ABSTRACT

Objective: To determine the prevalence of intestinal parasitism and relevant public health zoonotic ectoparasites in canines of indigenous communities of the Colombian Amazon. Materials and methods: This study included 421 canines from 68 communities, whose owners participated voluntarily in educational talks, interviews, and epidemiological surveys. Fecal samples were obtained by rectal palpation, and they were processed using the formalin-gasoline concentration technique. Double-blind triplicate microscopic analysis was carried out. Results: Parasite infection occurred in 89.8% of the samples, 57.7% protozoans and 73.9% helminthes. Hookworms were noteworthy, including *Toxocara* spp., *Strongyloides* spp., *Alaria* spp., and *Giardia* spp., among others. Ectoparasites were found in 32.8% of the cases. Conclusion: Our study showed the potential risk of transmission of zoonotic infections by canine parasites and the possibility of jungle transmission of the rabies virus, which require intervention with preventive and control programs by the health sector.

Keywords: Hookworms, *Toxocara* spp., *Strongyloides* spp., *Alaria* spp., *Giardia* spp., canines.

RESUMO

Objetivo: determinar a prevalência de parasitismo intestinal e ectoparásitos zoonóticos de saúde pública relevantes em caninos de comunidades indígenas da amazônia colombiana. materiais e métodos: este estudo incluiu 421 caninos de 68 comunidades, cujos proprietários participaram voluntariamente de palestras educativas, entrevistas e levantamentos epidemiológicos. amostras fecais foram obtidas por palpação retal e processadas pela técnica de concentração de
formalina-gasolina. análise microscópica em triplicata duplo-cega foi realizada. resultados: infecção por parasitas ocorreu em 89,8% das amostras, 57,7% em protozoários e 73,9% em helmintos. os ancilóstomos eram notáveis, incluindo toxocara spp., strongyloides spp., alaria spp. e giardia spp., entre outros. ectoparasitas foram encontrados em 32,8% dos casos. conclusão: nosso estudo demonstrou o risco potencial de transmissão de infecções zoonóticas por parasitas caninos e a possibilidade de transmissão de vírus da raiva na selva, o que requer intervenção com programas de prevenção e controle pelo setor de saúde.


1 INTRODUCTION

Canines in urban and rural environments are at risk of infections that may cause gastrointestinal parasitic diseases due to helminthes and protozoans. This causes a reduction in food intake, blood and plasma protein loss, protein metabolism disorders, mineral decrease, enzyme inactivation, and diarrhea (1-4). Some of these parasites might be transmitted to humans, causing affections such as visceral and cutaneous larva migrans, strongyloidiasis, and giardiasis, given the zoonotic character of these infections and the lack of knowledge about the mechanisms and ways of transmission (5,6).

Frequently, especially in rural areas where they are in constant contact with other domestic and wild animals, aside from endoparasites, dogs present with ectoparasites such as scabies, tungiasis, pulicosis, and myiasis. They may also become reservoirs of those that cause leishmaniasis and trypanosomiasis. Another risk factor for human health that could be attributed to them in jungle regions is the transmission of the rabies virus because of the continuous exposure to hematophagous chiroptera bites (7-10).

In the indigenous populations of the Colombian Amazon region, dogs are very important for obtaining food in hunting and in daily activities, and as rewards, they are given raw entrails and leftovers, which are parasite infection risk factors. Intestinal parasite eggs, larvae, and cysts are excreted in feces, causing environmental contamination and human infection (11). Additionally, the lack or misuse of latrines at home and defecating outdoors favor animal coprophagy, which in turn perpetuates the transmission of intestinal parasites among dogs and the communities (12,13). Furthermore, direct contact of canines with other animals helps ectoparasite infestation, which get transported to the houses and establish their life cycles in the households as what occurs with Tunga penetrans (14).

The objective of this research was to determine the frequency of intestinal parasitism and ectoparasitism in canines dedicated to hunting, and possible associated variables in
indigenous communities in the department of Vaupés in the Colombian Amazon region, and to highlight the risk of human infection.

2 MATERIALS AND METHODS

2.1 STUDY AREA AND POPULATION

Study design

We carried out a cross-section descriptive study, and we collected 421 fecal samples from mixed breed dogs, 257 males and 164 females. The average age was 26.7 months; animals were fed leftovers, and their main activity was hunting in indigenous communities in the department of Vaupés in the Colombian Amazon region. They were from nine biogeographical zones and 68 communities, as follows: Cuduyari, 29 (6.9%); Alto Apaporis, 96 (22.8%); Asatrizy (Yapú), 54 (12.8%); Asatiac (Acaricuara), 50 (11.9%); Acazunip, 29 (6.9%); Alubva (Bajo), 15 (3.6%); Querari, 41 (9.7%); Aatizot (Iquié), 36 (8.6%); and Acaipi (Ira Paraná), 71 (16.9%).

The department of Vaupés, whose capital is Mitú, is located between 00° 14” and 10° 48” N, 69° 50’ and 70° 30’ W, in the southeastern part of Colombia in the Amazon region. It is a humid forest at 200 meters above sea level, with an average temperature of 24° C (15), 42,817 inhabitants and an area of 54,135 km². Indigenous people make up 80% of the population, mestizos are 15%, and settlers 5%. The culture of veterinary service for dogs in the urban areas is limited, and it is non-existent in rural areas (16).

Information collection

The inclusion criteria were being canines with homes in the rural area, whose specific activity was hunting, and whose owner participated voluntarily in the study. The information was collected through structured epidemiological surveys applied to 68 rural communities in nine biogeographical zones, by means of a house call and an invitation to participate in the informational talks about canine parasitism and its repercussion in human health, with emphasis in children and pregnant women. Participants were interviewed, asked to sign an informed consent format and the authorization to take direct fecal samples from dogs (17).

The survey included the following variables: gender, race, height, physical condition, type of supplied food, frequency of anti-parasite therapy, and vaccination. The physical evaluation of the animal helped to complete the information about the presence of ectoparasites and skin affections caused by chiroptera bites and dipteran larvae, among other aspects. The
field phase was carried out in the last trimester of 2014 by specialized technician staff from the health secretary of the department of Vaupés.

**Sampling**

We took a 5 g sample, approximately, from each of the canines by rectal palpation. They were placed in a labeled plastic container and we added 5% formol until it was completely covered. They were mixed thoroughly trying to preserve parasite structures and then they were refrigerated at 4 °C and sent to Bogotá to the GIPAMT laboratory of the Universidad Incca de Colombia and to the Laboratorio de Investigaciones en Enfermedades Infecciosas of the School of Medicine of the Universidad Militar Nueva Granada (UMNG) (13).

**Sample processing and analysis**

Samples were processed using the formalin-gasoline concentration technique (18); readings were done by specialized professional personnel in double-blinded triplicate occasions. Those that presented at least one parasite structure were considered positive. They were measured with a lens calibrated with a micrometer, and confronted with the literature and positive controls from the ‘coprotheques’ at the research laboratories of UNINCCCA and UMNG (13,16,19). Records were entered in Excel tables for their treatment and statistical analysis.

**Statistical analysis**

The variables of the study were included in a spreadsheet in Excel-Windows, and then imported to Epi-Info, v.7.2.2.6, for analyses (20); we also characterized the positive and negative groups according to the variable to be analyzed. We determined frequencies and proportions in order to establish the most relevant characteristics in both groups, and we compared the categorical variables by means of the chi square test. To analyze the risk factors we used the corresponding OR with a 95 % CI for the numerical variables, and we calculated the averages and standard deviations; the respective comparisons were determined by applying Student’s t test for independent groups, and we considered p≤0.05 as a significant value criterion (21).

3 RESULTS

The presence of parasite species in the animals was 89.8% (378/421), 57.7% (243/421) by helminthes: hookworms, 17.6% (74/421); *Toxocara* spp., 12.6% (53/421); *Spirocercalupi*,
7.4% (31/421); Alaria spp., 6.9% (29/421); Dipylidium caninum, 5.7% (24/421); Strongyloides spp., 5.5% (23/421); and Trichuris vulpis, 2.1% (9/421). Protozoan infection was present in 73.9% (311/421): Entamoeba spp., 73.9% (311/421); Giardia spp., 31.8% (134/421); and Blastocystis spp., 14.7% (62/421). Ectoparasites—pulicosis, myiasis, scabies, and tungiasis—were found in 32.8% (138/421); 9.7% (41/421) presented hematophagous chiroptera bites. A total of 79.1% (333/421) of the animals showed poliparasitism by helminthes, protozoans and arthropodes. Parasite infection in males was 89.1% (229/257), and in females it was 90.9% (149/164).

The distribution by age group was as follows: 1 to 12 months, 33.5% (141/421); 13 to 48 months, 57.2% (241/421), and 49 months and older, 9.3% (39/421); 57.2% (241/421) had normal weight, 38.7% had cachexia (163/421), and we did not have available information for 4.0% (17/421) of the animals.

Mongrel dogs, hunting activity and agricultural labor were 100% in evaluated dogs that had not been treated for parasites when the study was conducted.

**Evaluated variables**

This study evaluated gender, physical condition, animal use, residence, type of food, vaccination, parasite treatment, race, age, and height; we found no statistical significance between animals that were treated for parasites and the variables, with p≥0.05 and OR≤1.0.

4 DISCUSSION

In Colombia, various studies on intestinal parasites in pet dogs have been reported, with prevalences of 37.4% and 76% (13). They are a risk factor for human infection by zoonotic parasites that cause toxocariasis, uncinariasis, strongyloidiasis, giardiasis, and in rural indigenous communities, jungle transmission of the rabies virus, where the culture of vaccinating and treating dogs for parasites is not part of the good practices of wellbeing and animal health (8,13,23,24).

This report is the first on canine parasitism whose main activity was hunting in indigenous populations of rural jungle areas of the country, and even though its prevalence greatly differs from what was previously reported, its importance lies in the environmental, socioeconomical, and population differences in the evaluated regions in the department of Vaupés. It is necessary to clarify that the diagnostic technique used in all the studies was the same (25).
Among identified helminthiases, hookworms accounted for 17.6%, which was similar to that in the municipality of La Mesa (17.2%), 16.8% and 13.9% for the departments of Huila and Quindío (10,11,24), and 8.6% in the municipality of Coyaima, which are regions of semi-desert and low-rain environments. This evidences the adaptability capacity of these parasites to extreme conditions, given the fact that this infection is cutaneously transmitted after contact with soils where filariform larvae live (13).

Another noteworthy geohelminthiasis was caused by *Toxocara* spp. in 12.6% of cases. Human infection occurs after the ingestion of eggs, which causes visceral larval migration, eye toxocariasis or neurotoxocariasis, among other manifestations. In canines, aside from fecal-oral infection, transplacental or transmammary transmission in lactating pups could occur (26). The entrails of game are part of the food given to dogs in indigenous communities, complemented with leftovers, which are thrown on the floor of the household making transmission easier due to infection by larved eggs from contaminated soil. An association between food supply and toxocariasis infection has been reported by other authors (23,27,28). Transmammary and transplacental infections are recurring in pups, due to the fact that their immune system is deficient in the first stages of their lives (13,29-31).

In the case of *D. caninum*, a common cestode in dogs, 5.7% of the infections presented in animals younger than two years of age, consistent with reports that found them in puppies between 6 and 24 months of age (23,32). Helmithiases, such as *Strongyloides* spp., were 5.5% which is a relevant zoonotic parasite in public health. Various species infect animals; even though it favors a host, its specificity is not strict, and dogs may act as reservoirs, facilitating human infection and displaying a variety of clinical manifestations and syndromes ranging from a self-contained and well-tolerated infection to an uncontrolled self-infection due to massive intestinal hyperinfection and, occasionally, an invasive fatal one (33,34).

One particular finding was the identification of trematode eggs in 6.9% of the samples. We calculated their length and diameter with the arithmetic mean of 53 measurements taken from the different structures, plus two standard deviations. The obtained measurement was a 67.5µm long and 37.5µm diameter egg. By means of photographic registries and a literature review, we identified an infection caused by *Alaria* spp. (*Trematoda, Strigeidae*), a parasite in wild carnivores, including canines, as reported by Rigonatto, *et al.* (figure 1) (35).

The adult phase of *Alaria* spp. is located in the small intestine of the definitive host and eggs are excreted in the feces. Its life cycle requires aquatic environments where it can find the first intermediate hosts –fresh water snails– which are infected by miracidia released from the...
eggs and where the cercariae develop. Subsequently, they infect tadpoles that later metamorphose into frogs with mesocercariae, which acquire the parasitosis after being predated by wild or domestic canines or being ingested by humans (36).

Figure 1. *Alaria* spp. 1a. Operculated egg with double elliptical membrane. 1b, 1c. 67.5 x 37.5 µm eggs, observed with a lugol solution, 40X.

Humans and some vertebrates may act as paratenic hosts for *Alaria* spp. Alariosis might cause ophthalmic affections, and even though no pathognomonic symptoms have been described yet, it could be considered an emerging parasitic entity. Differential diagnosis is done with an infection by ocular toxocariasis (36,37). Finding this trematode in the evaluated canine population confirms its parasitic character in hunting animals and rural life in jungle environments and it is the first report on dogs in Colombia.

Other identified parasites were protozoans in 73.9% of cases: *Giardia* spp. 31.8%. We confirmed the prevalence of this zoonotic parasitosis in several regions of Colombia after comparing it with 2.5% of a study in a veterinary clinic in Teusaquillo in Bogotá in animals that were treated and seen periodically, as well as 16% in dogs from the municipality of Coyaima, and 39% for Tunja in domestic and stray dogs. Likewise, they state that giardiasis and toxocariasis present indiscriminately in animals treated regularly for parasites and those left untreated, which is an indicator of resistance to anti-parasitic drugs or frequent reinfection (13,38-40).

Our results were 73.9% for *Entamoeba* spp., and 14.7% for *Blastocystis* spp., respectively. Human blastocystosis caused by this zoonotic chromista, whose pathogenic
character is still being discussed, ratifies fecal infection (41).

Ectoparasites identified in 32.8% of cases were larvae of dipterans causing myiasis, 10.9%; pulicosis, 22.6%; tungiasis, 12.6%; and scabies, 7.8%. The pathologies presented by the dogs were dermatitis and hematophagous chiroptera bites, which poses the risk of possible jungle transmission of wild rabies virus (7,13,14).

The first epidemiologic bulletin for the integrated surveillance of human rabies in the department of Vaupés up to week 14 in 2018 notified six cases of rabies accidents from which five were in the rural region of the municipality of Mitú, with a rate of 13.3 cases per 100,000 inhabitants, and one case for the small town of Pacoa. The affections were associated with lesions caused by domestic dog bites. Females were mostly affected, 67% of cases, while males were affected 33%. The third week presented the highest number of cases of rabies accident in the department of Vaupés.

Under the new concept of “One health” of the World Organization for Animal Health (OIE), the public health studies in human and animal are framed within the world strategy of human and animal health care and the interaction with the environment. OIE argues that 60% of zoonotic human infectious diseases originate in domestic or wild animals due to the role they represent as a primary source for protein for communities. Additionally, it attributes 75% of the emerging agents that cause infectious diseases that impact public health, especially those that affect the health in developing country communities, particularly children (43).

The scope of this research on canine intestinal parasitism in rural communities of the department of Vaupés was to obtain the report of endemic parasitosis in this population for this region, especially those zoonotic species. It allowed us to detect some limiting factors such as the lack of census information on canine population, and the need for implementing programs to treat parasites and to vaccinate dogs against the rabies virus.

5 CONFLICTS OF INTEREST

The authors declare no conflicts of interest in this study.

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