminated through the stools by the infected host. The transmission is via the fecal-oral route [5]. It is well known that the oocysts have thick covers, which guarantee the survival of the parasite in a long term, the environmental transmission and the resistance to commonly used disinfectants [6]. These protozoa can cause diarrhea, and usually lead to a higher mortality rate [7]. The prevalence of *Cryptosporidium* spp. in cats varies considerably, between 1 and 74%, depending on the analyzed population and the applied evaluation methods [8], however, the role of cats as transmitters of *Cryptosporidium* spp. is not clear [9]. The aim of the current study was to determine the prevalence and risk factors of *Cryptosporidium* spp. in cats around Mexico.

Materials and Methods

The protocol was approved by the Amecameca UAEM University Center Ethics Committee of the Universidad Autónoma del Estado de Mexico, UAEM-020-2019.

A transversal study was conducted in 31 out of the 32 States in Mexico, from June to December 2019, 614 stool samples were collected, from the recto and sandboxes, no matter breed, age, genre or health condition. The owners authorized their pet's participation

in the project through signed consent form, pet data was gathered for the evaluation of risk factors for cryptosporidiosis. The samples were analyzed by 198 veterinarians; previously trained with face-to-face workshops, webinars, videos, manuals, conferences, online classes and social media. The samples were processed through the cold modified Ziehl-Neelsen staining, for the detection of oocysts in stool samples, with sensibility and specificity of 98% [10]. A fine smear of the sample was made and it was heat fixed, later on, basic fuchsin was added at 1% for 3 minutes, it was washed with distilled water, then, acid-alcohol solution (bleaching agent 70%) was added for one minute, it was washed with distilled water, left to dry and examined throughout the microscope with 100X lens. The samples were determined positive with the presence of red/purple stained oocysts, rounded and with a 4–6 µm diameter.

Statistic analysis

The prevalence was calculated through the number of affected individuals, or existent cases, divided into the number of individuals in the population per 100. The variables were categoric, so, they were analyzed throughout no parametric tests, the Chi-square test was used to determine the association between the variables and Odds Ratio; OR≥ 1 was applied to determine the risk factor with regard to the presence of *Cryptosporidium* spp. in feline stools with an alpha of $P \leq 0.05$. Statistic software JMP 8.0. was used for the analysis.

Results

Of 614 examined samples, 319 were positive to *Cryptosporidium* spp. In which the prevalence was estimated in 51.9% for Mexico and for State: State of Mexico 26.2%, Nayarit 100%, Sonora 100%, Jalisco 100%, Oaxaca 50%, San Luis Potosí 78%, Hidalgo 76%, Campeche 29% and CDMX 45.6%. The association and risk factor results show that; the genre does not have association and was not risk factor to present *Cryptosporidium* spp. In stools, the age showed a tendency in association and risk factor (Chi2 = 5.52, $P = 0.06$, OR = 1.41, $P = 0.06$) to the cubs (Table 1), the small size in the felines had association with the presence of *Cryptosporidium* spp. (Chi2 = 5.78, $P = 0.05$), for this variable the value of Odds ratio was less than "1" (OR = 0.68, $P = 0.01$) for which medium-size cats have low probability of presenting *Cryptosporidium* spp. (Table 1), the kind of hair, the breed and body condition did not have association, nor are they considered risk factors.

	Positive n = 309	%	Negative n = 295	%	Chi^2	P	OR	P	IC
Gender									
Female	166	27.04	143	23.29	0.77	0.37	0.86	0.37	0.63-1.19
Male	153	24.92	152	24.76					
Age									
Puppy	90	14.66	64	10.42	5.52	0.06	1.41	0.06	0.98-2.05
Young	53	8.63	41	6.68					
Adult	176	28.66	190	30.94					
Size									
Small	96	15.64	76	12.38	5.78	0.05*			
Medium	149	24.27	166	27.04			0.68	0.01*	0.49-0.93
Large	74	12.05	53	8.63					
Hair type									
Short	248	40.39	233	37.95	0.13	0.70	1.07	0.70	0.73-1.58
Long	71	11.56	62	10.10					
Breed									
Mongrel	298	48.53	279	45.44	0.36	0.54	1.22	0.54	0.62-2.40
Breed	21	3.42	16	2.61					
Corporal condition									
Very thin	53	8.63	40	6.51					
Normal	193	31.43	179	29.15	1.47	0.68	0.99	0.96	0.71-1.37
Overweight	57	9.28	59	9.61					
Obesity	16	2.61	17	2.77					
Chi-square, OR, odds ratio, 95% CI, 95% confidence interval, * Significance.									

Table 1: General characteristics of felines and their association with the presence of *Cryptosporidium* and risk factor.

The origin of the feline did not show association, but the "shopped" cats had (OR = 0.32, *P* = 0.05), for what they have low probability of presenting *Cryptosporidium* spp. in stools. The hunting habits in the felines included in this studio did not have association, nor were they risk factor. Not bathing the cat was associated (Chi2 = 15.51, *P* = 0.001) to be positive to *Cryptosporidium* spp. and was a risk factor (OR = 1.60, *P* = 0.003) (Table 2). The access to the outside did not have association and was not a risk factor. The physical conditions of feline stools (Table 3), the consistency and findings in stools were not associated and were not risk factors.

	Positive n = 309	%	Negative n = 295	%	Chi²	P	OR	P	IC
Source									
Adopted	308	50.16	278	45.28					
Purchased	4	0.65	11	1.79			0.32	0.05*	0.10-1.04
Breeder	7	1.14	6	0.98	3.94	0.13			
Hunt									
Yes	202	32.90	199	32.41					
No	117	19.06	96	15.64	1.15	0.28	0.83	0.28	0.59-1.16
Grooming									
Daily	34	5.54	20	3.26					
Weekly	87	14.17	112	18.24					
Monthly	34	5.54	46	7.49					
Never	164	26.71	117	19.06	15.51	0.001*	1.60	0.003*	1.16-2.21
Access to the outside									
Yes	126	20.52	96	15.64					
No	193	31.43	199	32.41	3.21	0.07	1.35	0.07	0.97-1.88
Chi-square, OR, odds ratio, 95% CI, 95% confidence interval, * Significance									

Table 2: Origin and habits of felines and their association with the presence of Cryptosporidium and risk factor.

	Positive n = 309	%	Negative n = 295	%	Chi²	P	OR	P	IC
Colour									
Yellow	17	2.77	16	2.61	10.63	0.03*	1.96	0.05*	0.97-3.94
Light brown	190	30.94	186	30.29					
Brown	82	13.36	78	12.70					
Black	23	3.75	15	2.44					
Green	7	1.14	0	0					
Consistency									
Firm	285	46.42	258	42.02					
Liquid	34	5.54	37	6.03	0.53	0.46	0.83	0.46	0.50-1.36
Findings									
Mucus	44	7.17	47	7.65					
Parasites	12	1.95	8	1.30					
Blood	8	1.30	8	1.30	1.04	0.78	0.92	0.87	0.34-2.49
Nothing	255	41.53	232	37.79					
Chi-square, OR, odds ratio, 95% CI, 95% confidence interval, * Significance									

Table 3: Characteristics of feline feces and their association with the presence of Cryptosporidium and risk factor.

Discussion

Cryptosporidium spp. is one of the most common intestinal parasites in cats, around the world prevalence rates have been reported, which can vary from 0 to 30% [11], furthermore, it has a high zoonotic transmission potential, that can cause chronic gastrointestinal diseases [12]. In this study, a high prevalence (51.9%) of *Cryptosporidium* spp. was observed in 614 domestic cats, regarding the season in which this research was carried out, in The United Kingdom, a prevalence research was carried out in 1355 cats, were a tendency to detect infections for species of *Cryptosporidium* at the end of fall and beginnings of winter, was observed. The season variability, can be caused by the effect of the weather in the parasite or host physiology, however, the association between prevalence and seasonality has not been studied [13]. Several studies have demonstrated a positive correlation between rain and water-transmitted disease, such is the case of *Cryptosporidium* spp. considered as an important source of infection in recycled water and even in potable water [14]. A study proved the seasonal relationship between cryptosporidiosis, temperature and the first annual peak of raining in tropical humid weather. The meta-analysis of colder weather revealed a slight seasonal peak of cryptosporidiosis in fall, associated with a relatively higher rainfall [15].

There have been reported low prevalence rates of *Cryptosporidium* spp. in cats; Gil., *et al*. [16], reported 3 positive samples (4.6%) of a total of 65 cats in an animal rescue center in Northern Spain without meaningful differences in sex, age, condition or origin, whilst in Central Italy in a cat shelter 2 positive samples were reported out of 132 (1.6%) [17], this could be because of the fact that the sample size is small, and considering that there is a bigger quantity of dogs than cats in shelters [18], which could imply a bias in the epidemiologic information of *Cryptosporidium* spp.

The age and sex in positive to *Cryptosporidium* spp. cats, did not show statistic association. Li., *et al*. [19] reports a study of prevalence in cats from Eastern China and of the 346 examined samples, 47 (13.6%) were positive to *Cryptosporidium* and found predisposition neither for age nor sex. This could be due to proper *Cryptosporidium* spp. biological characteristics, because it alternates the sexual and asexual reproduction and the cycle can be concluded in an only host, the production of oocysts is essential for the transmission and these are unique because they mature inside the host tissue and they are self-infectious, hence they could be able to re-establish the biological cycle and sustain the infection no matter the genre nor the host age [20]. It was noticed that cubs of less than a year tend to have an association and risk factor with the protozoan presence, this data coincided with Rambozzi., *et al*. [21] ($\chi 2 = 6.5$, $P = 0.01$), which could be due to an association between the immune state and the ongoing disease because the cubs have a relatively immature immune system and a lack of immunity for the lack of previous exposition [21,22]. It is known that *Cryptosporidium* spp. has developed evasion mechanisms to the immune response, at least in the early stage of the infection and in spite of the meaningful progress made in the comprehension of the immunity of anti-*Cryptosporidium* spp. mucosa. And the way in which the adaptative immunity is regulated continuous uncertain [23]. In a prevalence study in dogs and cats from Thailand, it was reported that the positive to *Cryptosporidium* spp. animals developed acute diarrhea or antecedents of chronic diarrhea [24], however, in this study, the presence of oocysts in stools was observed in cats which did not present diarrhea, Moreira., *et al*. [25] reports that, out of 128 evaluated dogs and cats, only four stool samples were diarrheic and the presence of *Crypstosporidium* spp. was observed in none of them, so, the cryptosporidiosis epidemiology requires the bonding between environmental factors and even social factors [26].

In this research results, it was observed that the fact of not bathing the cats represents a risk factor to present *Cryptosporidium* spp. in stools. It has been noticed that the infection for mites in the felines is due to the cat's bathing habits, mite eggs are swallowed and thrown away in stools [27], which could have a coincidence with the case of the oocysts of the studied protozoan. In conclusion, there exists a high prevalence (51.9%) of *Cryptosporidium* spp. in domestic cats around Mexico. The risk factor for the presence of the protozoan was not bathing the cat.

Conflicts of Interest

None.

Bibliography

1. Nagamori Y., *et al*. "Retrospective survey of parasitism identified in feces of client-owned cats in North America from 2007 through 2018". *Veterinary Parasitology* 277 (2020): 109008.

2. Šlapeta J. "DNA barcoding of *Cryptosporidium"*. *Parasitology* 145.5 (2018): 574-584.

3. Scorza V and Tangtrongsup S. "Update on the diagnosis and management of *Cryptosporidium* spp. infections in dogs and cats". *Topics in Companion Animal Medicine* 25 (2010): 163-169.

4. Yang R., *et al*. "Molecular characterisation of *Cryptosporidium* and *Giardia* in cats (*Felis catus*) in Western Australia". *Experimental Parasitology* 155 (2012): 13-18.

5. Šlapeta J. "*Cryptosporidium*: Identification and Genetic Typing". *Current Protocols in Microbiology* 44 (2017): 20B.1.1-20B.1.17.

6. Morris A., *et al*. "Direct Sequencing of *Cryptosporidium* in Stool Samples for Public Health". *Frontiers in Public Health* 11. 7 (2019): 360.

7. Gałęcki R and Sokół R. "*Cryptosporidium canis* and *C. felis* as a potential risk to humans". *Polish Journal of Natural Science* 31. 2 (2015): 203-212.

8. Scorza V., *et al*. "*Cryptosporidium felis* in cat feces in the United Kingdom". *The Veterinary Record* 174.24 (2014): 609.

9. Beser J., *et al*. "Possible zoonotic transmission of *Cryptosporidium felis* in a household". *Infection Ecology and Epidemiology* 6 (2015): 28463.

10. Aghamolaie S., *et al*. "Evaluation of modified Ziehl-Neelsen, direct fluorescent-antibody and PCR assay for detection of *Cryptosporidium* spp. in children faecal specimens". *Journal of Parasitic Diseases* 40 (2016): 958-963.

11. Silveira NL., *et al*. "Is cryptosporidiosis an underestimated disease in cats?" *Archivos de Medicina Veterinaria* 47 (2015): 1-6.

12. Ito Y., *et al*. "Molecular prevalence of *Cryptosporidium* species among household cats and pet shop kittens in Japan". *Journal of Feline Medicine and Surgery Open* Reports 19 (2017): 2055116917730719.

13. Tzannes S., *et al*. "Prevalence of *Cryptosporidium*, *Giardia* and *Isospora* species infections in pet cats with clinical signs of gastrointestinal disease". *Journal of Feline Medicine and Surgery* 10 (2008): 1-8.

14. Sterk A., *et al*. "Effect of climate change on runoff of *Campylobacter* and *Cryptosporidium* from land to surface water". *Water Research* 95 (2016): 90-102.

15. Jagai JS., *et al*. "Seasonality of cryptosporidiosis: A meta-analysis approach". *Environmental Research* 109 (2009): 465-478.

16. Gil H., *et al*. "Detection and molecular diversity of *Giardia duodenalis* and *Cryptosporidium* spp. in sheltered dogs and cats in Northern Spain". *Infection Genetic and Evolution* 50 (2017): 62-69.

17. Sauda F., *et al*. "Gastrointestinal parasites in shelter cats of central Italy". *Veterinary Parasitology: Regional Studies and Reports* 18 (2019): 100321.

18. Vojtkovská V., *et al*. "Comparison of Outcome Data for Shelter Dogs and Cats in the Czech Republic". *Animals (Basel)* 9.9 (2019): 595.

19. Li W., *et al*. "Prevalence of *Cryptosporidium*, *Giardia*, *Blastocystis*, and trichomonads in domestic cats in East China". *Journal of Veterinary Medical Science* 81 (2019): 890-896.

20. Tandel J., *et al*. "Life cycle progression and sexual development of the apicomplexan parasite *Cryptosporidium parvum"*. *Nature Microbiology* 4 (2019): 2226-2236.

21. Rambozzi L., *et al*. "Prevalence of cryptosporidian infection in cats in Turin and analysis of risk factors". *Journal of Feline Medicine and Surgery* 9 (2007): 392-396.

22. De Oliveira LF., *et al*. "*Cryptosporidium* species screening using Kinyoun technique in domestic cats with diarrhea". *Journal of Feline Medicine and Surgery* 14 (2012): 113-117.

23. Hu G., *et al*. "Immunology of Cryptosporidiosis. *Cryptosporidium"*. *Journal of Parasitic Diseases* (2014): 423-454.

24. Tangtrongsup S., *et al*. "Seasonal distributions and other risk factors for *Giardia duodenalis* and *Cryptosporidium* spp. infections in dogs and cats in Chiang Mai, Thailand". *Preventive Veterinary Medicine.* 174 (2020): 104820.

25. Moreira A., *et al*. "Risk factors and infection due to *Cryptosporidium* spp. in dogs and cats in southern Rio Grande do Sul". *Revista Brasileira de Parasitologia Veterinaria* 27. 1 (2018): 112-117.

26. Lal A., *et al*. "Potential effects of global environmental changes on cryptosporidiosis and giardiasis transmission. *Trends in Parasitology* 29 (2013): 83-90.

27. Khalafalla RE. "A Survey Study on Gastrointestinal Parasites of Stray Cats in Northern Region of Nile Delta, Egypt". *PLoS One* 6 (2011): e20283.