Parasites of Zoonotic Interest Detected in *Felis catus domesticus* in Midwestern Brazil

Stephanie Ballatore Holland Lins; Maria Elizabeth Cavalheiros Dorval; Elenir Rose Jardim Cury Pontes; Ana Paula Antunes Nogueira; Eduardo de Castro Ferreira; Maria de Fatima Cepa Matos

*Federal University of Mato Grosso do Sul, Stricto Sensu Graduate Program in Infectious and Parasitary Diseases. MS, Brazil.
*Universidade Anhanguera-Underp, Stricto Sensu Graduate Program in Environment and Regional Development. MS, Brazil.
*Control Center of Zoonoses, City Hall of Campo Grande. MS, Brazil.

Abstract

Interactions between humans and animals can be considerably beneficial to human well-being, and the demand for domestic cats as pets has increased in recent years. Despite these benefits, however, cats may contribute to environmental dissemination of zoonotic pathogens, with potential risks to human health. The purpose of this study was to investigate the prevalence and diversity of feline parasites of zoonotic interest in Campo Grande, the capital city of Mato Grosso do Sul state, Midwestern Brazil, where studies on feline parasitic fauna remain scarce. Fecal samples from 210 male and female cats of varying ages, sheltered at the local Center for Zoonosis Control, were examined. Spontaneous and ether centrifugal sedimentation were used to detect the parasites, found in 149 animals (71.0%), 93 (62.4%) of which were infected with a single parasitic species and 56 (37.6%) with two or more species. Ten parasitic species were detected, where *Ancylostoma* sp. was the most frequent (65.2%), followed by *Platygnosomum concinnun* (21.0%), *Cystoisospora* sp. (7.1%), *Aelurostrongylus abstrusus* (1.9%), *Strongyloides* sp. (1.9%), *Dipylidium caninum* (1.4%), *Giardia* sp. (1.0%), *Toxocara* sp. (1.0%), *Physaloptera praeputialis* (1.0%), and *Sarcocystis* sp. (0.5%). The results obtained are relevant to human and veterinary public health policies and demonstrate the cats’ role in the transmission chain of parasitic zoonoses, particularly in urban areas. The findings can also serve to raise awareness among veterinarians and cat owners on the importance of preventive interventions to ensure healthier cohabitation with pets by reducing human exposure to cat borne parasites in urban areas.

Keywords: Zoonoses. Felines. Helminths. Protozoa. One Health.

1 Introduction

The interaction between living beings (men, animals and pathogens) that share the same environment, must be considered as a unique and dynamic system, where the functioning of each component is closely interconnected and dependent on the other (CALISTR1 *et al.*, 2013).

Emerging and re-emerging infections are currently acknowledged as a global challenge (TAYLOR *et al.*, 2001; GUIMARÃES *et al.*, 2010), and 61% of the human pathogens worldwide have been categorized as zoonotic (WHO, 2009).

The concern for zoonoses is compounded by human contact with pets being made more ubiquitous by growing urban sprawl into previously unpopulated areas and by the frequent presence of pets in public spaces and public transportation, as well as their transit across national borders, increasing the likelihood of environmental contamination and, consequently, of pathogen transmission, with potentially fatal outcomes (CHOMEI; SUN, 2011).

Zoonotic events control in urban areas is currently
centered on dogs, while overlooking the widespread presence of pet cats is a situation that calls for a reevaluation of the zoonotic potential of this species in terms of public health (Genaro, 2010).

In Brazil, data on parasitism in felines are scarce (Beugnet et al., 2013) but the pet cats population has been estimated at 22.1 million nationally, or 1.9 per household on average. In Midwestern Brazil, cats are found in 14.3% of households (IBGE, 2015). The purpose of this study was to estimate the prevalence and diversity of parasites with zoonotic potential in domestic cats (Felis catus domesticus) in Campo Grande county, Mato Grosso do Sul state, Midwestern Brazil.

2 Material and Methods

The study was based on fecal samples collected between September 2014 and May 2015 from 210 male and female cats of varying ages sheltered at Campo Grande Center for Zoonosis Control. The Center shelters lost and stray animals for an established period, after which those not reclaimed by their owners are euthanized. Only cats scheduled for euthanasia were used in this study. The project was authorized by the Ethics Committee on the Use of Animals (CEUA / UFMS) under protocol No. 609/2014.

The animals were grouped by sex and age. Adult cats were defined as those aged six months or older. When absent from the records, age was estimated from dentition.

Geographical animals’ origin took into account the county’s stratification into six health districts (North, South, East, West, Central, and Rural) adopted by the Center for Zoonosis Control, which, for the present purposes, were regrouped as rural region (comprising farms and rural settlements), central region (corresponding to the Central health district), and suburban region (combining the North, South, East, and West districts).

Fecal samples from euthanized animals were collected from the rectal ampulla and stored in universal specimen flasks containing 10% of formalin for subsequent parasitological examination at the Clinical Parasitology Laboratory of the Biological and Health Sciences Center at the Federal University of Mato Grosso do Sul (UFMS). Parasite detection was performed by spontaneous sedimentation (Hoffman et al., 1934) and ether centrifugal sedimentation (Blegg et al., 1955), which allow protozoan cysts and oocysts, as well as helminth eggs and larvae, to be observed.

Data on the prevalence of detected parasites are reported together with their respective 95% confidence intervals (95% CI). To compare proportions between the variable “parasite” and other variables (sex, age, animal origin, and domicile status), the Chi-squared test or Fisher’s exact test were applied using Epí Info 7.1.1.14 software (Centers for Disease Control and Prevention, Atlanta, GA, USA).

3 Results and Discussion

Of the 210 animals examined, 149 (71.0%; 64.8-77.1%, 95% CI) were infected and 61 (29.0%) tested negative. Of these 149 animals, 93 (62.4%) were infected with a single parasite species and 56 (37.6%) with two or more species. The association between Ancylostoma sp. and Platynosomum concinnum (13.3%) was the most frequent, followed by Ancylostoma sp. and Cystoisospora sp. (4.7% each).

Table 1 shows the prevalence rates of the diagnosed parasitic species. Infection by Ancylostoma helminths was the most frequent, at 65.2% (137/210), followed by Platynosomum concinnum, at 21.0% (44/210).

Table 1 - Cats (Felis catus domesticus) diagnosed with protozoan and helminth infection. Campo Grande, Mato Grosso do Sul, 2015 (n = 210)

<table>
<thead>
<tr>
<th>Parasite*</th>
<th>N</th>
<th>%</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancylostoma sp.</td>
<td>137</td>
<td>65.2</td>
<td>58.8-71.7</td>
</tr>
<tr>
<td>Platynosomum concinnum</td>
<td>44</td>
<td>21.0</td>
<td>15.4-26.5</td>
</tr>
<tr>
<td>Cystoisospora sp.</td>
<td>15</td>
<td>7.1</td>
<td>3.7-10.6</td>
</tr>
<tr>
<td>Aelurostrongylus abstrusus</td>
<td>4</td>
<td>1.9</td>
<td>1.3-2.5</td>
</tr>
<tr>
<td>Strongyloides sp.</td>
<td>4</td>
<td>1.9</td>
<td>1.3-2.5</td>
</tr>
<tr>
<td>Dipylidium caninum</td>
<td>3</td>
<td>1.4</td>
<td>0.9-1.9</td>
</tr>
<tr>
<td>Giardia sp.</td>
<td>2</td>
<td>1.0</td>
<td>0.5-1.4</td>
</tr>
<tr>
<td>Toxocara sp.</td>
<td>2</td>
<td>1.0</td>
<td>0.5-1.4</td>
</tr>
<tr>
<td>Physaloptera praeputialis</td>
<td>2</td>
<td>1.0</td>
<td>0.5-1.4</td>
</tr>
<tr>
<td>Sarcocystis sp.</td>
<td>1</td>
<td>0.5</td>
<td>0.2-0.8</td>
</tr>
</tbody>
</table>

*Infection by likely multiple parasite types.

Source: Research data.

The high prevalence of parasitosis found in the present study was within the 31.5-100% range reported for different Brazilian regions (Coelho et al., 2009; Colegenesi et al., 2018; Dall’agnol et al., 2010; Ferraz et al., 2019; Funada et al., 2007; Mósen et al., 2019; Pivoto et al., 2013; ; Ramos et al., 2020; Serra et al., 2003).

The high prevalence of hookworms has considerable epidemiological relevance, not only for the impact on feline health, but also for the high risk of environmental contamination. Larval forms, particularly of A. braziliense, may cause cutaneous larva migrans syndrome, also known as serpiginous dermatitis (popularly referred to as “bicho-geográfico” in Brazil), of cosmopolitan distribution and higher frequency in tropical and subtropical regions (Lima, 2005). In the county investigated, temperatures in the 25-30 °C range, typical of tropical climates, are common, encouraging the development and environmental persistence of parasites.

No differences in the prevalence of A. braziliense in humans have been reported regarding host age, sex, or ethnicity, but its zoonotic potential is greater among children, often more vulnerable for their likelihood of playing on potentially contaminated substrates, such as sandy beaches or sand boxes in public parks (Bricarello et al., 2018; Rocha et al., 2019; Santarém et al., 2004) or located in school yards (Araújo et al., 2000).

In Brazil, infection rates for the trematode Platynosomum
concinnum range from 1.07% to 40%, depending on the region investigated and the animals’ domicile status (GENNARI et al., 1999; RAGOZO et al., 2002; MUNDIM et al., 2004). The prevalence observed in the present study was very similar to the 26.03% rate found by another author (RAMOS et al., 2013), possibly owing to similarities in climate, subjects, and collection sites. Furthermore, the cats’ behavior and predatory instinct may explain the prevalence observed in the present investigation, although higher rates have been reported for free-ranging animals (SALOMÃO et al., 2005).

Despite the serious risks posed to cats, platynosomiasis has not been reported as a zoonosis. Its epidemiology and pathogenesis, however, have not been fully elucidated, requiring further investigation on epidemiological features (occurrence and distribution). Importantly, infection by Platynosomum concinnum should be included in differential diagnosis of liver disease (RAMOS et al., 2013).

Only two animals were infected by Toxocara sp. (1%), similarly to the rate observed in another study (FERREIRA et al., 2013), but in sharp contrast with prevalence rates detected in other Brazilian regions, in the 16.58-43.1% range (COELHO et al., 2009; GENNARI et al., 1999; PIVOTO et al., 2013; RAGOZO et al., 2002; RAMOS et al., 2020).

Despite the low prevalence of Giardia sp. in the samples, ingestion of as few as 10-100 cysts can prove sufficient for symptomatic infection in humans (RENDTORFF, 1954). In Brazil, the prevalence of Giardia sp. in animals ranges from 5.0 to 38.1% (BRINKER et al., 2009; COELHO et al., 2009; DALL’AGNOL et al., 2010; FERREIRA et al., 2013; FERRAZ et al., 2019; FUNADA et al., 2007; MORAES et al., 2019; MÔSENA et al., 2019), but rates are known to depend on geography and detection method, as well as on the animals’ age, habits, and clinical condition (BALLWEBER et al., 2010).

The prevalence of Cystoisospora sp., of only 7.1% (15/210), was in sharp contrast with rates found for the states of São Paulo (RAGOZO et al., 2002), Rio de Janeiro (SERRA et al., 2003), Paraná (FERREIRA et al., 2013), and Mato Grosso (GAVIOLI et al., 2011), of 26.09-70.6%. In a recent study carried out in Rio de Janeiro with domiciled cats (n = 57) and shelter cats (n = 336), the prevalence of Cystoisospora sp. was 8.33% and 26.20% respectively (RAMOS et al., 2020).

The presence of a single case of sarcocystosis corroborates the low prevalence of Sarcocystis sp. reported in other studies (SERRA et al., 2003; RAGOZO et al., 2002).

Infection with Physaloptera praeputialis, of only 1% in the present investigation, has been reported in the 1.06-54.54% range elsewhere in Brazil (GENNARI et al., 1999; SILVA et al., 2001; MUNDIM et al., 2004; ISHIZAKI et al., 2006; FERREIRA et al., 2013), although higher prevalence rates can be detected with active search of adult parasites on animal necropsy (SILVA et al., 2001; ISHIZAKI et al., 2006). Although rarely diagnosed in humans, the zoonotic potential of P. praeputialis should not be overlooked. Difficulties in identifying eggs of this parasite (highly similar to decorticated eggs of Ascaris), both in human and veterinary samples, can lead to underestimation of prevalence rates (CLEELAND et al., 2013).

With a prevalence rate of 1.9% (4/210), Aelurostrongylus abstrusus is being reported for the first time in Campo Grande, but prevalence rates from 2% to 29.5% have been reported elsewhere (CAMPOS et al., 1974; MUNDIM et al., 2004; EHLERS et al., 2013; RAMOS et al., 2013).

Factors such as global warming and changes in the vectors population dynamics, combined with frequent animals’ transit, may play a key role in the growing number of reports of A. abstrusus infection (TRAVERSA; GUGLIELMINI, 2008). Given its wide geographic range, this type of infection has recently been shown to be much more common than previously thought (RASSOULI et al., 2015).

A prevalence rate of 1.9% was observed for Strongyloides sp., similar to that of 1.6% detected by Gennari (GENNARI et al., 1999), and in contrast to the 25% observed in a study with domiciled cats in Rio de Janeiro (RAMOS et al., 2020). Strongyloidiases accounts for 60-85% mortality among immunocompromised patients. Affecting roughly 100 million globally, the disease mostly occurs in institutional settings, rural areas, and populations of lower socioeconomic status (IRIEMENAM et al., 2010).

Possibly, the actual infection prevalence by helminths released as larvae in the environment is higher than the rates found in the present study, which did not employ the Baermann method ideal for diagnosing larval forms.

Dipylidium caninum had a low prevalence, corroborating other reports (DALL’AGNOL et al., 2010; GARCÍA-AGUDO et al., 2014), and in contrast to the 16.67% observed in a study with domiciled cats in Rio de Janeiro (RAMOS et al., 2020). In humans, the risk of infection is low in adults, but high among young children, as this latter group is more exposed to accidental ingestion of fleas or contact with saliva of pet mammals. Non-specific clinical manifestations can render infection asymptomatic, under-recognized, or under-reported (NARASIMHAN et al., 2013), masking the true incidence of D. caninum.

No statistical difference was observed in parasite prevalence rates (p > 0.05) relative to host sex. Infection was detected in 71.9% (92/128) of females and 69.5% (57/82) of males. No differences were detected in the distribution of parasitized animals by county region or between household pet and stray animals. This fact is in agreement with other investigations (COELHO et al., 2009; RAMOS et al., 2013; GAVIOLI et al., 2011).

Despite showing no differences in parasitism status, stray cats have increased risk of exposure to parasitic infection, owing to predation of small rodents, birds, and arthropods, as well as exposure to contaminated drinking water and food scavenged from garbage containers (RAGOZO et al., 2002; TORRICO et al., 2008). However, the growing interest...
in adoption of homeless cats has increased the number of domiciled and semi-domiciled animals, with possible undesirable implications for human health (COELHO et al., 2009).

In the present study, a combination of centrifugation and spontaneous sedimentation allowed detection of different parasite species, although the methods employed may exhibit low sensitivity, depending on species-specific features (GENNARI et al., 1999; BLAZIUS et al., 2005; TAPARÓ et al., 2006; MANDARINO-PEREIRA et al., 2010).

The recognition that human health is directly associated with animal and environmental health is a fundamental element in monitoring and controlling threats to public health, and this is called One Health. For this reason, it is necessary to foster knowledge about how diseases spread among people, animals and the environment (CDC, 2013).

Among the many benefits of a One Health approach, there is a greater possibility of preventing and fighting parasitic diseases, but in order for One Health to occur effectively, knowledge about this new approach and its importance for the population must be stimulated. Health managers should be aware of the importance of the professionals participation from different areas in the decision-making process and in the area of basic health (CIRNE; CABRERA, 2019). Such works, in a way, indicate that doctors, veterinarians, other health professionals, researchers and even governmental and non-governmental bodies, must work together to ensure the health preservation in its most diverse forms (DAY, 2010).

4 Conclusion

The parasites detected in the present investigation are relevant to both human and veterinary public health policies, calling for interventions to reduce human exposure to these agents in urban areas.

Knowledge on the epidemiology of major zoonoses in felines is imperative for veterinarians, enabling these professionals to not only deliver timely treatment to affected animals, but also to provide owners with guidance on exposure risks.

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