

Occurrence of *Toxoplasma gondii* and other gastrointestinal parasites in free-roaming cats from the Rio de Janeiro zoo

Ocorrência de *Toxoplasma gondii* e parasitas gastrointestinais em gatos de vida livre do zoológico do Rio de Janeiro

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Abstract

This communication aimed to determine the frequency of infection by *T. gondii* and other gastrointestinal parasites in free-living cats captured in BioParque do Rio (Fundação RioZoo), Brazil. To this end, 58 blood and 51 fecal samples were collected from 68 cats from July 2019 to September 2020. The serum obtained was analyzed by indirect fluorescent antibody test for anti-*T. gondii* IgG. Fecal samples were examined by microscopic parasitological techniques. Of the total, 10.3% of the animals presented anti-*T. gondii* IgG. Parasitic structures were observed in 39.2% of the fecal samples. Hookworms were the most detected parasites (19.6%) followed by *Cystoisospora* sp. (11.7%), *Dipylidium caninum* (7.8%) and *Toxocara cati* (3.9%). These results indicated the exposure of this population of stray cats to potentially zoonotic parasites, which in addition to causing possible damage to domestic and wild animal health, also pose risks to public health.

Keywords: zoonoses, stray cats, zoo.

Resumo

Esta comunicação teve como objetivo determinar a frequência de infecção por *T. gondii* e outros parasitas gastrointestinais em gatos de vida livre capturados no BioParque do Rio (Fundação RioZoo), Brasil. Para isso, foram coletadas 58 amostras de sangue e 51 amostras fecais de 68 gatos capturados entre julho de 2019 e setembro de 2020. O soro obtido foi submetido à reação de imunofluorescência indireta para IgG anti-*T. gondii*. As amostras fecais foram submetidas a técnicas parasitológicas microscópicas. Do total, 10,3% dos animais apresentaram IgG anti-*T. gondii*. Estruturas parasitárias foram observadas em 39,2% das amostras fecais. Os ancilostomídeos foram os parasitas mais detectados (19,6%), seguidos por *Cystoisospora* sp. (11,7%), *Dipylidium caninum* (7,8%) e *Toxocara cati* (3,9%). Esses resultados indicaram a exposição dessa população de gatos de rua a parasitas potencialmente zoonóticos, que, além de causar possíveis danos à saúde dos animais domésticos e selvagens, também representam riscos à saúde pública.

Palavras-chave: zoonoses, gatos errantes, zoológico.

Over the years urban stray cat populations have increased and became a major public health issue (Ruyver et al., 2021). To make matters worse the abandonment, observed in several large urban centers (Lima & Luna, 2012) is also common in Rio de Janeiro city. These animals increase stray populations of individuals susceptible to infections by various pathogens (Baneth et al., 2016). Therefore, they can contribute with the transmission dynamics of etiological agents, especially *Toxoplasma gondii* (Baneth et al., 2016; Dubey et al., 2009). Aiming to increase knowledge on




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the exposure of free-roaming cats from the BioParque do Rio (Fundação RioZoo) to *T. gondii* and other gastrointestinal parasites, this survey was conducted.

Free-roaming cats from the internal area of the BioParque do Rio (Fundação RioZoo) were captured for a trap-neuter-release program. Blood samples were obtained through venipuncture of the cephalic, jugular, saphenolateral or femoral veins. Serum samples were analyzed for antibodies to *T. gondii* by the indirect fluorescent antibody test (IFAT) as described by Camargo (1964). The test was positive when the tachyzoite surface was totally fluorescent and the titer was at least 1:64 (Arruda et al., 2021a). Fecal samples were obtained by washing the rectal ampoule with sterile saline (Pereira et al., 2017). The fecal filtrate was aliquoted into 15 mL conical-bottom centrifuge tubes, one for each coproparasitological technique. Each aliquot was analyzed using centrifugal-flotation (Sheather, 1923); modified centrifugal-flotation (Huber et al., 2003) and; adapted centrifugal-sedimentation (Arruda et al., 2021b).

Fecal samples were obtained from 51 cats and blood samples from 58 cats. Six cats tested positive by the IFAT test (10.3% - 6/58), showing a reduction of exposure of cats kept in the same Zoo when compared to results from the previous decade (Mendes-de-Almeida et al., 2007) or in other areas of the city (Pereira et al., 2017). This reduction may be due to the commercial cat food provided by the Zoo or to a shorter exposure time of these animals to the environment. On the other hand, since cats will hunt and consume their prey even when well nourished (Alberigi et al., 2023), it is possible to suggest that a better rodent control in the area is the key for that reduction.

It is worth noting that *T. gondii* seropositive wild animals kept by the Zoo, as well as free-roaming ducks (*Cairina moschata*) captured in the same area were reported almost concomitantly (Santos et al., 2022; Villar-Echarte et al., 2021). In this context, it's possible to infer that there is a common source of *T. gondii* infection available in the area for all the animals.

Parasitic structures were observed in 39.2% (20/51) fecal samples. Hookworms were the most frequently detected 19.6% (10/51), followed by *Cystoisospora* sp., 11.7% (6/52), *Dipylidium caninum* 7.8% (4/51) and *Toxocara cati* 3.9% (2/51). These parasites have been reported in stray cats from Rio de Janeiro state (Labarthe et al., 2004; Pereira et al., 2017; Serra et al., 2003). The low frequency of gastrointestinal parasites may be inherent to the conditions of the environment or even the host, since this survey included animals of unknown ages, but which, due to their body score, resembled an adult animal, that is, already immunologically challenged. This fact continues to be corroborated by the low diagnosis of *T. cati* eggs.

T. gondii oocysts were not detected in the fecal samples of the cats evaluated. The frequency of cats in the active elimination phase of oocysts in coproparasitological surveys is very low, less than 1% (Dabritz & Conrad, 2010; Wallace, 1971). In the present study, seropositive cats had already been exposed to the parasite and consequently had already finished the patency phase of the protozoan cycle. Furthermore, a punctual sample collection (single fecal sample), associated with the fecal sampling technique may also have contributed to the low frequency of parasitic forms detected.

It is worth noting that most parasites targeted in this survey are also relevant to public health, as they can be transmitted to humans (Feldmeier & Schuster, 2012; García-Agudo et al., 2014; Lee et al., 2010; Montoya & Liesenfeld, 2004). In addition to the risk posed to human health, the parasitic structures detected in the feces of cats in the present study can infect other animal taxa present at the BioParque do Rio (Fundação RioZoo) (Barbosa et al., 2020). The diagnosed forms can be leached into the enclosures of wild animals that are under the care of this Institution or to other cat colonies. Therefore, measures to raise public awareness on responsible ownership of domestic cats are essential to educate the human population on this topic and thus increase responsible ownership and consequently reduce the rates of parasites that can be harmful to cats, humans and other animals.

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Ethics statement

This study was approved by the Animal Use Ethics Committee of the Oswaldo Cruz Institute/Fiocruz, Rio de Janeiro under numbers LA011-2017 and L-045/2016 A3.

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Conflict of interests

IFA, RCFR, ASB, GVE, AMA, FT and MRRA - No conflict of interest.

Authors' contributions

IFA, RCFR, ASB, GVE, AMA, FT and MRRA - Development of methodology; preparation and writing the initial draft. IFA, RCFR, GVE, FT - Data collection and storage. IFA, RCFR, GVE, ASB - Data analysis and application of statistical tests. IFA, 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

The work was carried out at Jardim Zoológico do Rio de Janeiro, São Cristóvão, Rio de Janeiro and at Laboratório de Protozoologia do Instituto Oswaldo Cruz, da Fundação Oswaldo Cruz, Mangueiras, Rio de Janeiro, RJ, Brazil

References

- Alberigi, B., Matos, M. D., Correia, T. R., Ferreira, B., Cassani, L. S., Roque, R. M. D. S., Nohara, S. J., & Labarthe, N. (2023). *Platynosomum illiciens* infection in domestic cats: Insights from a sanctuary. *Brazilian Journal of Veterinary Medicine*, 45, e005023. <http://dx.doi.org/10.29374/2527-2179.bjvm005023>. PMID:38093986.
- Arruda, I. F., Millar, P. R., Barbosa, A. S., Abboud, L. C. S., Dos Reis, I. C., Moreira, A. S. D. C., Guimarães, M. P. P., & Amendoeira, M. R. R. (2021a). *Toxoplasma gondii* in domiciled dogs and cats in urban areas of Brazil: Risk factors and spatial distribution. *Parasite (Paris, France)*, 28, 56. <http://dx.doi.org/10.1051/parasite/2021049>. PMID:34236311.
- Arruda, I. F., Ramos, R. C. F., Barbosa, A. S., Abboud, L. C. S., Dos Reis, I. C., Millar, P. R., & Amendoeira, M. R. R. (2021b). Intestinal parasites and risk factors in dogs and cats from Rio de Janeiro, Brazil. *Veterinary Parasitology. Regional Studies and Reports*, 24, 100552. <http://dx.doi.org/10.1016/j.vprsr.2021.100552>. PMID:34024369.
- Baneth, G., Thamsborg, S. M., Otranto, D., Guillot, J., Blaga, R., Deplazes, P., & Solano-Gallego, L. (2016). Major Parasitic Zoonoses Associated with Dogs and Cats in Europe. *Journal of Comparative Pathology*, 155(Suppl 1), S54-S74. <http://dx.doi.org/10.1016/j.jcpa.2015.10.179>. PMID:26687277.
- Barbosa, A. D. S., Pinheiro, J. L., Dos Santos, C. R., De Lima, C. S. C. C., Dib, L. V., Echarte, G. V., Augusto, A. M., Bastos, A. C. M. P., Antunes Uchôa, C. M., Bastos, O. M. P., Santos, F. N., Fonseca, A. B. M., & Amendoeira, M. R. R. (2020). Gastrointestinal parasites in captive animals at the Rio de Janeiro Zoo. *Acta Parasitologica*, 65(1), 237-249. <http://dx.doi.org/10.2478/s11686-019-00145-6>. PMID:31960215.
- Camargo, M. E. (1964). Improved technique of indirect immunofluorescence for serological diagnosis of toxoplasmosis. *Revista do Instituto de Medicina Tropical de São Paulo*, 6(3), 117-118. PMID:14177810.
- Dabritz, H. A., & Conrad, P. A. (2010). Cats and *Toxoplasma*: Implications for public health. *Zoonoses and Public Health*, 57(1), 34-52. <http://dx.doi.org/10.1111/j.1863-2378.2009.01273.x>. PMID:19744306.
- Dubey, J. P., Lindsay, D. S., & Lappin, M. R. (2009). Toxoplasmosis and other intestinal coccidial infections in cats and dogs. *The Veterinary Clinics of North America. Small Animal Practice*, 39(6), 1009-1034, v. <http://dx.doi.org/10.1016/j.cvsm.2009.08.001>. PMID:19932360.
- Feldmeier, H., & Schuster, A. (2012). Mini review: Hookworm-related cutaneous larva migrans. *European Journal of Clinical Microbiology & Infectious Diseases*, 31(6), 915-918. <http://dx.doi.org/10.1007/s10096-011-1404-x>. PMID:21922198.
- García-Agudo, L., García-Martos, P., & Rodríguez-Iglesias, M. (2014). *Dipylidium caninum* infection in an infant a rare case report and literature review. *Asian Pacific Journal of Tropical Biomedicine*, 4(Supl. 2), 565-567. <http://dx.doi.org/10.12980/APJTB.4.2014APJTB-2014-0034>.

- Huber, F., Bonfim, T. C., & Gomes, R. S. (2003). Comparação da eficiência da técnica de sedimentação pelo formaldeído-éter e da técnica de centrífugo-flutuação modificada na detecção do cisto de *Giardia* sp. e oocisto de *Cryptosporidium* sp. em amostras fecais de bezerros. *Revista Brasileira de Parasitologia Veterinária*, 12(2), 135-137.
- Labarthe, N., Serrão, M. L., Ferreira, A. M., Almeida, N. K., & Guerrero, J. (2004). A survey of gastrointestinal helminths in cats of the metropolitan region of Rio de Janeiro, Brazil. *Veterinary Parasitology*, 123(1-2), 133-139. <http://dx.doi.org/10.1016/j.vetpar.2004.06.002>. PMID:15265577.
- Lee, A. C. Y., Schantz, P. M., Kazacos, K. R., Montgomery, S. P., & Bowman, D. D. (2010). Epidemiologic and zoonotic aspects of ascarid infections in dogs and cats. *Trends in Parasitology*, 26(4), 155-161. <http://dx.doi.org/10.1016/j.pt.2010.01.002>. PMID:20172762.
- Lima, A. F. M., & Luna, S. P. L. (2012). Algumas causas e consequências da superpopulação canina e felina: Acaso ou descaso? *Revista de Educação Continuada em Medicina Veterinária e Zootecnia do CRMV-SP*, 10(1), 32-38. <http://dx.doi.org/10.36440/recmvz.v10i1.258>.
- Mendes-de-Almeida, F., Labarthe, N., Guerrero, J., Faria, M. C., Branco, A. S., Pereira, C. D., Barreira, J. D., & Pereira, M. J. (2007). Follow-up of the health conditions of an urban colony of free-roaming cats (*Felis catus* Linnaeus, 1758) in the city of Rio de Janeiro, Brazil. *Veterinary Parasitology*, 147(1-2), 9-15. <http://dx.doi.org/10.1016/j.vetpar.2007.03.035>. PMID:17481822.
- Montoya, J. G., & Liesenfeld, O. (2004). Toxoplasmosis. *Lancet*, 363(9425), 1965-1976. [http://dx.doi.org/10.1016/S0140-6736\(04\)16412-X](http://dx.doi.org/10.1016/S0140-6736(04)16412-X). PMID:15194258.
- 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. (2017). Gastrointestinal parasites in stray and shelter cats in the municipality of Rio de Janeiro, Brazil. *Revista Brasileira de Parasitologia Veterinária*, 26(3), 383-388. <http://dx.doi.org/10.1590/s1984-29612017024>. PMID:28678896.
- Ruyver, C., Abatih, E., Villa, P. D., Peeters, E. H. K. A., Clements, J., Dufau, A., & Moons, C. P. H. (2021). Public opinions on seven different stray cat population management scenarios in Flanders, Belgium. *Research in Veterinary Science*, 136, 209-219. <http://dx.doi.org/10.1016/j.rvsc.2021.02.025>. PMID:33689877.
- Santos, A. L. C., Arruda, I. F., Barbosa, A. S., Balthazar, D. A., Augusto, A. M., Magalhães, B. S. N., Silva, V. L., & Amendoeira, M. R. R. (2022). Research for anti - *Toxoplasma gondii* antibodies in free-living ducks (*Cairina moschata*) from Rio de Janeiro, RJ, Brazil. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 74(3), 542-548. <http://dx.doi.org/10.1590/1678-4162-12540>.
- Serra, C. M. B., Uchôa, C. M. A., & Coimbra, R. A. (2003). Exame parasitológico de fezes de gatos (*Felis catus domesticus*) domiciliados e errantes da Região Metropolitana do Rio de Janeiro, Brasil. *Revista da Sociedade Brasileira de Medicina Tropical*, 36(3), 331-334. <http://dx.doi.org/10.1590/S0037-86822003000300003>. PMID:12908032.
- Sheather, A. L. (1923). The detection of intestinal protozoa and mange parasites by a floatation technique. *The Journal of Comparative Pathology and Therapeutics*, 36, 266-275. [http://dx.doi.org/10.1016/S0368-1742\(23\)80052-2](http://dx.doi.org/10.1016/S0368-1742(23)80052-2).
- Villar-Echarte, G., Arruda, I. F., Barbosa, A. S., Guzmán, R. G., Augusto, A. M., Troccoli, F., Segón, A. M. R., Santos, A. L. C., Zanotto, P. F. C., Gava, M. Z. E., Langoni, H., & Amendoeira, M. R. R. (2021). *Toxoplasma gondii* among captive wild mammals in zoos in Brazil and Cuba: Seroprevalence and associated risk factors. *Revista Brasileira de Parasitologia Veterinária*, 30(2), e001921. <http://dx.doi.org/10.1590/s1984-29612021053>. PMID:34133615.
- Wallace, G. D. (1971). Isolation of *Toxoplasma gondii* from the feces of naturally infected cats. *The Journal of Infectious Diseases*, 124(2), 227-228. <http://dx.doi.org/10.1093/infdis/124.2.227>. PMID:5124973.