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ORIGINAL ARTICLE

OCCURRENCE OF PARASITES IN THE SOIL OF PUBLIC SQUARES IN VERANÓPOLIS, RIO GRANDE DO SUL, BRAZIL

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ABSTRACT

Human health is threatened by diseases transmitted between animals and humans, denominated zoonoses. Public parks and squares are environments used by the population and easily accessed by domestic and stray animals. The contact of dogs and cats with the soil from those places may favor the transmission of zoonoses to humans. This study aimed to determine the occurrence of parasites in the soil of public squares in the city of Veranópolis in Rio Grande do Sul State. Forty sand samples were collected in four squares throughout the months of December 2021, January, February and March 2022. The samples were processed by the Hoffman, Pons and Janer (HPJ) and Rugai methods. The results showed that 32.5% (13/40) of samples were positive for the presence of parasitic structures. Nematode larvae, including hookworm, were the most prevalent parasitic structures in the samples. In addition, *Capillaria* sp. eggs, *Strongyloides* sp. larvae, free-living larvae and *Entamoeba coli* cysts were also found. Two collections conducted after rainy days had a higher rate of contamination. The presence of parasites was observed in both superficial and deep samples. Therefore, the presence of parasites in the sand of Veranópolis' public squares demonstrates that there is a risk of parasitic infection for the local population.

KEY WORDS: Animals; parasites; soil; squares; zoonoses.

INTRODUCTION

Human health is globally threatened by diseases transmitted between animals and humans, denominated zoonoses, which affect both rural and urban areas. Zoonotic pathogens can be viruses, bacteria, fungi and parasites. Despite not being as feared as virus, the zoonotic parasites also have a high rate of dissemination and they cause frequent local outbreaks, therefore they might

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be a global public health problem (Cross et al., 2019). Developing countries are more likely to have a high index of zoonotic diseases due to precarious basic sanitation conditions, socioeconomic inequality and low education level, which consequently leads to bad hygiene habits (Rodrigues et al., 2017).

Dogs and cats are hosts of some species of zoonotic parasites and potential transmitters of these pathogens. Considering the high numbers of these animals at home and on the streets, the human population is exposed to higher risks of parasitic infection (Leon et al., 2020). Public parks and squares are leisure environments frequently visited by the population, mainly children, and they are also easily accessed by domestic and stray animals. The contact of infected animals with the soil of these recreational places creates a transmission route of zoonoses to humans because when defecating in the sand, their eggs and larvae may remain viable on the place for a long time (Rocha et al., 2011; Leon et al., 2020). Children are most likely to be contaminated since they usually have direct contact with the contaminated soil, less hygiene care as well as they have the habit of putting sand and objects in their mouths (Capuano & Rocha, 2006; Nooraldeen, 2015).

Soil-transmitted helminths are widely distributed in tropical and subtropical regions, due to the heat and high humidity that are essential for the development of these parasites until their infectious stage (Bethony et al., 2006). In Brazil, it is estimated that 93 million people are infected by soil-transmitted helminthiases, where *A. lumbricoides* is the most prevalent pathogen (Araújo-Jorge, 2011). However, a global estimate from the year of 2010 showed that approximately 575-740 million people were infected by hookworm (Webb Jr, 2020). In addition, despite being one of the most neglected tropical diseases, strongyloidiasis affects more than 100 million people around the world (Toledo et al., 2015).

Parasitic diseases can affect the nutritional level of the host and cause complications such as rectal prolapse, intestinal obstruction and neurological disorders (Chen & Mucci, 2012). The transmission of these diseases can be prevented with health educational actions and basic sanitation. The knowledge of the presence of parasites in the environment is essential for reducing soil contamination and the zoonoses occurrence along with the need of improving sanitary conditions (Araújo-Jorge, 2011; Dalzochio et al., 2020).

Therefore, given the lack of studies on parasitological contamination in public leisure places, as well as the fact that these places are usually used by the local population, mostly children, this study aimed to determine the occurrence of parasites in the soil from four public squares located in the city of Veranópolis in Rio Grande do Sul State (RS), Brazil.

MATERIAL AND METHODS

Veranópolis is a small city, with approximately 26,813 inhabitants and a total area of 289,464 km², located in the northeast of Rio Grande do Sul State (IBGE, 2021a), with a subtropical climate. In the present study, 40 soil samples were collected from four public squares, located in Medianeira, Palugana, Santo Antônio and São Pelegrino neighborhoods (Figure), throughout the months of December 2021, January, February and March 2022.

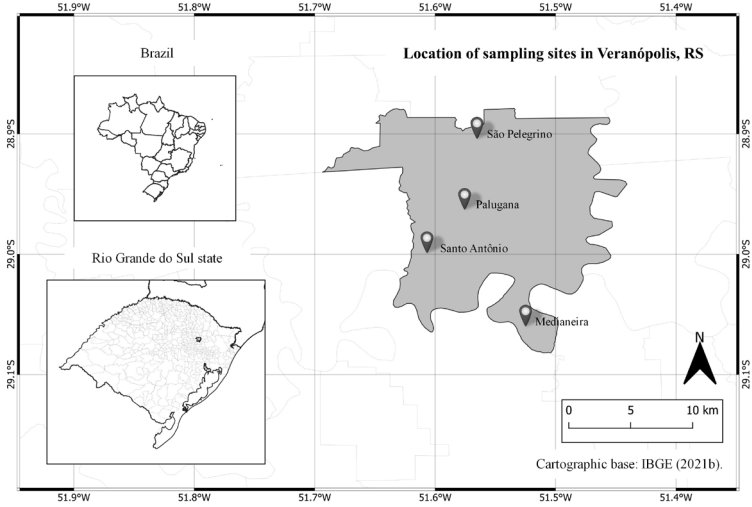

Figure. Sampling sites location in Veranópolis, RS, Brazil.

The collections were performed at five demarcated spots, four of them on the corners, establishing a quadrate, and another one in the center of the collection field. At each square, 10 samples of approximately 200gr of sand were collected (Bortolatto et al., 2017; Mota et al., 2018; Leon et al., 2020). In addition, other local characteristics, such as the presence of fences, trash and animal feces, were also registered during the collections.

During the field visits, two samples were collected in every square, one superficial and the other one deep, on the same spot. Samples with dirt, e.g. leaves and stones, were not collected. On rainy days no collections were done. Once the samples were collected, they were stored in plastic bags and then in a thermal box to preserve the soil characteristics. At the same day, the soil samples were transported to the laboratory of parasitology at *Centro Universitário CNEC de Bento Gonçalves*, where they were processed by the Hoffman, Pons and Janer (HPJ) method, based on the spontaneous sedimentation technique, and the Rugai method, based on the hydrotropism and thermotropism of larvae (Ferreira, 2021).

For each sample two slides were prepared, one from the HPJ sedimentation method and the other one from the Rugai method hence 80 slides in total. The samples were stained with Lugol and analyzed under an optical microscope (Olympus CX31). The entire slide was analyzed at 10X and at 40X magnification when confirmation of the parasitic structure was necessary. For a reliable identification of the parasites, an atlas of parasitology was used to compare the images with the structures found. Samples containing any parasitic structure were considered positive.

RESULTS

Among the samples analyzed, 32.5% (13/40) were positive for parasitic structures. According to Table 1, parasitic structures were found in all squares studied. The highest parasitological contamination was found at the Medianeira square, representing 46.2% (6/13) from the positive samples. Meanwhile, the Santo Antônio square was the least contaminated with just one positive sample (7.7%). Two squares, Palugana and Medianeira, presented polyparasitism. Santo Antônio and Medianeira had fences, while there were no barriers to the animals in the other squares. In addition, animals' feces were seen in all squares and trash was present in the sand of the Palugana and Santo Antônio squares.

Table 1. Occurrence of parasitic structures in the sandy soil from four public squares located in Veranópolis, RS, Brazil.

Squares	Number of samples analyzed	Number of positive samples	Frequency
Medianeira	10	6	60%
Palugana	10	3	30%
Santo Antônio	10	1	10%
São Pelegrino	10	3	30%
Total	40	13	32.5%

As shown in Table 2, unidentified larvae were present in 76.9% (10/13) from the positive samples, being the most frequent parasitic structure found, followed by hookworm larvae in 23.1% (3/13) and *Capillaria* sp. eggs in 15.4% (2/13). Also, free-living larvae, *Strongyloides* sp. larvae and *Entamoeba coli* cysts were identified in 7.7% (1/13) from the samples.

Table 2. Parasitic structures found in the sandy soil from four public squares located in Veranópolis, RS, Brazil.

Structures	n=13	Frequency (%)	Squares
Unidentified larvae	10	76.9%	All
Hookworm larvae	3	23.0%	Medianeira
Capillaria sp. eggs	2	15.4%	Medianeira
Free-living larvae	1	7.7%	Palugana
Strongyloides sp. larvae	1	7.7%	Medianeira
Entamoeba coli cysts	1	7.7%	Medianeira

The collections occurred in spring and summer time. The first three collections (December and January) occurred on sunny days, and the others (February and March) were conducted when the sand was more humid after rainy days. The latter samples presented greater contamination (Table 3). Twenty-four samples were collected through December and January, but just three of them were positive, whereas, the other 16 samples collected in February and March presented parasites in 10 of them.

The presence of parasites was observed in both superficial and deep samples. The results were similar, considering that out of 20 samples each, parasitic structures were found in seven and six soil samples collected in deep and superficial soil, respectively.

Table 3. Relation between the weather aspects and the number of positive samples.

Weather	Number of collected samples	Number of positive samples	Frequency
Sunny	24	3	12.5%
Rainy	16	10	62.5%
Total	40	13	-

DISCUSSION

According to the present study, parasites were observed in 32.5% of sand samples collected at different squares in Veranópolis. Other studies carried out in Rio Grande do Sul had a similar frequency of parasites in the sand. In Bento Gonçalves, a prevalence of 43.3% of parasites was found (Gonçalves & Paludo, 2018). Prestes et al. (2015) observed a prevalence of

41% of positive samples in squares located in six cities from the State. In Pelotas, 44% from the samples were contaminated with at least one parasite (Moura et al., 2013). The presence of parasites in the sand of public squares can be explained by the fact that animals have free access to these places. Dogs and cats, mainly stray ones, represent important sources of contamination because when infected by zoonotic parasites, they eliminate parasitic eggs, larvae, cysts and oocysts in the feces, thus contaminating the soil from squares, parks, beaches and peridomiciliar areas (Rocha et al., 2019; Alegría-Morán et al., 2021). Accordingly, animal feces were present in all the squares analyzed in this study. Another study analyzed dog feces collected in public areas in Ribeirão Preto city, Sao Paulo and parasites were present in 56.8% of the samples (Capuano & Rocha, 2006).

Although there were fences barring the circulation of animals, the Medianeira square was the most contaminated. In contrast, a previous study demonstrated a lower rate of positivity in the squares with fences (Prestes et al., 2015). This contamination can be explained by the fact that a large part of the sand in Medianeira square was in the shade, making the sand more humid than in the other squares. Factors such as the frequency of rain and the sun exposure of the contaminated soil are essential for parasitic development. The humidity of the soil is necessary for the survival of helminth larvae through their stages (Rocha et al., 2011).

Hookworm larvae, *Capillaria* sp. eggs, *Strongyloides* sp. larvae and *Entamoeba coli* cysts were the parasitic structures identified in this research. Similarly, Lee et al. (2021) verified the presence of hookworm larvae, *Strongyloides* sp. larvae and *Capillaria* sp. eggs in public squares in Aracaju, in Sergipe State. Hookworm larvae and *Strongyloides* sp. larvae were also reported in the soil from the city of Uberlandia, in Minas Gerais by Mota et al. (2018). In Caxias do Sul - RS, *Entamoeba coli* cysts were present in only 1% of the contaminated samples (Bortolatto et al., 2017).

The parasitic structures found are the agents of diseases. Cutaneous larva migrans is caused by percutaneous penetration of the hookworm larvae or by oral ingestion (Cirne et al., 2017). *Strongyloides* sp. causes strongyloidiasis, a disease that varies from asymptomatic to chronic symptomatic infections (Toledo et al., 2015). The soil-transmitted helminthiases have common symptoms such as diarrhea, abdominal pain, vomiting, reduced absorption of micronutrients and dehydration (Celestino et al., 2021).

The two collections performed after rainy days revealed a higher number of positive samples. In the study conducted by Mota et al. (2018), samples were collected during the rainy and dry seasons and a higher contamination was found in the rainy season. In contrast, Tiyo et al. (2008) observed a higher prevalence in the winter, corresponding to the dry season. Thus, both studies reinforce that the weather can influence the parasitological contamination of the soil.

The frequency of parasites, especially larvae, in the sand of the public squares in Veranópolis suggests a risk of parasitic contamination for the local population. Considering that Veranópolis has good sanitary conditions and only a few stray dogs on the streets in comparison to other cities, the notable contamination is very concerning. In order to reduce the risk of infection, the population need to be more aware of the importance of collecting dog feces, vaccination and periodical use of vermifuges.

For further studies, more samples should be collected in the squares. Additionally, the collections should be performed in different seasons, preferably in summer and winter, to better assess the climate influence on the contamination.

Considering that 32.5% of samples presented parasitological contamination, all the squares analyzed in this study presented a risk for parasitic infection. Factors such as the climate, sanitary conditions and the free access of animals on those areas are responsible for the sand contamination.

In order to prevent and reduce parasitic dissemination, sand contamination should be monitored occasionally. Besides, practices to control the increase of stray animals and frequent squares´ cleaning should be adopted by the city. Educational programs for the population, mainly for the children who are more likely to be infected, are necessary to make the population aware about parasites and their risks to health.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest to disclose.

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