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Risk factors associated with cat parasites in a feline medical center

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Abstract

Objectives The present study was carried out to evaluate the risk factors for and presence of intestinal parasites in cats at the feline hospital 'CEME Gatos', Mexico City.

Methods In total, 528 fecal samples from domestic cats were collected and analyzed in order to diagnose enteroparasites.

Results The parasite with the highest prevalence was *Giardia* species (21.97%), followed by *Cryptosporidium* species (7%), *Toxocara cati* (6.45%), *Cystoisospora* species (5.11%) and *Dipylidium caninum* (0.76%). One hundred and twenty-one cats (55.50%) were infected with a single parasite, 80 (36.69%) were infected with two and 17 (14.04%) were infected with three parasites. The results of the prevalence study showed that a liquid consistency of feces was associated with the presence of *Giardia* species, whereas age <7 months and mucus in the stool were factors associated with the prevalence of *Cystoisospora* species. Regarding *T cati*, the associated risk factors were age <7 months, being male, contact with other animal species and access to the outdoors. The last factor was strongly associated with the presence of *T cati* (eight times more likely) in outdoor cats' feces. Brushing frequency was also an associated factor: *T cati* was present in cats that were never brushed. The results of the analysis of cats infected with *D caninum* showed that interaction with other species was a risk factor for infection.

Conclusions and relevance Age <7 months, mucus in feces, living with other animal species, outdoor access and frequency of brushing are risk factors for the presence of parasites.

Keywords: Intestinal parasites; diarrhea; domestic cat; risk factor

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Introduction

Domestic cats (*Felis catus*) have become a popular pet worldwide,[1] and despite the numerous advantages of having a pet, the close contact between pet cats and humans can pose a risk, as cats are definitive hosts for a large number of parasites, some of which cause important zoonoses.[2] For example, *Toxocara* species have been identified as the cause of a parasitic zoonosis of global public health relevance associated with eye ailments and cognitive delays in children.[2] Additionally, *Giardia* species in cats have a zoonotic potential because cats can harbor zoonotic genotypes (assemblages A and B).[3] However, although the risk of *Dipylidium caninum* infection in humans is low, due to their play habits and proximity to domestic cats, *D caninum* can affect infants and young children.[1] Another parasite of public health importance is *Cryptosporidium* species;

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diarrhea is the main clinical sign of cryptosporidiosis. Humans can acquire this pathogen through contact with infected animals, or via the consumption of contaminated food or water.[4] *Cystoisospora* species are a protozoan parasite of the coccidia group; they are strictly host-specific and have a worldwide distribution.[5] This parasite does not cause zoonotic problems, as cats are definitive hosts of *Cystoisospora* species. However, diagnosis is important as infection produces watery diarrhea (sometimes accompanied by blood), vomiting, anorexia and dehydration. It can cause death in immunosuppressed cats and puppies.[6,7] Therefore, the objective of this study was to analyze the risk factors and presence of intestinal parasites in cats that attended medical examinations at the feline hospital 'CEME Gatos' in Mexico City, Mexico.

Materials and methods

In this study, we included 528 fecal samples from domestic cats attending medical examinations. These were analyzed using four specific techniques to detect protozoa, nematodes, trematodes and cestodes. Feline sex, age, habits, origin, characteristics of the feces and frequency of hair brushing were considered as explanatory variables. All the owners who agreed to participate signed an informed consent form. Additionally, as part of the study, cat owners answered a questionnaire about epidemiological data and risk factors for the presence of parasites.

The fecal samples were collected in polyethylene bags directly from the litter box and subsequently processed in the laboratory of the Medical Center for Cats ('Centro Médico para Gatos'), in Mexico City. Additionally, for the Graham test, the samples were collected from the perianal area of the patients using adhesive tape. A total of 6 g of feces were collected. Fecal matter from each individual was divided into samples to be used in different tests. Three grams of feces were processed using the following techniques: direct wet mount for the detection of *Giardia* species; Faust centrifugal flotation for the detection of nematodes and protozoa; Scotch tape or Graham's test for the detection of cestodes; and the Kinyoun stain technique for the detection of *Cryptosporidium* species. All fecal samples were analyzed individually by the direct wet mount technique with and without staining (Lugol).[8–10] When performing a Graham's test, we used adhesive tape (Scotch tape) to collect the samples from the perianal area of the cat.[11] When performing the Faust centrifugal flotation technique (also known as zinc sulfate flotation technique), we emulsified 1 g of feces in water and filtered the emulsion to remove fecal debris. Next, we centrifuged the filtrate to obtain a sediment, which was suspended in 4 ml of $ZnSO_4$ solution (1:200 dilution). The suspension was allowed to settle for 30 mins. A coverslip was placed on top of the tube to collect the eggs/larvae, which were transferred to a glass slide for microscopic examination.[12] The samples were also analyzed with the modified Kinyoun acid-fast stain for the detection of oocysts of *Cryptosporidium* species.[13] The fecal samples were carefully examined in an optical binocular bright field microscope at ×4, ×10, ×40 and ×100 magnifications. The observation was made field by field in each slide. The samples were classified as positive when at least one parasitic form was observed. Any parasitic stage was identified using the previously described morphologic characteristics.[14]

Statistical analysis

The explanatory variables considered were age (<7 months old, 7.1–13 months old, >13.1 months old), sex (female/male), interaction with other cats (yes/no), interaction with other animal species (yes/no), outdoor access (yes/no), brushing frequency (daily, weekly, monthly, never), cat's origin (shelter vs breeder), hair type (long vs short) and cat size (small, medium or large). Some characteristics of the stool samples were also considered as explanatory variables: color (yellow, brown, dark brown and green), consistency (liquid, firm, hard and dry) and the presence of mucus, blood and macroscopic parasites such as nematodes or proglottids of cestodes. The variables of this study were categorical; therefore, they were analyzed using non-parametric tests. A χ^2 test was performed to determine the association between each variable and the presence of each parasitic taxon, using an odds ratio of $\geqslant 1$ and an alpha of $P \leqslant 0.05$ to determine the risk factor for the presence of gastrointestinal (GI) parasites in feline feces. Statistical software (JMP 8.0) was used for the analysis.

Results

In total, 528 cat feces samples were analyzed (271 from females and 257 males). Cats were aged from 1 month to 18 years old; the average age was 3.5 years. The prevalence of gastroenteric parasites was 41.29% (218 positive and 310 negative). *Giardia* species were the parasite with the greatest prevalence, followed by *Cryptosporidium* species, *Toxocara cati*, *Cystoisospora* species and *D caninum* (Table 1). In total, 121 of the infected cats (55.50%) had a single parasite infection, 80 (36.69%) had two-parasite infections and 17 (14.04%) had three-parasite infections. The parasite combinations most frequently found in the samples were *Giardia* species/*Cystoisospora*

Table 1 Prevalence of parasites in domestic cats

Parasite	Positive cats (n = 528)
Cryptosporidium species	37 (7.00)
Cystoisospora species	27 (5.11)
Dipylidium caninum	4 (0.76)
Giardia species	116 (21.97)
Toxocara cati	34 (6.45)
Total positive	218 (41.29)
Number of parasites detected	310 (58.71)

Data are n (%)

Table 2 Prevalence of and risk factors for *Giardia* species in cats

	Positive (n = 116)	Negative (n = 412)	χ^2	*P* value	OR	*P* value	CI
Age (months)							
<7	32 (6.06)	90 (17.0)	2.14	0.36	–	–	–
7.1–13	15 (2.84)	49 (9.2)					
>13.1	69 (13.07)	273 (51.70)					
Sex							
Female	51 (9.66)	220 (41.67)					
Male	65 (12.31)	192 (36.36)	3.22	0.07	0.68	0.07	0.452–1.03
Interaction with other cats							
Yes	82 (15.53)	287 (54.36)	0.46	0.83	0.95	0.83	0.60–1.49
No	34 (6.44)	125 (23.67)					
Interaction with other animals							
Yes	30 (5.68)	105 (19.89)	0.007	0.93	0.98	0.93	0.61–1.57
No	86 (16.29)	307 (58.14)					
Outdoor access							
Yes	22 (4.17)	73 (13.83)	0.095	0.75	0.92	0.75	0.54–1.56
No	94 (17.80)	339 (64.20)					
Brushing							
Daily	15 (2.84)	59 (11.17)					
Weekly	47 (8.90)	139 (26.33)					
Monthly	18 (3.41)	72 (13.64)					
Never	36 (6.82)	142 (26.89)	1.82	0.60	–	–	–
Origin							
Adopted	108 (20.45)	392 (74.24)					
Cat breeder	8 (1.52)	20 (3.79)	0.75	0.38	0.68	0.38	0.29–1.60
Hair type							
Long	32 (6.06)	92 (17.42)	1.39	0.23	1.32	0.75	0.47–1.20
Short	84 (15.91)	320 (60.61)					
Size							
Large	18 (3.41)	76 (14.39)	0.53	0.46	0.81	0.46	1.18–3.11
Medium	98 (18.56)	336 (63.64)					
Small	0	0					
Characteristics of feces							
Color							
Yellow	7 (1.33)	10 (1.89)	4.83	0.18	1.99	0.16	0.74–5.33
Brown	101 (19.13)	375 (71.02)					
Dark	6 (1.14)	24 (4.55)					
Green	2 (0.38)	3 (0.57)					
Consistency							
Liquid	28 (5.30)	34 (6.44)	40.71	<0.0001	–	–	–
Soft	29 (5.49)	55 (10.42)					
Hard and dry	3 (0.57)	54 (10.23)					
Firm	56 (10.61)	269 (50.95)					
Findings							
Mucus	21 (3.98)	48 (9.09)					
Parasites	2 (0.38)	7 (1.33)	4.95	0.17	–	–	–
Blood	4 (0.76)	7 (1.33)					
No findings	89 (16.86)	350 (66.29)					

Data are n (%) unless otherwise indicated
OR = odds ratio; CI = confidence interval

species or *Giardia* species/*Cryptosporidium* species, followed by *Giardia* species/*T cati* and *T cati/D caninum*.

We analyzed the association between the presence of GI parasites and risk factors. Table 2 shows the results for the prevalence of *Giardia* species. Liquid consistency of feces was a factor associated with the presence of *Giardia* species ($\chi^2 = 40.71$, $P < 0.0001$). The presence of other parasites in the feces was not associated with *Giardia* species.

Table 3 Prevalence of and risk factors for *Cystoisospora* species in cats

	Positive (n = 27)	Negative (n = 501)	χ^2	*P* value	OR	*P* value	CI
Age (months)							
<7	14 (2.65)	108 (20.45)	14.68	0.0006	–	–	–
7.1–13	4 (0.76)	60 (11.36)					
>13.1	9 (1.70)	333 (63.07)					
Gender							
Female	16 (3.03)	255 (48.30)					
Male	11 (2.08)	246 (46.59)	0.71	0.39	1.40	0.39	0.63–3.08
Interaction with other cats							
Yes	17 (3.22)	352 (66.67)	0.64	0.42	1.38	0.64	0.62–3.10
No	10 (1.89)	149 (28.22)					
Interaction with other animals							
Yes	5 (0.95)	130 (24.62)	0.74	0.38	1.54	0.38	0.57–4.15
No	22 (4.17)	371 (70.27)					
Outdoor access							
Yes	4 (0.76)	91 (17.23)	0.195	0.65	1.27	0.65	0.43–3.77
No	23 (4.36)	410 (77.65)					
Brushing							
Daily	2 (0.38)	72 (13.64)					
Weekly	7 (1.33)	179 (33.90)					
Monthly	7 (1.33)	83 (15.72)	3.31	0.34	–	–	–
Never	11 (2.08)	167 (31.63)					
Origin							
Adopted	27 (5.11)	473 (89.58)					
Cat breeder	0 (0)	28 (5.30)	1.59	0.20	–	–	–
Hair type							
Long	6 (1.14)	118 (22.35)	0.02	0.87	1.07	0.87	0.42–2.73
Short	21 (3.98)	383 (72.54)					
Size							
Large	3 (0.57)	91 (17.23)	0.87	0.35	0.56	0.35	0.16–1.91
Medium	24 (4.55)	410 (77.65)					
Small	0 (0)	0 (0)					
Characteristics of feces							
Color							
Yellow	2 (0.38)	15 (2.84)	3.53	0.31	–	–	–
Brown	22 (4.17)	454 (85.98)					
Dark	3 (0.57)	27 (5.11)					
Green	0 (0.38)	5 (0.95)					
Consistency							
Liquid	3 (0.57)	59 (11.17)					
Soft	7 (1.33)	77 (14.58)	3.06	0.38	–	–	–
Hard and dry	4 (0.76)	53 (10.04)					
Firm	13 (2.46)	312 (59.09)					
Findings							
Mucus	9 (1.70)	60 (11.36)	11.92	0.007	–	–	–
Parasites	1 (0.19)	8 (1.52)					
Blood	1 (0.19)	10 (1.8)					
No findings	16 (3.03)	4.23 (80.11)					

Data are n (%) unless otherwised indicated
OR = odds ratio; CI = confidence interval

Table 3 shows the results of association between *Cystoisospora* species and risk factors. Age <7 months was a factor associated with the prevalence of *Cystoisospora* species ($\chi^2 = 14.68$, $P = 0.0006$). Mucus in the stool was also associated with the presence of *Cystoisospora* species.

Table 4 Prevalence of and risk factors for *Cryptosporidium* species in cats

	Positive (n = 37)	Negative (n = 491)	χ^2	*P* value	OR	*P* value	CI
Age (months)							
<7	8 (1.52)	114 (21.59)	0.142	0.93	–	–	–
7.1–13	4 (0.76)	60 (11.36)					
>13.1	25 (4.73)	317 (60.04)					
Sex							
Female	20 (3.79)	251 (47.54)					
Male	17 (3.22)	240 (45.45)	0.119	0.73	1.12	0.73	0.57–2.19
Interaction with other cats							
Yes	24 (4.55)	345 (65.34)	0.47	0.48	1.27	0.48	0.63–2.58
No	13 (2.46)	146 (27.65)					
Interaction with other animals							
Yes	11 (2.08)	124 (23.48)	0.36	0.54	0.79	0.54	0.38–1.66
No	26 (4.92)	367 (69.51)					
Outdoor access							
Yes	7 (1.33)	88 (16.67)	0.02	0.87	0.93	0.87	0.39–2.19
No	30 (5.68)	403 (76.33)					
Brushing							
Daily	10 (1.89)	64 (12.12)					
Weekly	6 (1.14)	180 (34.09)					
Monthly	4 (0.76)	86 (16.29)	11.56	0.009	–	–	–
Never	17 (3.22)	161 (30.4)					
Origin							
Adopted	37 (5.11)	463 (87.69)					
Cat breeder	0 (0)	28 (5.30)	2.22	0.13	–	–	–
Hair type							
Long	10 (1.89)	114 (21.59)	0.27	0.59	0.81	0.59	0.38–1.73
Short	27 (5.11)	377 (71.40)					
Size							
Large	5 (0.95)	89 (16.86)	0.50	0.47	0.70	0.47	0.26–1.86
Medium	32 (6.06)	402 (76.14)					
Small	0 (0)	0 (0)					
Characteristics of feces							
Color							
Yellow	0 (0)	17 (3.22)	1.75	0.62	1.99	0.16	0.74–5.33
Brown	35 (6.63)	441 (83.52)					
Dark	2 (0.38)	28 (5.30)					
Green	0 (0)	5 (0.95)					
Consistency							
Liquid	3 (0.57)	59 (11.17)	3.70	0.29	–	–	–
Soft	6 (1.14)	78 (14.77)					
Hard and dry	1 (0.19)	56 (10.61)					
Firm	27 (5.11)	298 (56.44)					
Findings							
Mucus	3 (0.57)	66 (12.50)					
Parasites	1 (0.19)	8 (1.52)	1.10	0.77	–	–	–
Blood	1 (0.19)	10 (1.89)					
No findings	32 (6.06)	407 (77.08)					

Data are n (%) unless otherwise indicated
OR = odds ratio; CI = confidence interval

Brushing frequency was associated with the prevalence of *Cryptosporidium* species ($\chi^2 = 11.56$, $P = 0.009$) (Table 4).

Table 5 shows the risk factors associated with *T cati* infection in cats. Age <7 months was a factor associated with the prevalence of *T cati* ($\chi^2 = 35.37$, $P = <0.0001$). Sex was a risk factor: males were more prone to infection ($\chi^2 = 5.39$ [$P = 0.02$]; odds ratio [OR] 0.41 [$P = 0.02$]). Contact with other animals was strongly associated with parasite prevalence ($\chi^2 = 17.54$ [$P < 0.0001$]; OR 4.12 [*P*

Table 5 Prevalence of and risk factors for *Toxocara* species in cats

	Positive (n = 34)	Negative (n = 494)	χ^2	*P* value	OR	*P* value	CI
Age							
<7	21 (3.98)	101 (19.13)	35.37	<0.0001	–	–	–
7.1– 13	6 (1.14)	58 (10.98)					
>13.1	7 (1.33)	335 (63.45)					
Sex							
Female	24 (4.55)	247 (46.78)					
Male	10 (1.89)	247 (46.78)	5.39	0.02	0.41	0.02	0.19–0.88
Interaction with other cats							
Yes	23 (4.36)	346 (65.53)	0.08	0.76	0.89	0.76	0.42–1.88
No	11 (2.08)	148 (28.03)					
Interaction with other animals							
Yes	19 (3.60)	116 (21.97)	17.54	<0.0001	4.12	<0.0001	2.03–8.38
No	15 (2.84)	378 (71.59)					
Outdoor access							
Yes	20 (3.79)	75 (14.20)	41.06	<0.0001	7.98	<0.0001	3.86–16.49
No	14 (2.65)	419 (79.36)					
Brushing							
Daily	0 (0)	74 (14.02)					
Weekly	7 (1.33)	179 (33.90)					
Monthly	3 (0.57)	87 (16.48)					
Never	24 (4.55)	154 (29.17)	23.40	<0.0001	–	–	–
Origin							
Adopted	37 (5.11)	463 (87.69)					
Cat breeder	0 (0)	28 (5.30)	2.22	0.13	–	–	–
Hair type							
Long	10 (1.89)	114 (21.59)	0.27	0.59	0.81	0.59	0.38–1.73
Short	27 (5.11)	377 (71.40)					
Size							
Large	5 (0.95)	89 (16.86)	0.50	0.47	0.70	0.47	0.26–1.86
Medium	32 (6.06)	402 (76.14)					
Small	0 (0)	0 (0)					
Characteristics of feces							
Color							
Yellow	0 (0)	17 (3.22)	1.75	0.62	1.99	0.16	0.74–5.33
Brown	35 (6.63)	441 (83.52)					
Dark	2 (0.38)	28 (5.30)					
Green	0 (0)	5 (0.95)					
Consistency							
Liquid	6 (1.14)	56 (10.61)					
Soft	9 (1.70)	75 (14.20)	5.22	0.15	–	–	–
Hard and dry	2 (0.38)	55 (10.42)					
Firm	17 (3.22)	308 (58.33)					
Findings							
Mucus	3 (0.57)	66 (12.50)					
Parasites	1 (0.19)	8 (1.52)	1.10	0.77	–	–	–
Blood	1 (0.19)	10 (1.89)					
No findings	32 (6.06)	407 (77.08)					

Data are n (%) unless otherwise stated
OR = odds ratio; CI = confidence interval

<0.0001]). Outdoor access was also a risk factor: cats with access to the outdoors were eight times more likely to be infected with *T cati* ($\chi^2 = 41.06$ [P <0.0001]; OR 7.98 [P <0.0001]). Brushing frequency was also a risk factor; lack of brushing was associated with the prevalence of *T cati* ($\chi^2 = 23.40$; P <0.0001).

Table 6 shows the results of the analysis performed on cats infected with *D caninum*. Interaction with other

Table 6 Prevalence of and risk factors for *Dipylidium caninum* species in cats

	Positive (n = 4)	Negative (n = 524)	χ^2	*P* value	OR	*P* value	CI
Age							
<7	2 (0.38)	120 (22.73)	1.88	0.38	–	–	–
7.1–13	0 (0)	64 (12.12)					
>13.1	2 (0.38)	340 (64.39)					
Sex							
Female	2 (0.38)	269 (50.95)					
Male	2 (0.38)	255 (48.30)	0.003	0.95	0.94	0.95	0.13–6.78
Interaction with other cats							
Yes	4 (0.76)	365 (69.13)	1.73	0.18	–	–	–
No	0 (0)	159 (30.11)					
Interaction with other animals							
Yes	3 (0.57)	132 (25.00)	5.17	0.02	0.11	0.02	0.01–1.08
No	1 (0.19)	392 (74.24)					
Outdoor access							
Yes	1 (0.19)	94 (17.80)	0.13	0.71	0.65	0.71	0.06–6.37
No	3 (0.57)	430 (81.44)					
Brushing							
Daily	0 (0)	74 (14.02)					
Weekly	0 (0)	186 (35.23)					
Monthly	1 (0.19)	89 (16.86)					
Never	3 (0.57)	175 (33.14)	4.17	0.24	–	–	–
Origin							
Adopted	4 (0.76)	496 (93.94)					
Cat breeder	0 (0)	28 (5.30)	0.22	0.63	–	–	–
Hair type							
Long	0 (0)	124 (23.48)	1.23	0.26	–	–	–
Short	4 (0.76)	400 (75.76)					
Size							
Large	0 (0)	94 (17.80)	0.87	0.35	–	–	–
Medium	4 (0.76)	430 (81.44)					
Small	0 (0)	0 (0)					
Characteristics of feces							
Color							
Yellow	0 (0)	17 (3.22)	0.44	0.93	1.99	0.16	0.74–5.33
Brown	4 (0.76)	472 (89.39)					
Dark	0 (0)	30 (5.68)					
Green	0 (0)	5 (0.95)					
Consistency							
Liquid	0 (0)	62 (11.74)					
Soft	2 (0.38)	82 (15.53)	3.94	0.26	–	–	–
Hard and dry	0 (0)	57 (10.80)					
Firm	2 (0.38)	323 (61.17)					
Findings							
Mucus	1 (0.19)	68 (12.88)					
Parasites	0 (0)	9 (1.70)	0.62	0.89	–	–	–
Blood	0 (0)	11 (2.08)					
No findings	3 (0.57)	436 (82.58)					

Data are n (%) unless otherwise stated
OR = odds ratio; CI = confidence interval

animal species was associated with infection ($\chi^2 = 5.17$ [$P = 0.02$]; OR 0.11 [$P = 0.02$]).

Discussion

Overall, the prevalence of gastroenteric parasites was 41.29%. In this study, the parasite with the highest prevalence was *Giardia* species followed by *Cryptosporidium* species, *T cati*, *Cystoisospora* species and *D caninum*. These results coincide with the results of a similar scope study conducted in Poland,[15,16] which showed that *Giardia* species are the most common parasites in cats. Nevertheless, our results differ from the results of Little

et al,[17] which indicated that *T cati* is the most common parasite (found in up to 40% of the total study population). Other studies argue that *Giardia* species are the most common parasite detected in cat and dog populations, followed by a significant prevalence of ascarid, hookworm and tapeworm infections.[18]

The results of our study on parasitic infection and associated risk factors showed that liquid feces were associated with the presence of *Giardia* species. This is an indicator mentioned by other researchers. For example, Gruffydd et al[19] stated that diarrhea or liquid stools, along with mucus/blood, are the main clinical signs to diagnose giardiasis.

Finding mucus in the stool was also associated with the presence of *Cystoisospora* species. Schuster et al,[3] reported a higher prevalence of this parasite in young cats vs adult cats and age as the only factors associated with prevalence. Unlike Schuster et al,[3] our results show that the prevalence of *Cryptosporidium* species in young cats was associated with infrequent brushing (less than once a month) and not only with age; this might be because at a young age the kitten does not frequently groom and has an immature immune system. *Cystoisospora* species infections can also occur via ingestion of sporulated oocysts present in the environment and can occur at any age and in different parasite life stages, including residual infection or infections in clowders of cats.[19–21]

Regarding the presence of *T cati*, we found that age (<7 months) is associated with infection. This is in contrast with Szwabe and Błaszkowska,[22] who reported more infections in cats older than 12 months of age (17.7%) than in animals aged <12 months (10.3%). Contact with other animals was strongly associated with the presence of parasites. Access to the outdoors was highly associated with the presence of parasites; this could be related to the predatory lifestyle of cats with access to the outdoors and their consumption of rodents and birds, which can act as transporters of *T cati*.[23,24] Brushing frequency was also associated with *T cati*. There was a high prevalence of *T cati* in cats that were never brushed. This result is similar to that reported by Keegan and Holland.[25] Keegan and Holland's study showed an association between the cat's lack of grooming and the presence of *T cati* eggs.

Our study showed that interaction with other species was a risk factor for infection with *D caninum*. It has recently been reported that the *Dipylidium* species found in dogs and cats are probably different, suggesting that cats could be infected by parasite species affecting dogs.[26]

Conclusions

In domestic cats, age, mucus in feces, living with other species, outdoor access and brushing frequency are risk factors for the presence of parasites such as *Giardia* species, *Cryptosporidium* species, *T cati*, *Cystoisospora* species and *D caninum*.

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Ethical approval This study only involved the use of non-experimental animals, including owned or unowned animals and data from prospective or retrospective studies. We followed the established internationally recognized high standards ('best practice') of individual veterinary clinical patient care. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*.

Informed consent Informed consent (either verbal or written) was obtained from the owner or legal custodian of all animal(s) studied in this work (either experimental or non-experimental animals) for the procedure(s) undertaken (either prospective or retrospective studies). For any animals or humans individually identifiable within this publication, informed consent (either verbal or written) for their use in the publication was obtained from the people involved.

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