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Risk factors associated with sero-positivity to *Toxoplasma gondii* in captive neotropical felids from Brazil

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Abstract

From September 1995 to February 2001, blood samples were collected from 865 neotropical felids belonging to 8 different species. These animals were housed in 86 institutions located in 78 cities of 20 Brazilian states. Our goal was to identify the risk factors associated with sero-positivity to *Toxoplasma gondii* in captive neotropical felids from Brazil. All serum samples were tested by the modified agglutination test (MAT), using formalin-fixed whole tachyzoites and mercaptoethanol. For each animal an individual questionnaire was filled with questions about tattoo number, felid species, age, sex, origin, number of animals in the group, introduction of new animals in the group, time in the institution, eating meat previously frozen for a period <7 days in the last 6 months, eating meat of run-over or euthanized animals in the last 6 months, predation of rodents or birds in the last 6 months and presence of domestic cats near the enclosures in the last 6 months. The total sero-prevalence was 55% (95% CI: 52%, 57%). We estimated a prevalence of 46% (95% CI: 40%, 54%) for jaguarundi (*Puma yagouaroundi*); 58% (95% CI: 53%, 63%) for ocelot (*Leopardus pardalis*); 50% (95% CI:

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45%, 56%) for oncilla (*L. tigrinus*); 54% (95% CI: 46%, 62%) for margay (*L. wiedii*); 12% (95% CI: 4%, 31%) for Pampas-cat (*L. colocolo*); 83% (95% CI: 65%, 93%) for Geoffroy's-cat (*L. geoffroyi*); 64% (95% CI: 50%, 68%) for jaguar (*Panthera onca*) and 48% (95% CI: 42%, 54%) for puma (*Puma concolor*). Multiple logistic regression was used to evaluate the association between the variables in the questionnaire and sero-positivity to *T. gondii*. We concluded that the independent risk factors for toxoplasmosis were: age >3 years (OR = 4.75 [2.75; 8.2]), eating meat previously frozen for a period <7 days (OR = 2.23 [1.24; 4.01]), and consumption of animals that were run-over or euthanized (OR = 1.64; [1.14; 2.37]).

Keywords: *Toxoplasma gondii*; Sero-prevalence; Risk factors; Captive neotropical felids; Zoological garden; Brazil

1. Introduction

Neotropical felids are represented by 10 species with a range extending from Mexico to Argentina, except for puma (*Puma concolor*), ocelot (*Leopardus pardalis*) and jaguarundi (*Puma yagouaroundi*), which may also be found in United States of America and Canada. Brazil hosts eight of these species (Oliveira, 1994) and only jaguarundi is not endangered (Fonseca et al., 1994). Nowadays, the greatest cause of decrease in felid population in the wild is the loss of habitats (Oliveira, 1994). Many species of wild felids are kept in zoological parks and private breeding centers in Brazil, as part of a national conservationist programme. Studies on neotropical felids, both in captivity and in the wild, will enable a better understanding of the epidemiology of zoonotic and non-zoonotic transmissible diseases (Munson and Cook, 1993; Thrusfield, 1995; Silva et al., 2001a).

Felids are important in the dissemination of *Toxoplasma gondii* infection to humans and other animals worldwide, because they are the only animals that excrete oocysts in the environment (Frenkel et al., 1970; Miller et al., 1972; Dubey and Beattie, 1988). Also, there are only a few reports on *T. gondii* infection in wild felids in Brazil, both in zoos (Sogorb et al., 1977; Silva et al., 2001a,b) and in animals in the wild (Ferraroni and Marzochi, 1980; Ferraroni et al., 1980).

Toxoplasmosis is a common infection that rarely evolves to clinical disease. Australian marsupials and neotropical primates are the groups most susceptible to clinical and fatal toxoplasmosis (Dubey and Beattie, 1988; Garrel, 1999). Toxoplasmosis is a serious threat to endangered primates in Brazil, as described by Epiphanio et al. (2000) in zoos in the state of São Paulo. That report showed fatal outbreaks of the disease in golden-headed lion tamarins (*Leontopithecus chrysomelas*) and emperor marmosets (*Saguinus imperator*).

Serological studies have shown a high prevalence of antibodies anti-*T. gondii* in zoo animals that indicates an important spread of this agent in this environment (Riemann et al., 1974; Sogorb et al., 1977; Ippen et al., 1981; Gorman et al., 1986; Choi et al., 1987; Murata, 1989; Zhang et al., 2000; Silva et al., 2001a,b; Spencer et al., 2003; Kikuchi et al., 2004). In studies of toxoplasmosis sero-prevalence performed in felids in zoos and breeding centers, the possible risk factors suggested included the presence of domestic cats roaming in the