

# Socioeconomic profile, animal care, sanitary practices, and knowledge about parasites among owners of domestic dogs and cats treated in Rio de Janeiro city

Perfil socioeconômico, cuidados com animais, práticas sanitárias e conhecimento sobre parasitoses entre proprietários de cães e gatos domésticos atendidos na cidade do Rio de Janeiro

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## Abstract

Urban canine and feline populations are expanding worldwide, a fact that can boost the transmission of zoonotic parasites. Thus, it is necessary understanding dog and cat owners' profile, as well as their perceptions about zoonoses, to develop preventive strategies based on the One Health approach. The aim of the current study is to compare the profile of dog and cat owners, whose domestic pets were treated at Jorge Vaitsman Veterinary Medicine Center, Rio de Janeiro, Brazil. Dog and cat owners, whose domestic pets were treated in the routine service of the aforementioned medical clinic, from August 2017 to November 2018, filled a structured questionnaire comprising closed questions in order to collect information about their socioeconomic profile, hygiene habits, animal care and knowledge about parasites. Comparative analysis was applied to data collected from dog and cat owners, based on using Fischer's Exact Test or Pearson's Chi-square. In total, 350 individuals - 244 dog owners and 106 cat owners - filled the questionnaire. The comparative analysis of socioeconomic profile, animal care, sanitary practices and knowledge about parasites did not show differences between dog and cat owners ( $p \geq 0.05$ ). Animal vaccination and deworming practices were significantly more prevalent among dog owners than among cat owners ( $p \leq 0.05$ ). Overall, respondents have shown lack of knowledge about parasitic zoonoses. Results in the current study have evidenced the need of mediating and promoting information about potentially zoonotic parasitic agents among domestic pet owners, as well as the key role played by veterinarians as mediators of primary prevention measures against these agents.

**Keywords:** knowledge, parasitic zoonoses, companion animals.

## Resumo

As populações urbanas de cães e gatos estão em expansão, o que pode facilitar a transmissão de parasitas zoonóticos. Nesse sentido, é necessário conhecer o perfil dos donos de cães e gatos e suas percepções sobre zoonoses para construir estratégias preventivas em uma abordagem em Saúde Única. Este estudo teve



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como objetivo comparar o perfil dos donos de cães e gatos atendidos no Centro de Medicina Veterinária Jorge Vaitsman, Rio de Janeiro, Brasil. Entre agosto de 2017 e novembro de 2018, proprietários de cães e gatos atendidos na rotina da clínica médica responderam a um questionário estruturado composto por questões fechadas relacionadas ao seu perfil socioeconômico, hábitos de higiene, cuidados com os animais e conhecimento sobre parasitas. A análise comparativa dos dados obtidos de proprietários de cães e gatos foi realizada por meio do Teste Exato de Fischer ou Qui-quadrado de Pearson. No total, 350 indivíduos responderam ao questionário, sendo 244 donos de cães e 106 donos de gatos. A análise comparativa do perfil socioeconômico, cuidados com os animais, práticas sanitárias e conhecimento sobre parasitos não mostrou diferenças entre proprietários de cães e gatos ( $p \geq 0,05$ ). As práticas de vacinação e desparasitação dos animais foram significativamente mais frequentes entre os donos de cães do que entre os donos de gatos ( $p \leq 0,05$ ). De maneira geral, foi possível evidenciar entre as respostas recuperadas um desconhecimento sobre zoonoses parasitárias. Os resultados obtidos evidenciam a necessidade de mediação e divulgação de informações sobre agentes parasitários potencialmente zoonóticos para os proprietários, destacando os veterinários, no papel de mediadores das medidas de prevenção primária contra esses agentes.

**Palavras-chave:** conhecimento, zoonoses parasitárias, animais de companhia.

## Introduction

The beginning of the human-animal relationship dates back to primitive times, when this interaction type, which nowadays is mainly featured by the owner-pet binomial, emerged. Benefits of coexisting with animals, mainly with dogs and cats, have been reported in several studies conducted with different animal groups. McNicholas and Collis (2001) have attributed to dogs and cats the role of comfort, trust and emotional support promoters for children living in the UK. Elderly people, in their turn, see their pets as family members; this affinity helps minimizing feelings, such as lack of affection, and avoiding severe psychological disorders (Costa et al., 2009). The social distancing imposed by the Sars-CoV-2 pandemic has often turned dogs and cats into the only constant companions in their owners' lives. Giumelli and Santos (2016) identified positive aspects in young Brazilian university students' relationship with their pets such as feelings of responsibility, love and affection, as well as negative aspects associated with illness and death.

However, humans' closer coexistence with dogs and cats can increase the risk of transmitting zoonotic parasitic infections between these animals and their owners. Zoonoses comprise a set of diseases and infections naturally transmitted among vertebrate animals (Jaffry et al., 2009). Based on the variety of parasites with zoonotic potential to infect domestic dogs and cats, one can infer that these animals take prominent position in these infections' epidemiological chain, since they can contaminate the environment with parasitic structures observed in their feces (Robertson & Thompson, 2002). Parasitic zoonoses have significant impact on human and animal populations, mainly in developing countries such as Brazil (Dantas-Torres & Otranto, 2014). The living conditions in these locations favor the exposure of human populations, among other animal species, to certain parasites, whose transmission takes place under precarious sanitary and housing conditions, as well as in places where inequality in access to education and primary health care services prevails (Dantas-Torres & Otranto, 2014).

Overall, parasitological surveys have shown varied frequency of infections caused by zoonotic parasites in dog and cat populations living in Rio de Janeiro. Parasites with zoonotic potential, such as *Toxocara* sp., hookworms, *Dypilidium caninum*, *Giardia duodenalis*, *Cryptosporidium* spp. and *Toxoplasma gondii*, stand out among the ones identified in these animals (Arruda et al., 2021a, b; Balassiano et al., 2009; Bastos et al., 2014; Cunha et al., 2016; Leal et al., 2015; Ramos et al., 2020). Owners' lack of knowledge about parasites may be one of the factors contributing to animal infections and to parasites' permanence in the environment. With respect to pet animals, mainly to dogs and cats, it is necessary understanding pet owners' perception about zoonotic parasites to help developing preventive strategies focused on promoting public and animal health, with emphasis on the One Health approach. This concept comprises transdisciplinary and multi-sectoral collaborative actions aimed at reaching better health levels by better understanding the connection among humans, animals and the environment (Centers for Diseases Control and Prevention, 2022).

Studies carried out in Brazil and abroad have indicated variations in dog and cat owners' knowledge and perception about zoonoses, responsible ownership and animal vaccination

(Oliveira-Neto et al., 2018; Suhett et al., 2013; Tome et al., 2010). Factors, such as schooling, gender, family income and geographic location of the assessed populations, can contribute to these variations (Oliveira-Neto et al., 2018; Suhett et al., 2013). Thus, it is necessary taking actions to raise awareness and to sensitize owners about prevention and control measures associated with these diseases to help reducing the risk of zoonotic agents' transmission between humans and their companion animals.

Based on Rio de Janeiro Municipal Health Department Resolution n. 3784, from August 21<sup>th</sup>, 2018, which establishes the compulsory notification about zoonoses in animals living in the city (Secretaria Municipal de Saúde do Município do Rio de Janeiro, 2018), as well as about increase in the population of companion animals living in large urban centers, the aim of the current study was to analyze the socioeconomic profile, sanitary practices, animal care, and knowledge about parasites and zoonotic disease transmission of domestic dog and cat owners, whose pets were treated at Jorge Vaitsman Municipal Veterinary Medicine Center, Rio de Janeiro, Brazil.

## Materials and methods

### Ethical considerations

The current research was approved by the Human Research Ethics Committee of Oswaldo Cruz Institute/Fiocruz project CAAE: 67408817.9.0000.5248, under approval number 2,054,938; as well as by the Scientific Committee of the Secretariat for Surveillance, Sanitary Inspection and Zoonosis Control of Rio de Janeiro City, under license 001/17.

### Study site and population

Jorge Vaitsman Municipal Veterinary Medicine Center (CJV) is located in São Cristóvão neighborhood, Northern Rio de Janeiro City; it is a reference center in the epidemiological surveillance and control of zoonoses of public health importance. The aforementioned Institution offers a wide variety of veterinary services, either free of charge or at popular prices, to Rio de Janeiro State' population; among them, one finds clinical care for animals, mainly for dogs and cats, surgical procedures, diagnostic tests and vaccinations.

Cross-sectional study was carried out with domestic dog and cat owners, whose pets were treated in the routine service of CJV veterinary medical clinic, from August 2017 to November 2018. Sample size was previously calculated by taking into consideration the frequency of intestinal parasitism cases observed in dogs and cats treated at CJV: 11% and 24%, respectively (Arruda et al., 2021a). The predicted total number of owners included in the study was 430 participants, 150 dog owners and 280 cat owners, at 95% confidence level. However, only dog and cat owners, whose animals were referred to biological sample collection at CJV, and who accepted to participate in the study, were included in it.

### Sensitization and epidemiological questionnaire

Owners who agreed to participate in the study were informed about the research purpose, as well as assured about the confidentiality of their identity and that of their animals, and of any other collected data. Then, they were handled a Free and Informed Consent Term (FICT) written in clear and objective language, which described all research stages; this document was signed by the owner, a witness, and by the researcher in charge of the study. Three signed FICT copies of equal content were produced: one was handled to the pet owner; one remained at CJV and the last one was handled to the Laboratory of Toxoplasmosis and other Protozoan Diseases-LabTOXO (IOC/Fiocruz).

A structured questionnaire comprising closed questions about owners' socioeconomic profile (gender, age group, family income, schooling, employment status, basic sanitation, garbage collection, whether participants lived near a forested area, a river or stream), animal care (animal vaccination, vaccines applied to dogs and cats, regular veterinary care provided to animals, deworming), hygiene habits (washing fruits and vegetables before eating them, drinking water type, eating raw or undercooked meat, walking barefoot, dog and cat feces disposal, proximity and other animal species coexisting with dogs and cats) was applied to participants. Moreover,

their knowledge about parasites and zoonotic transmission was evaluated through questions, such as: "It is important not to catch worms because...", "Where do you think worms live in the body?", "Have you ever heard of...", "How do worms "enter" people's bodies?", "Do you think humans can transmit worms to their animals?", "Do you think animals can transmit worms to humans?", "What could be done if you, someone in your household, or your pet was suspected of having worms?", "Do you believe your pet has worms when it rubs its rear along the floor?". The questionnaire was applied and completed by the group of researchers, during interviews carried out with animal owners in a private room. It is worth mentioning that the questionnaires applied to owners who refused to answer one, or more, questions were not excluded from the study in order to maximize sample size.

### Statistical analysis

Collected data were stored in Microsoft Excel®, 2013 spreadsheets for later absolute and relative frequencies' calculation. Statistical analysis was performed in the free Epi Info 7.2 software ([https://www.cdc.gov/epiinfo/por/pt\\_pc.html](https://www.cdc.gov/epiinfo/por/pt_pc.html)). Pearson's Chi-square ( $\chi^2$ ) test or Fisher's Exact Test was performed, at 5% significance level, to investigate association between owner type and answers.

### Results

In total, 350 individuals answered the epidemiological questionnaire: 244 were dog owners and 106, cat owners. Table 1 presents the comparative analysis applied to the socioeconomic profile of dog and cat owners. No significant difference in socioeconomic profile between dog and cat owners was observed ( $p > 0.05$ ). Overall, the investigated population comprised women (71.4%), individuals in the age group 31 years or over (80.3%), with family income ranging from R\$ 998.00 to R\$ 3,992.00 (80%), high school degree or higher schooling (73.9%), and salaried workers (60.8%). Most interviewed owners reported to live in households with access to basic sanitation (97.1%), garbage collection (97.4%), and located far from forested areas (76.7%) and rivers/streams (83.2%).

Most individuals - 81.2% of dog owners and 75% of cat owners - were born in different cities in Rio de Janeiro State, Southeastern Brazil. More specifically, 10% of dog owners were born in Northeastern states; 4.5%, in other Southeastern states; 1.8%, in Northern states; and 0.5%, in Southern Brazil. On the other hand, most cat owners (14.6%) were born in Northeastern states, which were followed by Southeastern (6.2%) and Northern (4.2%) states. Moreover, 2% of dog owners were foreigners from Argentina, Peru, Portugal and China.

Significant difference in animal care (animal vaccination and deworming) was observed between dog and cat owners (Table 2). No difference in the frequency of veterinary medical care was observed between dog and cat owners. The comparison of hygiene habits between dog and cat owners is also shown in Table 2. There was no association between sanitary behaviors and pet type among interviewees. However, litter box was one of the destinations of animal feces; it was exclusively reported by cat owners, as well as associated with this group of participants.

Results regarding dog and cat owners' knowledge about parasites and their zoonotic transmission are shown in Table 3. Overall, there was no significant difference in knowledge about the importance of preventing parasitic infections, parasites' habitat, likely transmission mechanisms, and zoonotic transmission between dog and cat owners (Table 3). However, significant difference was observed between dog and cat owners when they were exposed to the following statement: It is important not to catch worms because: 'if you catch them, you get sick'.

### Discussion

The number of dog owners interviewed in the current study was larger than that of cat owners. This pattern was also observed in other studies conducted with pet owners in Brazil and in foreign countries, such as Canada, Italy, and Portugal (Cardoso et al., 2016; Lima et al., 2010; Neto & Coelho, 2016; Oliveira-Neto et al., 2018; Stull et al., 2012; Zanzani et al., 2014;). In addition to the numerical superiority of urban canine populations and to their higher prevalence as companion animals, other factors may have contributed to the higher adherence of dog owners to epidemiological studies. The overall skittish behavior presented by some felines, due

**Table 1.** Socioeconomic profile of domestic dog and cat owners treated at the Municipal Veterinary Medicine Center Jorge Vaitsman, Rio de Janeiro, from August 2017 to November 2018.

Variables	Total	Dog Owners	Cat Owners	<i>p-value</i>
		%	%	
<b>Gender</b>				
Female	250	66.8	33.2	0.08 <sup>a</sup>
Male	100	77	23	
<b>Age Group</b>				
15 to 20 years old	12	50	50	0.35 <sup>a</sup>
21 to 30 years old	57	64.9	35.1	
31 to 45 years old	103	71.8	28.2	
≥ 46 years old	178	71.3	28.7	
<b>Family Income</b>				
Less than R\$ 998.00	22	8.6	5.6	0.53 <sup>b</sup>
R\$ 998.00 to R\$ 1,996.00	100	32.8	39.3	
R\$ 1,996.00 to R\$ 2,994.00	71	23.7	27	
R\$ 2,994.00 to R\$ 3,992.00	37	14.1	10.1	
R\$ 3,992.00 to R\$ 4,990.00	24	9.6	5.6	
R\$ 4,990.00 to R\$ 5,988.00	13	3.5	6.7	
More than R\$ 5,988.00	20	7.6	5.6	
<b>Level of Education</b>				
Illiterate	4	75	25	0.11 <sup>b</sup>
Basic schooling incomplete	43	53.5	46.5	
Basic schooling complete	19	57.9	42.1	
High school incomplete	25	72	28	
High school complete	152	75	25	
University degree complete or more	106	70.7	29.3	
<b>Employment</b>				
Yes	211	72	28	0.3 <sup>a</sup>
No	136	66.2	33.8	
<b>Has Basic Sanitation?</b>				
Yes	336	69.6	30.4	0.17 <sup>a</sup>
No	10	80	20	
<b>Has garbage collection?</b>				
Yes	335	69.8	30.1	1 <sup>b</sup>
No	9	66.7	33.3	
<b>Do you live near a forested area?</b>				
Yes	80	62.5	37.5	0.13 <sup>a</sup>
No	263	72.2	27.8	
<b>Do you live near a river or streams?</b>				
Yes	58	70.7	29.3	1 <sup>a</sup>
No	287	70.4	29.6	

<sup>a</sup> Pearson  $\chi^2$ ; <sup>b</sup> Exact Fischer Test.

**Table 2.** Animal care and sanitary practices and informed by domestic dog and cat owners treated at the Jorge Vaitsman Municipal Veterinary Medicine Center, Rio de Janeiro, from August 2017 to November 2018.

Variables	Total	Dog Owners	Cat Owners	p- value
		%	%	
<b>Animal vaccination</b>				
Yes	263	78	22	0 <sup>a</sup>
No	83	43.4	56.6	
<b>Vaccines applied to dogs and cats</b>				
Rabies	214	78.5	21.5	0 <sup>a</sup>
Multiple Vaccine (Canine or Feline)	145	85.5	14.5	0 <sup>a</sup>
Not informed	29	86.2	13.8	0.02 <sup>b</sup>
<b>Regular care of animals with a veterinarian</b>				
Yes	165	73.9	26.1	0.13 <sup>a</sup>
No	181	66.3	33.7	
<b>Deworming</b>				
Yes	267	73	27	0.01 <sup>a</sup>
No	77	57.1	42.9	
<b>Do you wash fruits and vegetables before eating?</b>				
Yes	330	70.3	29.7	0.78 <sup>b</sup>
No	15	66.7	33.3	
<b>The water that you drink is:</b>				
Boiled	1	0	100	0.26 <sup>b</sup>
Filtered	286	71	29	
Mineral	28	64.3	35.7	
Well Water	1	0	100	
Tap Water	30	73.3	26.7	
<b>Do you eat raw or undercooked meat?</b>				
Yes	21	66.7	33.3	0.89 <sup>a</sup>
Yes, only at barbecues or tasting the meat during the cooking process	100	69	31	
No	226	70.8	29.2	
<b>Do you walk barefoot?</b>				
Yes	140	67.9	32.1	0.4 <sup>a</sup>
No	204	72	28	
<b>Where do you dispose dog and cat feces?</b>				
Litter box	13	0	100	0.0002 <sup>b</sup>
Common waste	225	74.2	25.8	0.65 <sup>a</sup>
Backyard	21	81	19	0.61 <sup>a</sup>
Open sewer	2	100	0	1 <sup>b</sup>
Toilet	38	65.8	34.2	0.36 <sup>a</sup>
<b>Proximity of dogs and cats with other animal species</b>				
Yes	42	71.4	28.6	0.94 <sup>a</sup>
No	305	69.5	30.5	
<b>Other animals near dogs and cats</b>				
Pigs	11	81.8	18.2	0.51 <sup>b</sup>
Chickens	28	78.6	21.4	0.40 <sup>a</sup>
Cattle	11	81.8	18.2	0.51 <sup>b</sup>
Others	13	61.5	38.5	0.46 <sup>b</sup>

<sup>a</sup> Pearson  $\chi^2$ ; <sup>b</sup> Exact Fischer Test.

**Table 3.** Knowledge about parasites and zoonotic transmission of parasites from owners of domestic dogs and cats treated at the Municipal Veterinary Medicine Center Jorge Vaitsman, Rio de Janeiro, from August 2017 to November 2018.

Variable	Total	Dog Owners	Cat Owners	p-value
		%	%	
<b>It is important not to catch worms because:</b>				
Not to get sick	224	71	29	0.65 <sup>a</sup>
To be healthy	223	73.5	26.5	0.06 <sup>a</sup>
If you "catch them" destroys the person	73	76.7	23.3	0.21 <sup>a</sup>
If you "catch the" harms health and development	188	72.3	27.7	0.34 <sup>a</sup>
Not catching worms has more health	173	70	30	0.19 <sup>a</sup>
The child who does not have these things is healthier	186	70	30	0.42 <sup>a</sup>
If you "catch them" you must undergo treatment and take medicine	249	70.3	30.7	0.94 <sup>a</sup>
If you "catch them" gives a lot of problems	130	74.6	25.4	0.17 <sup>a</sup>
If you "catch them", you get sick	167	76	24	0.02 <sup>a</sup>
<b>Where do you think worms are on the body?</b>				
Intestine	316	69.6	30.4	0.45 <sup>b</sup>
Blood	105	68.6	31.4	0.75 <sup>a</sup>
Stomach	152	71.7	28.3	0.68 <sup>a</sup>
Brain	92	70.6	29.4	1.00 <sup>a</sup>
Liver	67	73.1	26.9	0.67 <sup>a</sup>
Lungs	45	75.6	24.4	0.50 <sup>a</sup>
Heart	81	74	26	0.47 <sup>a</sup>
<b>Do you have heard of:</b>				
Roundworm	330	70.6	29.4	0.20 <sup>b</sup>
Solitary	310	70	30	1.00 <sup>a</sup>
"Bicha"	141	75.2	24.8	0.10 <sup>a</sup>
Worm	282	69.9	30.1	1.00 <sup>a</sup>
Pinworm	112	69.6	30.4	1.00 <sup>a</sup>
Hookworm	93	62.4	37.6	0.08 <sup>a</sup>
<i>Toxoplasma</i>	175	68.6	31.4	0.62 <sup>a</sup>
<i>Giardia</i>	204	71.1	28.9	0.69 <sup>a</sup>
Amoebas	238	71.8	28.2	0.32 <sup>a</sup>
<b>How does the worm "enter" people?</b>				
"Enter" through the wound	84	66.7	33.3	0.42 <sup>a</sup>
No needs to have a wound for the worm to "enter"	176	69.3	30.7	0.64 <sup>a</sup>
"Enter" through the mouth	234	69.7	30.3	0.60 <sup>a</sup>
"Enter" through the anus	119	69.7	30.3	0.88 <sup>a</sup>
"Enter" through the vagina	86	71.0	29.0	1.00 <sup>a</sup>
Pass from mother to child	62	74.2	25.8	0.60 <sup>a</sup>
By blood donation	30	80.0	20.0	0.33 <sup>a</sup>
By transplant	30	83.3	16.7	0.14 <sup>b</sup>
When you eat too much candy	91	71.4	28.6	0.96 <sup>a</sup>
<b>Do you think a person can pass worm to their animal?</b>				
Yes	133	69.2	30.8	0.62 <sup>a</sup>
No	198	71.7	28.3	
<b>Do you think an animal can pass a worm to a person?</b>				
Yes	249	68.3	31.7	0.13 <sup>a</sup>
No	87	77	33	
<b>What could be done if you, someone in your household or your pet is suspected of having worms?</b>				
Go to the doctor/vet	328	70.1	29.9	0.36 <sup>b</sup>
Drinking tea or other home medications	13	84.6	15.4	
Giving medicine that was prescribed for another person or animal	27	70.4	29.6	
<b>Do you think your pet has worms when he rubs his butt on the floor?</b>				
Yes	231	70.6	29.4	0.90 <sup>a</sup>
No	93	69.9	30.1	

<sup>a</sup> Pearson  $\chi^2$ ; <sup>b</sup> Exact Fischer Test.

to stress and discomfort resulting from having to leave their homes, can not only contribute to low veterinary care demand by their owners, but also to their low adherence to studies based on data collected through interviews, since they require time to complete the questionnaires. According to Cardoso et al. (2016), dogs are often taken as pets due to the multiple functions they can perform, since, in addition to act as companion animals, they can be used for household protection purposes. However, it is important highlighting that the population of cats used as pets in Brazil has been significantly increasing and that it may outnumber the dog population within a few years (G1, 2019).

Similar to Loss et al. (2012), Stull et al. (2012) and Oliveira-Neto et al. (2018), the present study recorded higher female owners' adherence to the research. Most interviewed owners were 31 years old or older. Interestingly, the age group 20-60 years was the one most often observed in other studies conducted with dog and cat owners in Brazil (Oliveira-Neto et al., 2018; Tome et al., 2010). The mean age of individuals who had pets in a study conducted in Canada was 44 years old, whereas most dog and cat owners living in urban and rural areas in Portugal were in the age group 40-49 years (Neto & Coelho, 2016; Stull et al., 2012). Despite these findings, results in the present study have indicated that such factors do not appear to be determinant for owners' option to have dogs or cats as pet animals. However, it is important emphasizing that the female prevalence among participants may be associated with women's higher patience to fill questionnaires, and it explains their higher adherence to interview-type studies, as well as with the fact that women are often the ones accounting for taking pets to clinical care services. In addition, women may be the ones who mostly adopt animals and develop maternal feelings for them. The prevalence of age group older than 31 years among the herein interviewed dog and cat owners appears to be associated with the financial independence achieved at this point in life, which favors both the maintenance and all the care required by pets.

With respect to participants' schooling, most interviewed owners had at least completed high school. This educational profile was also observed in owners interviewed by Lima et al. (2010), in Pernambuco State, and by Cardoso et al. (2016), in Piauí State. However, studies carried out in São Paulo State reported low frequency of owners with high schooling (Oliveira-Neto et al., 2018; Tome et al., 2010). Neto and Coelho (2016) observed schooling among dog and cat owners from urban areas in Portugal higher than that observed among owners from rural areas. The high adherence of owners with high school degree, or more, to the current study may be linked to factors such as awareness about the importance of maintaining animal health. It is important emphasizing that this educational profile may have contributed to owners' decision to pursue veterinary care at Jorge Vaitsman Center. This finding is also substantiated by the demand for veterinary care from foreign owners living in Rio de Janeiro. In addition, the number of Basic Health Units providing veterinary medical care for dogs and cats in Rio de Janeiro City - either free of charges or at popular prices - remains small. This scenario may express higher demand for quality services from this Institution.

Overall, dog owners have vaccinated and dewormed their pets more often than cat owners. This difference may be associated, above all, with the higher expressive frequency of owners who reported to have administered the rabies vaccine to their animals, at least once in their lives. This high rate of dogs and cats vaccinated against rabies can be observed in other Brazilian regions (Cardoso et al., 2016; Lima et al., 2010). Rio de Janeiro City holds several annual anti-rabies vaccination campaigns focused on dogs and cats; they are carried out by municipal health agencies, based on guidelines provided by the Ministry of Health. These campaigns - which take place on public roads, often on the weekends - can be more attractive to dog owners who take advantage of street walks along with their pets to vaccinate them. With respect to deworming, the natural difficulty of orally administering drugs to cats may have contributed to the low frequency of owners who administered anthelmintic medications to their pets. Cat and even dog owners who have a hard time restraining their pets should be increasingly encouraged to adopt other antiparasitic application routes, such as products in pipettes for "pour on" skin application, to help minimizing such a difficulty. However, these products have the disadvantage of being more expensive, a fact that hinders equal access to them by the entire population. It is important emphasizing that irregular anthelmintic drug administrations may be ineffective in controlling zoonotic intestinal parasites.

Overall, most dog and cat owners reported habits and sanitary behaviors classified as protective against intestinal parasites. Among them, one finds: washing fruits and vegetables before eating them, consuming filtered water and well-cooked meat, wearing footwear and properly disposing animals' feces. From the One Health perspective, this set of practices reported by the interviewed owners is of paramount importance, since they can contribute to interrupt the transmission of zoonotic parasites between humans and animals (Cardoso et al., 2016; Loss et al., 2012), mainly of those featured by passive oral infection, such as *Giardia duodenalis*, *Toxoplasma gondii*, *Cryptosporidium* sp., *Toxocara* sp., and those featured by active skin infection, such as hookworms.

With respect to participants' knowledge about parasitosis, a considerable number of dog owners associated the importance of not being infected by helminths to avoid diseases, in comparison to cat owners. It should be noticed that this association was already expected, since people tend to acknowledge parasitic infections when they visualize their clinical manifestation in the form of diseases. On the other hand, this association was the one presenting the lowest response rate among cat owners, and it indicated that this group also correlated the importance of avoiding helminth infections to overall enhance health, instead of only being restricted to symptomatic infections. Most interviewed dog and cat owners correctly associated animals' behavior of rubbing their rear along the floor with parasitic infections, since it is one of the main symptoms evidencing infections caused by *Dypildium caninum*. However, this change in animals' behavior may due to other etiologies.

The intestinal system was the main habitat of zoonotic parasites pointed out by participants, although the stomach was also (wrongly) mentioned. Siqueira et al. (2016) also observed correct and incorrect answers indicating parasites' location at the time they assessed the knowledge of schoolchildren and employees of the public school system in Niterói City, RJ. Moreover, other organs, such as liver, lungs, brain and heart, were also mentioned by pet owners. Although the assessed answers were associated with likely location sites of zoonotic parasites affecting dogs and cats, such as visceral larva migrans and *T. gondii*, these answers may have been listed based on popular knowledge acquired throughout individuals' lives about other parasites, such as cysticercosis, that may also infect these organs.

According to study conducted by Moraes Neto et al. (2010) in two communities in Campos dos Goytacazes City, RJ, pet owners referred to parasites by mainly using terms such as "worm" and "beef tapeworm", a fact that was also observed in the present study. According to Mello et al. (1988) the use of common names to refer to parasites has shown that the population has its own coding to identify helminths. It is important highlighting that the questionnaire used in the present study to assess participants' knowledge about parasites adopted terms that may have been mistaken for human parasites, such as *Ascaris lumbricoides* and *Enterobius vermicularis*, for example. This fact may have made it hard for participants to understand the questions. Although no difference in response profile was observed between dog and cat owners, most of them have correctly reported that the oral route is the main form of infection by parasites. In addition, there were also owners who reported infection caused by parasite penetration in healthy skin, which is an infection mechanism used by hookworm larvae observed in dogs and cats - these larvae account for cutaneous larva migrans cases in humans. The most frequent incorrect answer about the transmission of zoonotic parasites associated infection acquisition with candy consumption. Similar scenario was also evidenced in responses provided by children and employees of the public education network in Niterói City, RJ (Siqueira et al., 2016). According to the aforementioned authors, this belief prevails in non-formal environments due to diarrheal condition observed in some children after the consumption of many candies, which is associated by parents with diarrhea - however, this symptom can also be observed in infections caused by intestinal parasites. Thus, several people, as well as participants in the current study, started using this culturally incorporated discourse and orally transmitted this belief to successive generations.

The human-animal parasite transmission route was not scored by most interviewed pet owners. This finding highlights the scarce information and poor knowledge built by these individuals about the concept of zoonoses and their transmission routes. On the other hand, the expressive majority of owners identified animals as likely source of parasite infections in humans. This scenario highlighted owners' anthropocentric perception since they did not acknowledge themselves as hosts and, consequently, as components of the zoonotic transmission chain.

Limitations and difficulties faced in the current study were associated with the tool selected for data collection purposes. The adopted questionnaire only provided an idea about owners' knowledge on the topic, due to its limited number of questions. Another limitation of it lied on owners' response depending on their level of adhesion to the study, which may vary based on their emotional state at interview time. In addition, the questionnaire applied in the present study was a punctual tool, i.e., it only allowed recovering participants' perceptions and knowledge at data collection time, and disregarded the dynamics of information and concepts built by individuals, overtime. Moreover, the veracity of data collected through this tool cannot be confirmed, since their validity is only credited by information provided through participants' response. It is worth emphasizing that the questionnaire was only applied to pet owners who use CJV's services; thus, their profile cannot be extrapolated to other locations in the same city. However, results presented in the current study are pioneering, since the literature does not have other studies focused on assessing the profile of dog and cat owners, based on their knowledge about zoonotic parasites in cities belonging to the metropolitan region of Rio de Janeiro State.

There was no difference in responses about the zoonotic transmissibility pattern - i.e., infectious agents transmitted between animals and humans - between dog and cat owners. Overall, most pet owners reported likely parasite transmission from animals to humans. However, transmission from humans to other animals was rarely mentioned, and it indicated lack of knowledge about zoonosis and anthropocentrism. Other studies also confirmed lack of knowledge about zoonoses or zoonotic parasites among pet owners in Brazil (Oliveira-Neto et al., 2018; Tome et al., 2010).

The option made for consulting with health professionals, whether doctors or veterinarians, was widely reported by the owners of different animal species, whenever a parasitic infection was suspected. However, misconducts such as self-medication or taking home-made remedies based on popular knowledge were also reported.

## Conclusions

Finally, results in the present study have indicated lack of difference in socioeconomic profile, animal care, hygiene habits and knowledge about zoonotic parasites between dog and cat owners, whose pets were treated at Jorge Vaitsman Center. Overall, knowledge about parasitic zoonoses, and their forms of transmission among pet owners, remains fragmented and insufficient. Thus, health professionals, mainly veterinarians, as well as public managers, are important mediators of information about potentially zoonotic parasitic agents capable of affecting this specific group of individuals, since they can sensitize pet owners about measures to be taken to help controlling and preventing these infections. However, it is worth mentioning that communication between these health professionals and other professionals, such as doctors, nurses and ecologists, plays essential role in the process to cope with these parasites, from a broader and more complete perspective, as recommended in the One Health approach.

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## Ethics statement

This research was approved by the Human Research Ethics Committee, IOC/Fiocruz project CAAE: 67408817.9.0000.5248, with approval number 2,054,938; by the Scientific Committee of the Secretariat for Surveillance, Sanitary Inspection and Zoonosis Control of Rio de Janeiro city under license 001/17.

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## Conflicts of interests

IFA, YACM, TFB, IMSG, PRM, ASB, LCSA and MRRA - No conflict of interest.

## Authors' contributions

IFA, PRM, ASB, LCSA, MRRA - Development of methodology; preparation and writing the initial draft; IFA, YACM, LCSA - Data collection and storage; IFA, TFB, IMSG - Data analysis and application of statistical tests; IFA, PRM, ASB, MRRA - Writing, Review and Editing manuscript

## Availability of complementary results

Readers may have access to any additional information through direct contact with the authors.

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