



Review

Water-borne protozoa parasites: The Latin American perspective



Félix Manuel Rosado-García^{a,b,1}, Milena Guerrero-Flórez^{a,c,1}, Gabriele Karanis^{a,d},
María Del Carmen Hinojosa^b, Panagiotis Karanis^{a,*}

^a State Key Laboratory of Plateau Ecology and Agriculture, Center for Biomedicine and Infectious Diseases, Qinghai Academy of Animal Science and Veterinary Medicine, Qinghai University, Xining, Qinghai, PR China

^b National Institute of Hygiene, Epidemiology and Microbiology of Cuba, Cuba

^c Universidad Nacional de Colombia, Doctorate in Biotechnology, Universidad de Nariño, Research Group of Functional Materials and Catalysis, GIMFC, Colombia

^d Qinghai University Affiliated Hospital, Xining City, 810016, Qinghai Province, PR China

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ABSTRACT

Health systems, sanitation and water access have certain limitations in nations of Latin America (LA): typical matters of developing countries. Water is often contaminated and therefore unhealthy for the consumers and users. Information on prevalence and detection of waterborne parasitic protozoa are limited or not available in LA. Only few reports have documented in this field during the last forty years and Brazil leads the list, including countries in South America and Mexico within Central America region and Caribbean islands. From 1979 to 2015, 16 outbreaks of waterborne-protozoa, were reported in Latin American countries. *T. gondii* and *C. cayetanensis* were the protozoa, which caused more outbreaks and *Giardia* spp. and *Cryptosporidium* spp. were the most frequently found protozoa in water samples. On the other hand, Latin America countries have not got a coherent methodology for detection of protozoa in water samples despite whole LA is highly vulnerable to extreme weather events related to waterborne-infections; although Brazil and Colombia have some implemented laws in their surveillance systems. It would be important to coordinate all surveillance systems in between all countries for early detection and measures against waterborne-protozoan and to establish effective and suitable diagnosis tools according to the country's economic strength and particular needs.

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1. Introduction

During the past century, the human population has more than tripled, and water consumption has more than quadrupled, plac-

ing ever-increasing demands on the world's limited freshwater resources. Approximately one-third of the world's population now lives in areas with scarce water resources. Increasing amounts of pollution from domestic, industrial and agricultural runoff is contaminating an ever-shrinking water supply (Institute of Medicine (US), 2009).

Every year, millions of people, most of them children, die because of inadequate water supply and hygiene (González, 2013). In addition, there is an obvious link between these issues and

* Corresponding author.

E-mail address: panagiotis.karanis@uk-koeln.de (P. Karanis).

¹ These authors contributed equally to this work.

waterborne infections caused by bacteria, viruses, protozoa and helminths. It would be accurate understanding the magnitude of this problem as there is currently an increasing number of infectious agents responsible for different outbreaks in which protozoa play an important role.

Waterborne protozoan parasite infections represent a public health risk in both developed and developing countries responsible for numerous outbreaks in the world (Baldursson and Karanis, 2011; Efstratiou et al., 2017; Karanis et al., 2007). *Giardia intestinalis*, *Cryptosporidium* spp., and *Entamoeba histolytica* are common etiological agents in most of this outbreaks (Baldursson and Karanis, 2011; Karanis et al., 2007; Lee et al., 2014), followed by less frequent water-borne protozoa such as *Toxoplasma gondii*, *Acanthamoeba* spp., *Cyclospora cayetanensis*, *Cystoisospora belli*, *Blastocystis* spp., *Sarcocystis* spp., *Naegleria* spp., *Balantidium coli* and *Microsporidium* spp. (Plutzer and Karanis, 2016). Microsporidia initially were considered to be protozoa and recently have been reclassified as fungi (WHO, 2011). They are typically transmitted through the fecal-oral route and can infect humans and animals through spread faeces in the environment contaminating water sources, recreational water venues, lands and food (Baldursson and Karanis, 2011; Efstratiou et al., 2017; Karanis et al., 2007; Plutzer and Karanis, 2016).

The Journal of Water and Health published in 2007 a review about worldwide waterborne outbreaks caused by parasitic protozoa in almost hundred years “Waterborne transmission of protozoan parasites: a worldwide review of outbreaks and lessons learnt”(Karanis et al., 2007). In addition, in 2011 the journal Water Research published “Waterborne transmission of protozoan parasites: Review of worldwide outbreaks-An update 2004–2010”(Baldursson and Karanis, 2011). Recently, the same journal published “Waterborne transmission of protozoan parasites: Review of worldwide outbreaks – An update 2011–2016” in 2017 (Efstratiou et al., 2017), highlighting that *Giardia intestinalis* and *Cryptosporidium* spp. are the most frequent cause of outbreaks and stating the need to establish an uniform and supraregional surveillance system for these parasites and an international standardization of the reports.

Previously, Plutzer and Karanis, (2016) discussed the current detection tools used in water surveillances of the neglected waterborne protozoa and the consequences of their presence and provide future perspectives. However, it is noticed that only few or no reports from Latin-American countries are available.

Health systems, sanitation and potable water access have certain limitations in nations from Latin America, typical problems from developing countries. Considering factors related with waterborne parasites and the transmission routes in vulnerable hosts to be infected, there are enough reasons to hypothesize that these are issues not discussed in depth in Latin American region.

To analyse the situation of the waterborne protozoa parasites in the Latin American context, it is important to assess it, not just from the outbreaks point of view, but also exploring the findings of these parasites in water samples. Taking into consideration, the impact of climate change on them and always reflecting on the link among parasites, the environment and susceptible host, these issues and other factors are analysed in the present review from the Latino-American perspective.

2. Literature search

We reviewed sources like Science direct, Scopus, Scielo Colombia, Scielo Latin America, Wiley, Highwire, ASM journals online, Google Scholar, Pubmed, Scielo Cuba, EBSCO, Cuban’s Health Virtual Library, Latin-American’s Health Virtual Library, mainly using keywords, such as: “waterborne transmission”, “waterborne parasites”, “protozoa”, “waterborne protozoa outbreaks” and

“climate change”. In addition, we used the Boolean operator’s combination. Searching was limited to English, Spanish and Portuguese languages.

We have put in the cited electronic databases keywords like “genus of waterborne protozoa” followed by the word “outbreak” and on the other hand, the word “outbreak” followed by the possible infectious disease which etiological agent is a waterborne protozoan.

The following table shows the selected keywords.

Protozoa Genus	(AND)	“Outbreak”	(AND)	Disease
“Toxoplasma”				“Toxoplasmosis”
“Cryptosporidium”				“Cryptosporidiosis”
“Giardia”				“Giardiasis”
“Cyclospora”				“Cyclosporiasis”
“Blastocystis”				“Blastocystosis”
“Entamoeba”				“Amoebiasis”
“Acanthamoeba”				“Acanthamoebiasis”
“Naegleria”				“Naegleriosis”
“Microsporidium”				“Microsporidiosis”
“Sarcocystis”				“Sarcocystosis”
“Balantidium coli”				“Balantidiosis”
“Cystoisospora”				“Cystoisosporosis”

In addition, we used in the searching process other combined words like “Diarrhea” AND “Waterborne protozoa parasites”, “Climate Change” AND “Waterborne protozoan parasites” and “Diagnostic Methods” AND “Waterborne protozoan parasites”.

After removal of redundant documents, 125 papers (including published summaries or complete articles), have been considered eligible to be included in this review. Finally, 66 documents with relevant information allowed table designs.

Tables 1 and 2 have similar formats. Additionally, Table 2 adds a column regarding some general procedures for the detection of protozoa in water samples in Latin America whose information discussed on details in an independent chapter.

The current review also describes some aspects on the climate change in Latin America and its potential impact in the distribution and transmission of the waterborne protozoa parasites.

3. Reports of waterborne protozoa in latin america, coordinative activities and current limitations

Protozoan parasites are among the most common parasitic pathogens present in environmental samples and there are significant concerns for most countries in LA regardless its sanitation level (Shanan et al., 2015). Since the toxoplasmosis outbreak in Panama in 1979 and during the last forty years, Latin America published just a few reports in this field (Baldursson and Karanis, 2011; Efstratiou et al., 2017; Karanis et al., 2007). The reviews pointed out, that South America is leading of outbreaks reporting in comparison with Central America and Caribbean islands (Fig. 1).

By countries, Brazil leads the reports of waterborne protozoa parasites in South America with 30.3% (20/66), followed by Argentina with 15.1% (10/66), Colombia 10.6% (7/66), Venezuela 7.6% (5/66), Peru 4.5% (3/66), Ecuador, Chile and Suriname 1.5% (1/66). The distribution among the Caribbean and Central American countries is as follows: Mexico 12.1% (8/66), Cuba and Puerto Rico 3% (2/66), Guatemala, Honduras, Costa Rica, Haiti and Nicaragua 1.5% (1/66), (Fig. 1).

Some countries like Brazil, Argentina and Mexico, which are responsible of most of reports, undoubtedly, they have better technological and logistical opportunities than other countries of the region. However, high economic incomes are not enough to establish a successful epidemiological surveillance. It is also important to have political engagement by the different governments.

In recent decades, it has been recognized internationally that the conditions in Latin America have improved and impacted significantly in a positive way on health indicators in the region, although

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