

# Viral hepatitis, helminthiasis and protozoan disease in neotropical primates raised in captivity: potentially zoonotic affections with fecal-oral transmission

Ocorrência de hepatites virais, helmintíases e protozooses em primatas neotropicais procedentes de criação domiciliar: afecções de transmissão fecal-oral com potencial zoonótico

Ocurrencia de hepatitis virales, helmintiasis y protozoosis en primates neotropicales procedentes de cría domiciliar: afecciones de transmisión fecal oral con potencial zoonótico

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## ABSTRACT

Brazilian environmental legislation does not allow non-human primates to be raised in captivity. However, this remains a common practice in the Amazon region, and the close proximity of animals and humans facilitates the transmission of zoonotic diseases. The goal of the present study was to evaluate the presence of zoonotic agents in household-raised non-human primates. We analyzed animals donated or apprehended by Brazil's Environmental Police and/or the *Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renováveis* in Pará State, Brazil, and sent to the *Centro Nacional de Primatas*. Blood samples taken from 25 animals during the quarantine period were subjected to serum and antibody tests for viral hepatitis (types A, B and E) at the Instituto Evandro Chagas. Parasitological analysis of fecal material was performed on 29 animals using direct examination and the Willis and Hoffman methods. None of the animals tested positive for anti-hepatitis B or anti-hepatitis E virus antibodies, but 12% were positive for total anti-hepatitis A antibodies. In addition, parasitological studies showed that 48.2% of the animals had parasites with zoonotic potential. *Strongyloides stercoralis* was observed in 17.2%, but this parasite was associated with *Giardia lamblia* in only 3.4% of the samples. *Giardia lamblia* and *Entamoeba histolytica* were detected in 3.4% and 10.3% of the samples, respectively. All of the pathogens described in this study are transmitted through the fecal-oral route. Therefore, we concluded that non-human primates should not be raised in captivity, and this practice should be addressed as an important public health concern.

**Keywords:** Zoonoses; Intestinal Diseases, Parasitic; Hepatitis Viruses; Primates.

## INTRODUCTION

The rise and spread of zoonoses is an important public health and safety issue, especially when close contact occurs between humans and animals. Non-human

primates in particular expose humans to a high risk of disease transmission due to their close taxonomic position and region of origin<sup>1</sup>.

The likelihood of disease transmission by these animals is primarily determined by the degree of physical proximity to humans and by the handling of organic material when animals are in captivity. In northern Brazil, it is a common regional and cultural practice to raise primates as pets<sup>2</sup>. The environments in which non-human primates are raised often lack minimum sanitary conditions, which facilitates the spread of zoonotic diseases as humans come into contact with body fluids and excrement produced by the animals<sup>3</sup>.

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Non-human primates can transmit many zoonotic agents<sup>3</sup>, including protozoa such as *Toxoplasma gondii*, *Giardia lamblia* and *Entamoeba histolytica*, intestinal worms, heartworms, hookworms, strongyles (which spreads via the feces of its host) and *Leishmania* (a mosquito-borne disease). Other groups of etiologic agents, such as viruses, can also cause zoonotic disease, some of which are extremely serious and dangerous, such as rabies and viral hepatitis. Hepatitis A and E can be transmitted to humans by non-human primates, primarily through the fecal-oral route. Animals carrying the virus and raised at home can contaminate the environment, food and, consequently, people<sup>4</sup>. Another virus of great importance due to its lethality and transmissibility by non-human primates is Herpesvirus simiae. This virus can be transmitted by indirect contact through saliva and aerosols, with a higher risk of transmission in cases of animal bites<sup>5</sup>.

The aim of this study was to evaluate the sanitary conditions of non-human primates raised in captivity in Pará state, Brazil, by testing the animals for zoonotic diseases, with a particular focus on viral hepatitis and intestinal parasites that can be transmitted to humans.

## MATERIALS AND METHODS

We analyzed 29 non-human primates that were donated or apprehended by the Environmental Police and/or the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA/PA) in households located in the State of Pará. Animals were allocated to the National Primates Center (CENP/IEC/SVS/MS), where they remained in quarantine before selection for the study.

During the quarantine period, blood samples for serological analysis were collected by femoral vein puncture, and fecal samples were collected for general parasitological analysis. Blood cell count and tuberculin tests were performed according to established protocols.

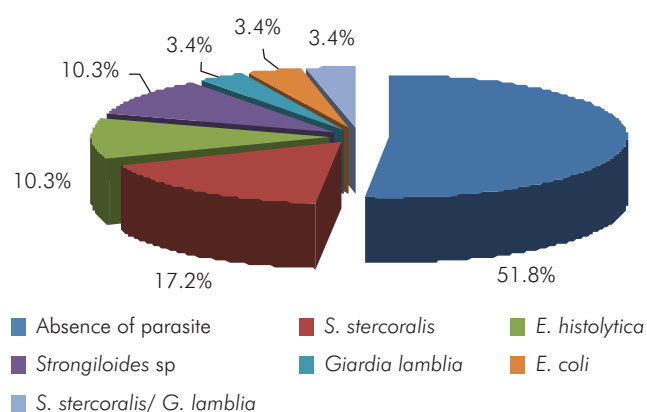
Fecal analysis of 29 animals from different species was performed in the parasitology laboratory at CENP/IEC/SVS/MS. The animals analyzed belonged to the following species: *Cebus apella* (n = 20), *Saguinus niger* (n = 2), *Callicebus moloch* (n = 1), *Saimiri sciureus* (n = 4), *Saguinus fuscicollis* (n = 1) and *Cebus nigrivittatus* (n = 1). Fecal analyses were performed using the Willis and Hoffman methods and by direct examination. Briefly, direct examination was performed by placing a small amount of feces homogenized with a mixture of Lugol's solution and saline on a microscope slide, which was observed using an optical microscope to detect the presence of protozoa (especially trophozoites).

To determine the seroprevalence of hepatitis B (HBV), hepatitis A (HAV) and hepatitis E (HEV) antibodies, 25 samples of blood serum were analyzed. The collected sera were stored at -20°C and thawed at the time of processing. Serological testing was performed using enzyme immunoassays for markers of HBV (HBsAg and anti-HBc), HAV (anti-HAV) and HEV (anti-HEV). Positive serum

samples were subjected to quantitative tests for antigens and/or antibodies. These analyses were performed in the laboratory of the Section of Hepatology (SAHEP) of the Evandro Chagas Institute (IEC).

## RESULTS

Of the 29 stool samples analyzed, 48.2% tested positive for parasites with zoonotic potential. The helminth *Strongyloides stercoralis* was found in 17.2% of samples and was associated with the parasite *Giardia lamblia* in 3.4% of samples (Figure 1). It is noteworthy that 100% of *Saimiri sciureus* stool samples contained this helminth, which was found in only 4.5% of *Cebus apella* samples. In addition, 10.3% of samples tested positive for *Entamoeba histolytica* and 3.4% contained *Entamoeba coli*. Viral hepatitis analysis showed that 12% of samples were positive for specific anti-HAV antibodies, but with no IgM and IgG specificity.



**Figure 1** – Zoonotic enteroparasites identified in non-human primates raised in captivity in the metropolitan area of Belém City in Pará State, Brazil

## DISCUSSION

In this study, we found that *Strongyloides stercoralis* (17.2% positive samples) can be hosted by a variety of species of non-human primates. The presence of *Strongyloides* in monkeys deserves special attention not only due to the danger of natural infection of other animals, but also because the parasite has the potential to infect humans<sup>6</sup>. Strongyloidiasis, which is caused by an intestinal nematode, occurs asymptotically in most infected individuals. However, it is considered of great medical importance because it results in hyperinfection and dissemination in immunodeficient patients<sup>7,8,9</sup>. *Strongyloides* hyperinfestation was previously reported in marmosets<sup>10</sup>, causing severe damage mainly to the lungs and liver, with chronic inflammation, fibrosis and widespread bleeding, a progression very similar to what is observed in humans<sup>9</sup>. In addition, Strongyloidiasis can lead to death, especially in malnourished animals.

*Giardia lamblia* was identified in only 3.4% of analyzed samples and showed no host specificity. Because it can parasitize both humans and animals, it is considered to be

a potential zoonotic agent. Infected non-human primates are usually asymptomatic and are important sources of infection<sup>11,12</sup>. *Entamoeba histolytica*, which was the most common pathogenic parasite in the samples analyzed in this study (10.3%), is responsible for many deaths in Neotropical primates. However, Old World apes are asymptomatic carriers of *Entamoeba* infection<sup>2</sup>. Therefore, natural infection of Neotropical monkeys presents more severe pathogenic effects compared to those observed in Old World monkeys<sup>13</sup>.

Most of the infections with intestinal parasites in the studied animals were asymptomatic, which highlights the need for prophylactic deworming of animals in captivity because they may be able to transmit the disease to both other animals and humans.

Hepatitis A infection is usually asymptomatic in non-human primates and children; however, when clinical manifestations are present, they are nonspecific and range from mild disease symptoms to death. The disease spreads primarily via the fecal-oral route or by ingestion of the virus from contaminated food or objects. The virus replicates in the liver and is eliminated in the feces<sup>14,4</sup>.

The results obtained in this study for viral hepatitis show the importance of this zoonosis and confirm that non-human primates are hosts of the Hepatitis A virus. Raising these animals at home favors human infection because monkeys do not have hygienic habits like humans and often contaminate their hands and body with their own stool. In

these conditions, direct and intimate interactions between monkeys and humans facilitate the transmission of this virus.

## CONCLUSION

We have shown that non-human primates host of a variety of parasites with zoonotic potential, including *Giardia lamblia*, *Entamoeba histolytica* and *Strongyloides stercoralis*. These results justify the need for better health surveillance to curb household captivity and improve human health by reducing exposure to zoonotic agents. Because zoonoses can be transmitted from animals to humans and vice versa, humans exposed to direct contact with animals in household environments are at high risk for viral diseases such as hepatitis A.

In summary, non-human primates are reservoirs for a variety of infectious agents that present severe implications for public health. However, despite the existence of Brazilian legislation prohibiting the raising of wild animals in household captivity, the number of apprehended non-human primates in captivity remains high, reflecting the public's ignorance about the risk of zoonotic transmission.

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## Ocorrência de hepatites virais, helmintíases e protozooses em primatas neotropicais procedentes de criação domiciliar: afecções de transmissão fecal-oral com potencial zoonótico

### RESUMO

A criação de primatas não humanos em domicílio não é permitida pela legislação ambiental. Entretanto, na Região Amazônica é comum encontrar primatas não humanos convivendo em ambientes familiares. Essa interface favorece a transmissão de doenças de caráter zoonótico. Esta pesquisa se propôs avaliar a presença de alguns agentes zoonóticos em primatas não humanos de criação domiciliar. Foram investigados animais doados ou apreendidos pelo Batalhão de Policiamento Ambiental e/ou Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renováveis no Estado do Pará e encaminhados ao Centro Nacional de Primatas. Durante a quarentena, 25 animais foram submetidos a coletas de sangue para a obtenção de soro e pesquisa de anticorpos para hepatites virais (tipos A, B e E), realizada no Instituto Evandro Chagas. A análise parasitológica fecal foi realizada em 29 animais, sendo utilizados os métodos de Willis, Hoffman e exame direto. Nenhum dos animais apresentou anticorpos positivos para anti-HBV e anti-HEV; entretanto, 1,2% dos animais apresentaram positividade para anticorpos anti-HAV totais. Os estudos parasitológicos demonstraram que 48,2% apresentavam algum tipo de parasita com potencial zoonótico, ocorrendo *Strongyloides stercoralis* em 17,2% casos, sendo que em 3,4% dos casos este parasita estava associado à *Giardia lamblia*. Isoladamente, *Giardia lamblia* e *Entamoeba histolytica* ocorreram, respectivamente, em 3,4% e 10,3% dos casos estudados. Os patógenos descritos nesse estudo são de veiculação fecal-oral. Portanto, concluiu-se que a relação domiciliar de primatas não humanos com o homem não é recomendável e deve ser encarada como problema de saúde pública.

**Palavras-chave:** Zoonoses; Enteropatias Parasitárias; Vírus da Hepatite; Primatas.

## Ocorrência de hepatites virais, helmintíase e protozoose em primatas neotropicais procedentes de criação domiciliar: doenças de transmissão fecal oral com potencial zoonótico

### RESUMEN

La cría de primates no humanos en domicilio no está permitida por la legislación ambiental. Sin embargo, en la Región Amazónica es común encontrar primates no humanos conviviendo en ambientes familiares. Esa interfaz favorece la transmisión de enfermedades de carácter zoonótico. Esta investigación se propuso a evaluar la presencia de algunos agentes zoonóticos en primates no humanos de cría domiciliar. Fueron investigados animales donados o aprendidos por el Batallón de Policía Ambiental y/o el Instituto Brasileño de Medio Ambiente y Recursos Renovables en el Estado de Pará y encaminados al Centro Nacional de Primates. Durante la cuarentena, 25 animales fueron sometidos a colectas de sangre para obtener suero e analizar anticuerpos para hepatitis virales (tipos A, B y E), realizadas en el Instituto Evandro Chagas. El análisis parasitológico fecal se realizó en 29 animales, siendo utilizados los métodos de Willis, Hoffman y el examen directo. Ninguno de los animales presentó anticuerpos positivos para anti-HBV y anti-HEV; sin embargo, un 12% de los animales presentó positividad para anticuerpos anti-HAV totales. Los estudios parasitológicos demostraron que un 48,2% presentaba algún tipo de parásito con potencial zoonótico, ocurriendo *Strongyloides stercoralis* en 17,2% de casos, siendo que en 3,4% de los casos este parásito estaba asociado a la *Giardia lamblia*. Aisladamente, *Giardia lamblia* y *Entamoeba histolytica* ocurrieron, respectivamente, en 3,4% y 10,3% de los casos estudiados. Los patógenos descritos en este estudio son de vehiculación fecal oral. Por lo tanto, se concluyó que la relación domiciliar de primates no humanos con el hombre no es recomendable y debe ser encarada como problema de salud pública.

**Palabras clave:** Zoonosis; Parasitosis Intestinales; Virus de la Hepatitis; Primates.



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