



## CONTAMINATION OF URBAN RIVERS IN THE CITY OF ASUNCIÓN, PARAGUAY, WITH OOCYSTS OF *CRYPTOSPORIDIUM* SPP. AND CYSTS OF *GIARDIA* SPP.

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### ABSTRACT

Although the presence of protozoa in drinking water is a major public health problem in many countries, knowledge about the risks of these organisms in the anthropogenic environment in Paraguay is still scarce. *Giardia* spp. and *Cryptosporidium* spp. are pathogenic protozoa with faecal-oral hydric transmission that cause gastrointestinal disorders which reflexes may be severe for children, old-aged individuals and immunocompromised people. The research aims to investigate oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. in water samples from four rivers that cross the city of Asunción, capital of Paraguay. Water samples were collected from the Riachuelo, Antequera, Peru

and Mburicaó rivers. The spontaneous sedimentation technique was used for all water samples to concentrate the particulate material. For the research of cysts of *Giardia* spp. slide-coverslip preparation was used. For the search for *Cryptosporidium* spp. Ziehl-Neelsen staining was used. The results presented positivity for both oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. in the water samples that were collected in the Antequera, Peru, and Mburicaó rivers, and only *Cryptosporidium* spp. in the waters of the Riachuelo River. The

concentration of cysts and oocysts per microscopy field was higher in the Mburicaó river sample and, in decreasing order, in Peru and Antequera rivers. The concentration of *Cryptosporidium* spp. in the sample of the Riachuelo River was lower than the other samples. This was the first record of *Cryptosporidium* spp. in rivers of Paraguay in the scientific literature. We concluded that waters of urban rivers of the city of Asunción are contaminated with oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. through the domestic sewage discharge. It is recommended that the population be advised to avoid contact with water from contaminated rivers and that sanitation measures to improve river water quality should be adopted by health authorities.

**KEYWORDS:** *Cryptosporidium* spp., *Giardia* spp., Enteroparasitoses, Rivers contamination, Paraguay.

## INTRODUCTION

The etiological agents of enteroparasitoses are widespread in the environment and among a significant part of the world's population. These parasitic diseases constitute one of the most relevant public health problems worldwide. The World Health Organization estimates that about 3,5 billion people are hosts of parasites.<sup>[1]</sup> The high prevalence rates of enteroparasites in various regions of the globe are related to the environmental, social, economic, cultural and educational conditions of infected populations. High rates of parasitic infections generally linked to pollution of water, soil and food consumed.<sup>[2,3,4]</sup> The World Health Organization estimated that  $1,38 \times 10^9$  people in the world are parasitized by *Ascaris lumbricoides*, and among these hosts,  $250 \times 10^6$  are sick;  $1,25 \times 10^9$  are parasitized by species of the Ancylostomatidae family, with  $151 \times 10^6$  sick people;  $4,5 \times 10^6$  cases of trichuriasis;  $1,7 \times 10^6$  onchocerciasis, and still 1,8 million people from various regions of the world die each year as a result of gastroenteritis whose etiological agents spread due to the lack of treated water. Among these pathogenic biological agents contaminating water stand out helminths, protozoa, viruses and bacteria.<sup>[1]</sup>

Enteroparasitoses are more frequent in children and young adults, and depending on the action of the parasite on the host, it may interfere with the nutritional status and physical development of the infected one, causing losses to the intellectuality, with reflexes on low learning rate.<sup>[5]</sup> Episodes of diarrhea caused by *Cryptosporidium* spp. in children under five years-old are associated with developing growth problems.<sup>[6]</sup>

Human faecal contamination of the aquatic environment originates from discharges of public or domestic sewage. Contaminant parasitic elements adhere to soil particles and are carried by water mainly during rainfall and flooding, which impairs the water quality of springs.<sup>[7,8]</sup> The World Health Organization considers the genera *Cryptosporidium* and *Giardia* as reference pathogens in the evaluation of water potability. Reference pathogens are those that serve as a framework for the design and implementation of sanitary measures and targets for the treatment of drinking water with acceptable quality. Among protozoa, several species can be transmitted to humans through the ingestion of satisfactorily untreated water, such as *Cryptosporidium* spp., *Giardia* spp., *Entamoeba histolytica*, *Toxoplasma gondii*, *Balantidium coli*, *Cyclospora cayetanensis*, *Isospora belli* among others.<sup>[9]</sup>

The genus *Cryptosporidium* was described in 1907 as a rat parasite<sup>[7]</sup> and is now recognized as an intracellular parasite of the gastrointestinal epithelium, causing self-limiting diarrhea in immunocompetent people and severe gastrointestinal disorders in immunocompromised patients.<sup>[4,10]</sup> Some species of the genus *Cryptosporidium* are identified as agents of intestinal, respiratory and hepatobiliary infection. Regarding intestinal disease, *Cryptosporidium* spp. can cause four distinct clinical forms: asymptomatic and self-limiting; acute or transient, forms diagnosed in immunocompetent people, and chronic and fulminant clinical forms in immunocompromised individuals, as in AIDS patients.<sup>[2,11]</sup> The genus *Cryptosporidium* was the fifth leading cause of diarrhoeal mortality in children younger than 5 years old, causing over 48300 deaths and affecting approximately 4,2 million people in the year of 2016.<sup>[6]</sup>

*Giardia lamblia* infection usually occurs by the ingestion of cysts diffused in water contaminated with faecal matter. Asymptomatic infection can occur in both adults and children. The acute phase of this parasitosis is characterized by a diarrheal condition lasting from two to four weeks. The most common clinical signs are steatorrhea, abdominal discomfort, nausea, vomiting, and weight loss. The disease in immunocompromised individuals can present symptoms persisting for seven weeks or more. In these cases, weight loss occurs as a result of nutrient malabsorption.<sup>[12,13]</sup> Giardiasis affects approximately 280 million people a year worldwide and is considered an underreported disease.<sup>[14]</sup>

Considering the importance of the infections caused by *Cryptosporidium* spp. and *Giardia* spp., this research has the objective to investigate the occurrence of oocysts and cysts of these protozoa in water samples from four tributaries that flow to the Paraguay River in the urban area of the city of Asunción, Paraguay.

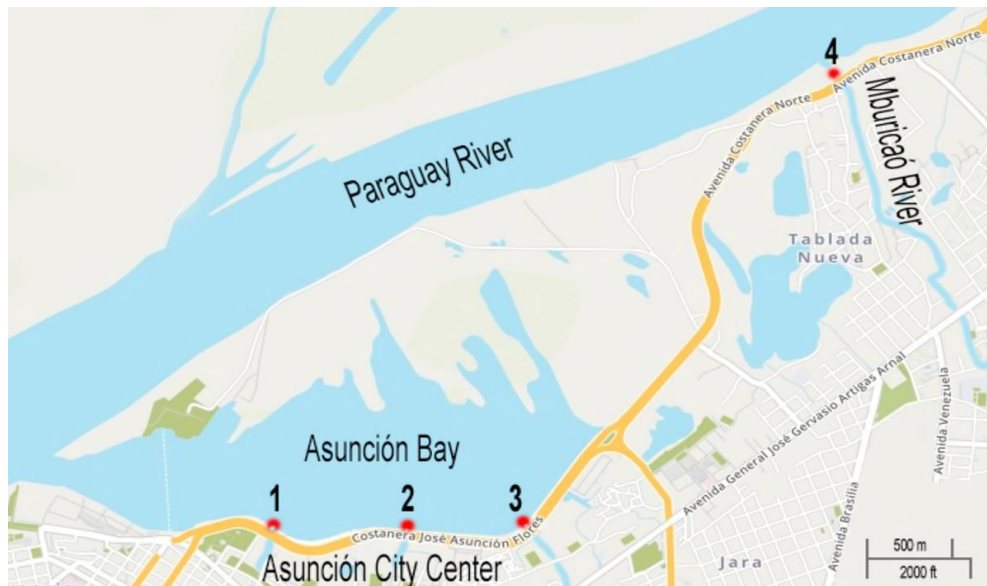
## STUDY FIELD

The research for oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. was performed in the year 2019 with samples of waters from rivers of the city of Asunción that converge to the Paraguay River. Asunción is the capital of the country. According to the General Department of Census and Statistics (DGEEC), the city had 524190 inhabitants in 2017. The country registered 92466 hospitalizations for diarrhea in 2017 and 3946 cases of giardiasis. The infant mortality rate in 2017 was estimated at 26,05 per Thousand.<sup>[15]</sup>

According to Estigarribia *et al.*<sup>[16]</sup>, Asunción's popular neighborhoods near the Paraguay River are vulnerable to contamination by solid waste and urban effluents. These authors describe that the riverside neighborhoods do not have a sewage collection service and that the more distant neighborhoods discharge the sanitary sewage in rivers that converge to the Paraguay River, further degrading the quality of river water of this region of the city. Similarly, the Mburicaó River, which crosses seven Asunción neighborhoods and has a length of 16,25 km, is contaminated by domestic and industrial discharges.<sup>[17]</sup>

## MATERIAL AND METHODS

The research for oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. was conducted in October 2019 on water samples collected from four urban rivers: Riachuelo, Antequera, and Peru rivers, which flow to the Asunción Bay, and the River Mburicaó, which flows directly to the Paraguay River (Figure 1). The sources of these rivers rise in the region of the capital of Paraguay and receive domestic and industrial discharges along their course. Samples of two liters of water from each river were collected in October 2019, time of the year with warm weather and average rainfall. The samples were examined at the Parasitic Diseases Research Laboratory of the UNIABEU University Center in the city of Belford Roxo, Province of Rio de Janeiro, Brazil. The spontaneous sedimentation method was used to concentrate the particulate material. The search for cysts of *Giardia* spp. was performed by observing the sediment in preparation between slide and coverslip, in which a drop of lugol was added, and observed under bright microscopy with the 40X objective. The search for oocysts of *Cryptosporidium* spp. was performed by fixing the sediment on slides using the staining method of Ziehl-Neelsen. *Cryptosporidium* spp. preparations were dried at room temperature and examined under light microscopy with the 100X objective.



**Figure 1: Sampling points of Asunción rivers.**

Point 1 - Riachuelo River; Point 2 - Antequera River; Point 3 - Peru River; Point 4 - Mburicaó River.

## RESULTS

The results showed positivity for *Cryptosporidium* spp. and cysts of *Giardia* spp. in the water samples collected in the Antequera, Peru, and Mburicaó rivers, and only *Cryptosporidium* spp. in waters from the Riachuelo River. The concentration of cysts and oocysts per microscopic field was higher in the Mburicaó River sample and, in decreasing order, in Peru and Antequera rivers. The concentration of *Cryptosporidium* spp. in the Riachuelo River was lower than the other samples.

## DISCUSSION

According to Razzolini *et al.*<sup>[18]</sup>, the presence of *Cryptosporidium* spp. and *Giardia* spp. in water is worrisome even at low concentrations due to the high infectivity of these protozoa associated with a high prevalence rate in the global population. Despite the attributes that give to these protozooses great importance in public health, considered as reference pathogens in the water quality control by WHO<sup>[9]</sup>, there are scarce researches on the incidence of these parasitic agents in Latin America, particularly in Paraguay.

Water transmission of protozoans can affect a large population that uses this source for supply. Mac Kenzie *et al.*<sup>[19]</sup> reported that in 1993 in the cities of Milwaukee and Wisconsin, United States of America, approximately 400000 people were contaminated by drinking

water supposedly clean, but contaminated with *Cryptosporidium* spp. Campos and Guerreiro<sup>[20]</sup> and Alarcón *et al.*<sup>[21]</sup> affirmed that rivers are often used as a discharge of untreated wastewater, and these contaminated waters are used downstream for domestic consumption and agricultural irrigation. Alarcón *et al.*<sup>[21]</sup> mentioned that the Bogota River, which flows through some densely populated regions of Colombia, has its waters used for livestock, agricultural activities and as a source of water for treatment and human consumption. River pollution increases as it passes through cities located in its basin discharging domestic sewage and industrial wastewater without any prior treatment. This fact is considered the main source of water contamination. The authors cited the need for resources to evaluate water quality and treatment efficiency, and the consequent health risk to the population. We consider that the conditions pointed by Alarcón *et al.*<sup>[21]</sup> in Colombia are similar to that found in Asunción, Paraguay, and that the microbiological assessment of the water quality of Asunción's urban rivers should be periodically checked in order to draw decontamination plans and targets, with repercussions for the environment and the quality of life of the inhabitants.

Ibrahim *et al.*<sup>[22]</sup> investigated the occurrence and concentration of *Giardia* spp. in sewage and in water samples from rivers of the Al-Jinberiyah region, Syria, and the affluent and effluent waters of the water treatment plant. Samples of three contaminated river water were also examined. The results showed that 87.5% of the effluent samples from the treatment station were positive for *Giardia* spp. and 75% of the effluent waters were also positive for this protozoan. From the river contaminated with treated sewage, 100% of the samples showed positivity. These authors indicated that the levels of *Giardia* spp. Al-Jinberiyah river waters figures as a potential risk to the health of riverside inhabitants, particularly in activities like irrigation, swimming, bathing and other contacts with water. We agree with Ibrahim *et al.*<sup>[22]</sup> as the Asunción bay, where the rivers Riachuelo, Antequera, and Peru dumps, is a traditional water recreative site.

The researchers Ma *et al.*<sup>[23]</sup> investigated protozoa of the genera *Cryptosporidium* and *Giardia* in rivers, sewages and slaughterhouses waters located in Qinghai, China. From a total of 456 samples, 10 (2.2%) were positive for *Cryptosporidium* and 97 (21.3%) for *Giardia*. *Cryptosporidium* was detected only in river and sewage waters. The results suggest that *Cryptosporidium* and *Giardia* circulate through the water medium and through different hosts. The authors recommend that China's health and local authorities perform control

measures to reduce contamination of water sources by these protozoans, thus protecting the health of humans and animals. We agree with the recommendations of Ma *et al.*<sup>[23]</sup>, reinforcing the same suggestions for Paraguay's health authorities.

Hsu *et al.*<sup>[24]</sup> investigated waters of the Kau-Ping river, Taiwan, for *Giardia* spp. and *Cryptosporidium* spp., founding 87,5% of positivity for *Giardia* spp. and 75% for *Cryptosporidium* spp. The authors highlighted the rivers as potentially important transmission ways for pathogenic protozoa.

A research of waters from rivers used for recreation in Malaysia was performed by Azman *et al.*<sup>[25]</sup> The analysis of water samples from the Sungai and Cong Kak and Sungai Batu rivers located in Selangor state revealed the occurrence of *Giardia* spp. and *Cryptosporidium* spp. with different concentrations of cysts and oocysts. The results showed that the rates of *Giardia* spp. cysts were higher than *Cryptosporidium* spp. oocysts in the water of both rivers. It was also recorded the presence of faecal coliforms in the waters of these rivers. In our research in rivers of Asunción, the rates of oocysts of *Cryptosporidium* spp. were higher than cysts of *Giardia* spp.

Utaaker *et al.*<sup>[26]</sup> researched *Cryptosporidium* spp. and *Giardia* spp. in drinking water sources in the city of Chandigarh, India, during the dry season and during the monsoon season. Among the examined samples, 22.5% were positive for oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. The research result did not find an association between contamination and the rainy season, but observed an association in the persistence of positivity with the locations of the water sources. These researchers found that even in a city with a well-developed infrastructure, contamination of drinking water by protozoa and other parasites still poses a risk to public health.

Mons *et al.*<sup>[27]</sup> evaluated the contamination of waters from rivers that supply the population of Paris and surrounding cities. The research result revealed the presence of oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. respectively in 47,7% and 93,8% from 172 water analyzed samples. The authors considered as probable sources of contamination the residues of agricultural practices, besides the inadequate treatment of sanitary sewage in rainy periods. The Parisian situation differs from that found in Asunción, where sanitary sewage treatment is precarious or absent and the rivers examined in our research do not cross agricultural areas, only the urban environment.

Moutinho *et al.*<sup>[28]</sup> conducted a research for *Cryptosporidium* spp. and *Giardia lamblia* in waters collected prior to sewage treatment in the Tejo River basin in Lisbon, Portugal. All examined samples were positive for oocysts of *Cryptosporidium* and cysts of *Giardia lamblia*. The authors manifested that the presence of these parasitic agents constitutes a risk to the health of children, the elderly and immunocompromised people. We agree with Moutinho *et al.*<sup>[28]</sup> regarding the risk to vulnerable populations and we highlight that the population of the communities near the collection points in Asunción inhabit informally populated urban areas, occupying marginal and urban territories susceptible to flooding, without basic sanitation infrastructure and precarious health quality, which makes them particularly vulnerable to contamination.

Parasitological water examinations of four Washington State rivers and two California State rivers were performed by Ongerth and Stibbs.<sup>[29]</sup> The results revealed positivity for *Cryptosporidium* spp. in all 11 examined samples. The authors suggest that more detailed studies should be performed to define the temporal and geographical distribution of water contamination by *Cryptosporidium* oocysts and highlight the important role of water transmission of these protozoa.

The occurrence of oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. in the Vargem das Flores dam, in the Province of Minas Gerais, Brazil, was studied by Lopes and Padua.<sup>[30]</sup> These authors evaluated the association between these protozoa with the presence of faecal coliforms in the dam water. Four sites with depths of 2,4 meters and 6 meters were monitored. The result revealed low concentrations of *Cryptosporidium* oocysts, ranging from 0 to 4 oocysts per 100 ml and 0 to 8 *Giardia* spp. per 10 liters of water. The authors considered that the occurrence of these protozoans poses as a risk to the health of the human population if the water is consumed without previous treatment, or in recreational activities. The contamination of the Asunción Bay, with slower water flow than the Paraguay River stream, should have dynamics similar to the dam studied by Lopes and Padua<sup>[30]</sup>, with the same risk pattern in the use of the water.

Mastropaulo and Razollini<sup>[31]</sup> analyzed the quality of the supply water supplied from a neighborhood of the city of São Paulo, Brazil. The research involved faecal coliforms and 13 water samples using the techniques of filtration, separation and immunofluorescence microscopy. The research revealed positivity for *Giardia* spp. for 46% of the *Cryptosporidium* spp. for 7% of the samples. The water samples used in the research by



Mastropaulo and Razollini<sup>[31]</sup> were from underground sources used for human consumption, different from our kind of sample in Asunción, but demonstrate the soil infiltration capacity of *Giardia* spp. and *Cryptosporidium* spp. and the possibility of contamination of the springs, underground waters and aquifers near the contaminated sources by these parasitic agents.

Species of the genus *Cryptosporidium* are pointed by Farias *et al.*<sup>[32]</sup> as one of the causes of outbreaks of gastroenteritis in various countries of the world, mainly in children and immunocompromised patients. In an attempt to understand and monitor the meaning of this pathogen in environmental samples, several methods have been described for the identification of this protozoan oocysts. The authors researched *Cryptosporidium* spp. in sewage waters and a river in the city of São Paulo, Brazil. The analysis revealed oocysts of this protozoan in all examined samples, demonstrating the spreading risk of this parasite through the aquatic environment.

Razzolini *et al.*<sup>[18]</sup> investigated the presence of *Giardia* spp. and *Cryptosporidium* spp. in reuse water samples from two treatment plants in the city of São Paulo, Brazil. The result revealed positivity for cysts of *Giardia* for 35.8% of the samples and *Cryptosporidium* spp. for 30.2%. These authors affirmed that the presence of these protozoa in water is alarming, since even in low concentrations the infectivity rate is high, especially for the most sensitive population, such as elderly and immunocompromised children. They emphasized that combating these protozoans is most critical in developing countries, where water treatment systems are less sophisticated and monitoring of distribution water is poor, as in the capital of Paraguay.

Medeiros *et al.*<sup>[33]</sup> examined water samples from the Itabapoana River in the city of Bom Jesus do Itabapoana, Province of Rio de Janeiro, Brazil. The authors verified the presence of oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. in all sewage samples and in all samples collected near the treatment plant. Samples collected from running water were negative for protozoan cysts and oocysts. They concluded that the source of water contamination of the Itabapoana river with *Cryptosporidium* spp. and *Giardia* spp. was the discharge of domestic sewage from the city, and that the population should be oriented to avoid the use of river water for bathing, swimming, and irrigation of vegetables intended for consumption without cooking. We corroborate the recommendations of Medeiros *et al.*<sup>[33]</sup> and we emphasize that areas near the Paraguay River and its tributaries are subject to

frequent flooding, spreading waterborne pathogens over nearby areas, increasing the risk of contamination.

The researchers Grott *et al.*<sup>[34]</sup> investigated the occurrence of cysts of *Giardia* spp. and *Cryptosporidium* spp. in raw water from admitted to treatment plants in the city of Blumenau, Province of Santa Catarina, Brazil. They analyzed 67 water samples and used the membrane filtration method followed by the immunofluorescence reaction. The positivity for cysts of *Giardia lamblia* was 23.19%, and 7.24% for oocysts of *Cryptosporidium* spp. The detection of pathogenic protozoa in the raw water before the treatment plants points to the value of adopting preventive measures, such as the protection of watershed areas and the proper treatment of domestic sewage in order to reduce the risks of transmission of protozoa and other pathogens to human drinking water. Although the rivers examined in our research are not used for the supply of drinking water, we agree that the protection of springs and the treatment of domestic sewage is fundamental for the control of water contamination by *Giardia* spp., *Cryptosporidium* spp. and other pathogens.

The water quality of the Ibirapuera lake, located in the city of Imbituba, in the Province of Santa Catarina, Brazil, was studied by Abreu.<sup>[35]</sup> The main objective of this research was to evaluate the protozoan contamination of the genera *Giardia* and *Cryptosporidium* and to investigate the environmental characteristics that ease the presence of these parasitic agents. The author cited that around the lake there was an increase of buildings with sanitary structure deficiencies and the consequent discharge of sanitary sewage in the lake without previous treatment. The result of water analysis revealed positivity for oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. 59% of the sample points. The author considered that the main factors associated with the distribution of protozoa in the Ibirapuera lake were related to the contaminated water dispersion according to the wind direction, besides recreational activities and the resistance of infecting agents in the environment.

Touchet<sup>[36]</sup> conducted an epidemiological survey on the incidence of enteroparasitoses among 10 to 19-year-old adolescents living in the area surrounding the Santa Maria Family Health Unit in Asunción, Paraguay. Among the parasitic elements, the author found *Blastocystis hominis* (40%), *Giardia lamblia* (15%), *Endolimax nana* (5%) and *Entamoeba histolytica/dispar* (5%). The author did not refer to coccidial parasitism. In the same line of research, Canese *et al.*<sup>[37]</sup> conducted a research involving 3744 children and found 64% positivity for enteroparasites. Among the parasitic agents diagnosed: *Blastocystis hominis*

(28.1%), *Giardia lamblia* (24.1%) and *Entamoeba coli* (12.5%). The number of children examined was significant (3744), and these researchers also did not refer to coccidial parasitism. Other research by Araújo *et al.*<sup>[38]</sup> in children from an indigenous community of Paraguay revealed the presence of enteroparasites with a rate of 44.6% of the examined samples. They diagnosed *Blastocystis hominis* (31.8%), *Ascaris lumbricoides* (22.7%), *Entamoeba coli* (22.7%), Ancylostomatidae (15.9%), *Giardia duodenalis* (15.9%) and *Iodamoeba butchlii* (2, 3%). These authors, as well as those previously mentioned, also did not refer to the diagnosis of intestinal coccidia. Considering *Cryptosporidium* as a parasite of worldwide distribution, we are of the opinion that the cited researchers did not diagnose the occurrence of coccidia because they did not use specific techniques to detect oocysts in faecal matter. Most enteroparasites found by researchers in Paraguayan territory are transmitted by water transmission, highlighting this medium as one of the main sources of contamination by parasitic elements in that country.

Valinotti *et al.*<sup>[39]</sup> analyzed water samples from 10 rivers that flow to the Paraguay River in the city of Asunción. The samples were obtained by filtration and the filter residues were observed under the microscope. The result showed positivity for *Giardia* spp. in half of the examined samples. Cysts concentration in the studied rivers ranged from 24 to 540 cysts per liter. These authors mentioned that the Mburicaó river was the most contaminated with *Giardia* spp. The results of our survey of samples obtained from the Riachuelo, Antequera, Peru, and Mburicaó rivers in October 2019 coincided with the largest cyst contamination in the Mburicaó River found by Valinotti *et al.*<sup>[39]</sup> in 1998. The Mburicaó River was also the most contaminated by *Cryptosporidium* spp. among the four rivers analyzed in our research, however, this protozoan was not mentioned in the research by Valinotti *et al.*<sup>[39]</sup>

Norberg *et al.*<sup>[40]</sup> investigated the incidence of cryptosporidiosis among Toba Qom indigenous people of the San Francisco de Asis community, in the Cerrito district, city of Benjamín Aceval, Paraguay. Among the 90 faecal examined samples, oocysts of *Cryptosporidium* spp. were found in eight, which corresponds to the prevalence coefficient of 8.9%. The research revealed the need to implement health care programs to improve the living conditions of the Toba Qom community members. This is the only research on the prevalence of *Cryptosporidium* spp. in humans in Paraguay found in the scientific literature. However, the use of water sources far from the Paraguay River, different living conditions, and low prevalence probably represent a distinct epidemiological pattern from the Asunción

city dwellers, as the rates of river water contamination by oocysts of *Cryptosporidium* spp. suggest higher levels of infected individuals in the urban population.

## CONCLUSION

This research is the first record of *Cryptosporidium* spp. in river waters in Paraguay. From the analysis of the results, we concluded that the water in urban rivers of the city of Asunción is contaminated with oocysts of *Cryptosporidium* spp. and cysts of *Giardia* spp. through the discharge of sewage. The concentration of cysts and oocysts per field of microscopy was higher in the Mburicaó river sample, and the samples of all rivers studied were positive for *Cryptosporidium* spp. It is concluded that the Asunción river dumps are sources of contamination of the Paraguay River and the Asunción Bay. The protozoa *Cryptosporidium* spp. and *Giardia* spp. are reference pathogens in the assessment of water potability, indicating contamination by faecal matter, and should be frequently monitored. The urban rivers' contamination with pathogens as *Cryptosporidium* spp. and *Giardia* spp. is of concern for sanitary, environmental and health authorities, indicating that policymakers should define priority strategies in order to protect the streams that cross the city of Asunción and furthermore human health. The population should be advised to avoid contact with water from these contaminated rivers while these sanitation measures are not taken.

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