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Risk factors for intestinal parasitoses among children and youth of Buenos Aires, Argentina

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Abstract

Introduction. Intestinal parasitoses affect millions of people worldwide, especially children of developing countries. In Argentina, the prevalence of these infections varies among areas according to socio-economic and climatic variability. This study aimed to evaluate the prevalence of intestinal parasitoses and risk factors in child and youth populations from neighbourhoods of La Plata (Buenos Aires province, Argentina) affected by occasional floods, including a serious flood in 2013.

Methods. Serial stool samples and anal swabs of 398 individuals were processed using techniques of sedimentation and flotation. Socio-economic variables were surveyed using a semi-structured questionnaire and the land use/cover was determined by classification of a satellite image.

Results. Of all examined individuals, 70.9% were parasitized by at least one of the 12 parasites identified. The most prevalent species were *Blastocystis* sp. (42.7%), *Enterobius vermicularis* (34.7%) and *Giardia lamblia* (17.6%). Infection risk factors included houses built with makeshift materials and dirt floors; lack of piped water and public waste collection service, bed-sharing and living in the non-urban area. More than 70.3% of the participants that lived within less than 200 m from watercourses or permanent water bodies were parasitized.

Conclusion. This research shows that parasitic infections are still a serious public health problem and that they are strongly associated with socio-economic conditions and land use/cover. In this context, studies focused on One Health strategy are need to ensure the diagnosis and surveillance of parasitosis and to tackle zoonotic diseases as well as to encourage the development of sanitary and educational programs sustainable over time.

Keywords

Intestinal parasite; Risk factor; Children; Argentina

Highlights

- More than 70% of children and youth were parasitized.
- 12 parasitic species were identified.
- *Blastocystis* sp., *Giardia lamblia* and *Enterobius vermicularis* were the most prevalent species.
- Intestinal parasitoses are strongly associated with socio-economic conditions.
- Land use/cover was an important infection risk.

1. Introduction

Intestinal parasitoses represent a long-standing problem among the Neglected Infectious Diseases (NIDs) and affect millions of people worldwide, especially children of developing countries. They are mainly associated with the lack of safe drinking water and sewage systems as well as with a limited access to health education and to diagnosis and treatment of infections. Geohelminthiases or soil-transmitted helminthiases are the most prevalent NIDs and affect 24 countries in the Americas. It has been estimated that almost 46 million people were at serious risk of being infected by at least one geohelminth species in 2014 (i.e. *Ascaris lumbricoides, Trichuris trichiura,* hookworms*, Strongyloides stercoralis*) (Pan American Health Organization, 2019). Moreover, among the most prevalent protozoa, *Blastocystis* sp. affects one billion people and *Giardia lamblia* 200 million (Osman et al., 2016; del Coco et al., 2017). Despite the values mentioned, these infections can be controlled or reduced drastically, which proves to be a great challenge for the public health community (Pan American Health Organization, 2019). In this context, there is a constant need to implement new tools to broaden the epidemiological knowledge of enteroparasitoses for developing strategies to mitigate their negative effect on the population. Among these tools, the use of geographic information systems and remote sensing contributes to the epidemiological study of infectious diseases (Rotela et al., 2014). In this regard, different studies were carried out in countries of Africa (Clements et al., 2010; Chadeka et al., 2017), Asia (Ngui et al., 2014; Wardell et al., 2017) and recently, in some countries of South America (Chammartin et al., 2013; Gamboa et al., 2014; Faria et al., 2017).

Studies focused on the One Health approach considering the health of people and that of animals and the environment from a holistic point of view are suggested. Surveys with a multilevel analysis of different factors related with infection could provide useful information for understanding the transmission of intestinal parasites as well as for prioritizing prevention, particularly in sites where there are not regular programs of control of these infections (Rivero et al., 2017). These types of studies become necessary particularly in La Plata, capital city of the province of Buenos Aires (Argentina), where the environmental heterogeneity and the different cultural and social patterns determine variations at a sanitary-epidemiological level. In addition, La Plata suffers occasional floods and, in particular, the city was affected by a serious flood in 2013, aggravating the already existing problems (Ceraso et al., 2018). In this context, the present study aimed to evaluate the intestinal parasitoses and risk factors in child and youth populations from neighbourhoods of La Plata affected by the flood in 2013.

2. Materials and methods

2.1 Study area

The study was carried out in the city of La Plata (La Plata Department, Buenos Aires province). La Plata (34°55′S, 57°57′W) is located near the La Plata River and 60 km away from the Autonomous City of Buenos Aires. La Plata Department is crossed by multiple streams, whose upper and middle watersheds are developed within its territory. The climate is humid-temperate with average annual temperatures of 17 °C and annual rainfall of 1000 mm. Soils are rich in nutrients and organic waste.

The last national census indicated that most households in the city were provided with piped water and sewage systems (National Institute of Statistics and Censuses, 2019). However, only 35%-55% of the periurban area is connected to public services (Oyhenart et al., 2013). Houses often have makeshift connections for water of consumption. Moreover, 8.4% of the households had at least one indicator of unsatisfied basic needs (National Institute of Statistics and Censuses, 2019).

2.2 Samples collection

A cross-sectional study was performed in children and youth of both sexes under 14 years old between school term dates 2014 and 2016. Meetings were performed in public primary schools, health care centers, community canteens and non-governmental institutions placed in the neighbourhoods since most of families attended them for free education, health, meal and recreational activities. Meetings with children, youth and parents were held to inform them about the biology of intestinal parasites, their means of transmission and strategies to prevent them. Free parasitological tests were offered. Each consenting family was provided with two vials for each participant containing formalin 10% for stool samples and anal swabs to diagnose intestinal parasites. Samples were collected by parents or legal guardians during 5-7 successive days, prior to verbal and written instructions. They were asked to fill the vial with a nut-sized stool sample each day. Anal swabs were specifically obtained each morning before getting up by rubbing the perianal margins with sterile gauze and the samples were placed in the vial immediately after (Pezzani et al., 2004; Cazorla-Perfetti, 2014).

The neighbourhoods were randomly selected and at least three meetings were held in each of them. Children and youth who decided to participate voluntarily and whose parents and legal guardians had given written and oral consent were included in the study. Those who had been given some antiparasitic treatment by the time of the research were excluded.

2.3 Parasitological analysis

Coproparasitological tests were performed using techniques of sedimentation (formalin-ethyl acetate concentration) and flotation (Willis/Sheather) (World Health Organization, 1991; Kaminsky, 2014). The anal swab technique was used as a specific method for the detection of *Enterobius vermicularis* since, due to this species is transmitted by anus-hand-mouth route, it is not common to find its eggs in feces. The anal-swab vials were agitated vigorously, and all suspension was placed in 15 ml tubes and then centrifuged for 10 min at 400 g (World Health Organization, 1991; Cazorla-Perfetti, 2014). Staining with Lugol and Ziehl-Neelsen was used when necessary. Every sample was examined using an optical microscope at 100x, 400x and 1000x magnifications. Identification of parasitic elements (eggs/larvae/cysts/oocysts) was based on their measures and morphological characteristics (Thienpont et al., 1979; World Health Organization, 1994).

All families and institutions received the results of the parasitological diagnosis. Positive cases were referred to healthcare units for specific treatment.

2.4 Socio-economic data collection

A semi-structured questionnaire was completed voluntarily by each parent and legal guardian. Information about sex, age and address of each participant was gathered as well as about the housing and peridomiciliary area conditions (e.g. house building materials, lodging or house tenure status, source of drinking water, wastewater disposal, solid waste disposal, flooding), overcrowding (more than three people per room), bed-sharing, parents' education level, parents' employment, governmental food and monetary support, pet ownership, animal husbandry and orchard agriculture for personal consumption. Hygiene practices were included in the questionnaire (hand washing before eating and after going to the toilet and caressing pets, washing of raw vegetables and fruits, walking barefoot, onychophagia and playing in the soil).

2.5 Environmental analysis

Each participant was georeferenced using Google Earth. Thereby, a Landsat 8 OLI image from November 2015 provided by the Comisión Nacional de Actividades Espaciales (CONAE) was analyzed to evaluate the distribution of intestinal parasitosis respect to land use/cover. The image was atmospherically corrected by dark-object subtraction method and classified by the k-means unsupervised classification (Macedo-Cruz, 2010). The classes were validated by field visits and by inspection of a SPOT 6 image (AIRBUS/CNES, provided by CONAE). A confusion matrix was constructed, and the classification showed an overall accuracy of 86% and a Kappa coefficient of 0.78 (Olaya, 2011). In this way, the following six classes of land use/cover were classified: water, agropastoral (low vegetation), arboreal-shrubby (high vegetation), rural constructions, bare soil and urban constructions.

The distance of the georeferenced points from watercourses and permanent water bodies was calculated. The properties were defined as being near areas of water sources when located at a distance ≤ 200 m from this area, and as distant when located at a distance > 200 m.

Environmental analysis was done using the SoPI 3.0 and Quantum GIS 2.14.15 softwares.

2.6 Statistical analysis

A sample was considered positive when at least a parasitic species was observed by any diagnostic method. The prevalence was calculated as the number of parasitized individuals divided by the total number of analyzed individuals, expressed in terms of percentage.

The parasitosis and parasitic species detected were analyzed statistically in relation to the socio-economic and environmental factors. The independence between the variables was determined using the Chi-square test or Fisher's exact test at a significance level of $p < 0.05$. The variables that turned out to be significant associated with the parasitosis were evaluated by means of logistic regression models using stepwise forward variables selection to identify risk factors of intestinal parasitosis. The model with the lowest residual deviance was chosen and, in the case of several competitive models, the most parsimonious was used comparing Akaike Information Criterion and p value. Odds ratio (OR) and 95% confidence interval (95% CI) were calculated. All statistical analyses were done using the R software.

2.7 Ethical aspects

The study was performed without affecting the physical, psychic and moral integrity of the participants and protecting their identity. This research was approved by the Comité de Ética de la Escuela Latinoamericana de Bioética (CELABE) under Resolution No. 003/2016, Record No. 73. The study was conducted attending the principles proclaimed in the Universal Declaration of Human Rights (1948), the ethical standards established by the Nüremberg Code (1947), the Declaration of Helsinki (1964) and its successive amendments. Special attention was also paid to Article 5 of the Regulation Decree of National Law 25.326.

3. Results

3.1 Parasitological analysis

Three hundred and ninety-eight individuals of both sexes were analyzed (49.6% boys and 50.4% girls); ages ranged from 1 to 14 years (40.4% preschoolers -children of ages 1 to 5 years- and 59.6% schoolchildren -children and youth of ages 6 to 14 years-). Overall, 70.9% were parasitized with at least one species. Of the total of the population, 50.4% of girls and 49.6% of boys were parasitized ($p > 0.05$). Parasitosis was higher in schoolchildren (59.6%) compared with preschoolers (40.4%) ($p > 0.05$).

In addition, 67.6% (269/398) were infected by pathogenic species and only 3.3% (13/398) by non-pathogenic protozoa. The total number of identified parasite species was 12 and the most prevalent were *Blastocystis* sp. (42.7%), *E. vermicularis* (34.7%) and *G. lamblia* (17.6%). Moreover, 3.8% (15/398) were parasitized with at least one geohelminth species, the most frequent being *A. lumbricoides* (2.5%). All species found are shown in Table 1. Of the population parasitized, 51.1% presented mono-parasitism and 48.9% multiple parasitism with a maximum of seven species.

Table 1. Prevalence of protozoa and helminths species in children and youth from neighbourhoods of La Plata (Buenos Aires, Argentina)

Parasitic species	No. of positive cases	Prevalence
Protozoa		
Pathogenic species		
Blastocystis sp.	170	42.7
Giardia lamblia	70	17.6
Non-pathogenic species		
Chilomastix mesnili	1	0.3
Endolimax nana	31	7.8
Entamoeba coli	54	13.6
Enteromonas hominis	7	1.8
Iodamoeba bütschlii	3	0.8
Helminths		
Enterobius vermicularis	138	34.7
Hymenolepis nana	11	2.8
Geohelminths		
Ascaris lumbricoides	10	2.5
Strongyloides stercoralis	3	0.8
Trichuris trichiura	4	1.0
Total	282	70.9

3.2 Risk factors of intestinal parasitosis

Three hundred and ninety-seven participants completed the questionnaire with socio-economic data and hygiene practices (the data collected are shown in the Table A.1 and Table A.2 of Supplementary material). Risk of parasitosis and infection for *Blastocystis* sp. was greater in individuals whose houses were built with makeshift materials (OR = 2.6 and OR = 1.9, respectively) and in those who shared bed (OR = 1.8 and OR = 2.3, respectively). Infection for *Blastocystis* sp. was also great in individuals who lived in houses did not have a public waste collection service (OR = 2.2). The infection for *G. lamblia* was higher in participants whose houses had dirt floors (OR = 3.5). On the other hand, the risk of infection for *E. vermicularis* was greater in participants who lived in houses without piped water (OR = 2.1) (Table 2).

Table A.1. Frequency of socio-environmental variables of the population from neighbourhoods of La Plata (Buenos Aires, Argentina)

Socio-economic variables	Frequency	
	No.	%[a]
Lodging or house tenure status		
House owner	214	53.9
Lease holder	92	23.2
Others (e.g. free logding)	64	16.1
Non-answered	28	7.1
Building materials		
Fired-brick masonry/pre-fabricated	210	52.9
Makeshift materials	163	41.1
Non-answered	24	6.0
Flooring		
Concrete or other	350	88.2
Dirt	29	7.3
Non-answered	18	4.5
Wastewater disposal		
Sewage system	42	10.6
Septic tank	236	59.4
Latrine	93	23.4
Open-air defecation	25	6.3
Non-answered	1	0.3
Drinking water		
Piped water	251	63.2
Protected well	125	31.5
Public faucet	21	5.3
Non-answered	--	--
Solid waste collection		
Public waste collection	229	57.7
Open-air pits, incineration or non-sanitary burial	165	41.6
Non-answered	3	0.8
Flooding		
Never	179	45.1
Occasionally	168	42.3
Always	41	10.3
Non-answered	9	2.3
Roads condition		
Paved	161	40.6
Dirt	234	58.9
Non-answered	2	0.5

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Overcrowding		
Yes	241	60.7
No	98	24.7
Non-answered	58	14.6
Bed-sharing		
Yes	198	49.9
No	174	43.8
Non-answered	25	6.3
Mother’s education		
Unschooled	107	27.0
Primary	151	38.0
Secondary	84	21.2
Tertiary/University	12	3.0
Non-answered	34	8.6
Father’s education		
Unschooled	96	24.2
Primary	137	34.5
Secondary	69	17.4
Tertiary/University	18	4.5
Non-answered	77	19.4
Mother’s employment		
Housewife	223	56.2
Unemployed	5	1.3
Autonomous worker	45	11.3
Temporary worker	40	10.1
Employed	49	12.3
Freelance worker	5	1.3
Retired/Pensioner	2	0.5
Non-answered	28	7.1
Father’s employment		
Unemployed	11	2.8
Autonomous worker	73	18.4
Temporary worker	104	26.2
Employed	105	26.4
Freelance worker	41	10.3
Retired/Pensioner	2	0.5
Non-answered	61	15.4
Monetary support		
Yes	221	55.7
No	160	40.3
Non-answered	16	4.0
Food support		
Yes	67	16.9
No	314	79.1
Non-answered	16	4.0
Animal husbandry		
Yes	32	8.1
No	349	87.9
Non-answered	16	4.0
Orchard		
Yes	73	18.4
No	310	78.1

Non-answered	14	3.5
Contact with dogs		
Yes	342	86.1
No	46	11.6
Non-answered	9	2.3
Contac with cats		
Yes	155	39.0
No	233	58.7
Non-answered	9	2.3

[a] Percentage was calculated in relation to the total number of individuals with socio-environmental data (n = 397).

Table A.2. Hygiene practices of the population from neighbourhoods of La Plata (Buenos Aires, Argentina)

Hygiene practices	Frequency	
	No.	%[a]
Handwashing after playing with pets		
Never	22	5.5
Occasionally	159	40.1
Always	163	41.1
Non-answered	53	13.4
Handwashing before eating		
Never	13	3.3
Occasionally	73	18.4
Always	272	68.5
Non-answered	39	9.8
Handwashing after going to the toilet		
Never	7	1.8
Occasionally	103	25.9
Always	252	63.5
Non-answered	35	8.8
Washing of fruits and vegetables		
Never	5	1.3
Occasionally	38	9.6
Always	320	80.6
Non-answered	34	8.6
Disinfect water by boiling		
Never	218	54.9
Occasionally	78	19.6
Always	57	14.4
Non-answered	44	11.1
Disinfect water by adding bleach		
Never	251	63.2

Occasionally	54	13.6
Always	40	10.1
Non-answered	52	13.1
Playing in the soil		
Never	68	17.1
Occasionally	197	49.6
Always	97	24.4
Non-answered	35	8.8
Walked barefoot		
Never	160	40.3
Occasionally	157	39.5
Always	45	11.3
Non-answered	35	8.8
Onychophagia		
Never	134	33.8
Occasionally	131	33.0
Always	91	22.9
Non-answered	41	10.3

[a] Percentage was calculated in relation to the total number of individuals with socio-environmental data (n = 397).

Table 2. Risk factors for parasitosis and infection with *Blastocystis* sp., *Giardia lamblia* and *Enterobius vermicularis*[a]

Risk factor	Coefficients			
	β	SE	OR (95% CI)	p value
Parasitosis[b]				
Houses with makeshift material	0.9	0.2	2.6 (1.6-4.3)	< 0.01
Bed-sharing	0.6	0.2	1.8 (1.1-2.8)	< 0.05
Blastocystis sp.[c]				
Houses with makeshift material	0.7	0.3	1.9 (1.2-3.2)	< 0.01
Bed-sharing	0.8	0.2	2.3 (1.5-3.7)	< 0.01
Open-air pits, incineration or non-sanitary burial	0.8	0.3	2.2 (1.3-3.6)	< 0.01
Giardia lamblia[d]				
Dirt floor	1.3	0.4	3.5 (1.6-7.8)	< 0.01
Enterobius vermicularis[e]				
Protected well or public faucet	0.7	0.2	2.1 (1.4-3.4)	< 0.01

SE: standard error; OR: odds ratio; CI: confidence interval; RD: residual deviance; AIC: Akaike Information Criterion.

[a] Other models were considered but only the ones selected are shown.

[b] Selected model: Building materials + Bed-sharing. RD = 20.8, AIC = 69.3.

[c] Selected model: Building material + Bed-sharing + Solid waste collection. RD = 13.6, AIC = 67.5.

[d] Selected model: Flooring. RD = 342.1, AIC = 346.1.

[e] Selected model: Drinking water. RD = 454.4, AIC = 458.4.

With respect to the environmental analysis, 61.3% (244/398) of the total of participants lived in the urban area (urban constructions class) and 38.7% (154/398) in the non-urban area (agropastoral or rural constructions classes). Parasitosis was higher in children and youth living in the non-urban area than who living in the urban area (81.2% and 64.3%, respectively) and participants in this area had a higher risk factor of infection (OR = 2.4; 95% IC = 1.5-3.9). Table 3 shows the frequencies of socio-economic variables related to housing and peridomiciliary area according to urban and non-urban area. Participants in the non-urban area lived in houses built commonly with makeshift materials (58.4%), with protected well (79.2%), with septic tank (71.4%) and without public waste collection service (79.9%). Likewise, participants in this area shared beds (63%).

In addition, it was observed that 9.3% (37/398) of participants lived less than 200 m from watercourses or permanent water bodies and 90.7% (361/398) lived more than 200 m. In this respect, 70.3% (26/37) of participants living less than 200 m were parasitized. However, no significant differences were found between this environmental variable and parasitosis ($p > 0.05$).

Table 3. Frequency of socio-environmental variables of the population from urban and non-urban areas in La Plata

Variables	**Frequency**			
	Urban area[a]		**Non-urban area[b]**	
	No.	**%**	**No.**	**%**
Building materials				
Fired-brick masonry/pre-fabricated	155	63.5	50	32.5
Makeshift materials	73	29.9	90	58.4
Non-answered	16	6.6	14	9.1

Flooring				
Concrete or other	218	89.3	132	85.7
Dirt	21	8.6	8	5.2
Non-answered	5	2.0	14	9.1
Wastewater disposal				
Sewage system	36	14.8	6	3.9
Septic tank	126	51.6	110	71.4
Latrine	58	23.8	35	22.7
Open-air defecation	22	9.0	3	1.9
Non-answered	2	0.8	--	--
Drinking water				
Piped water	224	91.8	27	17.5
Protected well	3	1.2	122	79.2
Public faucet	16	6.6	5	3.2
Non-answered	1	0.4	--	--
Solid waste collection				
Public waste collection	198	81.1	31	20.1
Open-air pits, incineration or non-sanitary burial	42	17.2	123	79.9
Non-answered	4	1.6	--	--
Overcrowding				
Yes	151	61.9	90	58.4
No	93	38.1	64	41.6
Non-answered	--	--	--	--
Bed-sharing				
Yes	101	41.4	97	63.0
No	143	58.6	57	37.0
Non-answered	--	--	--	--

[a] Urban area: urban constructions class.

[b] Non-urban area: agropastoral and rural constructions classes.

Percentages were calculated in relation to the total number of individuals living in each area (244 for urban area and 154 for non-urban area).

4. Discussion

The present study showed that of the total of children and youth examined, 70.9% were parasitized by at least one of the 12 parasites identified. The most prevalent species were *Blastocystis* sp., *E. vermicularis* and *G. lamblia*. According to different studies, prevalence values greater than 50% have been reported in Argentina and other countries (Cañete et al., 2012; Rivero de R et al., 2012; Zonta et al., 2013; Devera et al., 2014; Garraza et al., 2014; Santos et al., 2014; Zonta et al., 2014; Belleza et al., 2015; Cociancic et al., 2018 a, b). In Argentina the prevalence of these infections is heterogeneous, and it responds to the climatic and socio-economic variability of the country. There is a declining trend from north to south and from east to west (Rivero et al., 2017; Cociancic et al., 2018 a, b; Costamagna & Visciarelli, 2008; Dib et al., 2012; Navone et al., 2017).

Moreover, three species of geohelminths (*A. lumbricoides*, *T. trichiura* and *S. stercoralis*), with prevalence values between 0.8-2.5% were identified. In Argentina, the prevalence of geohelminths is generally high in northeastern and northwestern provinces where the warm and humid climate and certain cultural practices (e.g. open-air defecation, walking barefoot, and being in close contact with soil) favor the transmission of these infections. However, these low values should not be underestimated for they are an indicator of the deficient sanitary and ecological conditions (Socías et al., 2014). In addition, non-pathogenic protozoa such as *Chilomastix mesnili*, *Endolimax nana, Entamoeba coli*, *Enteromonas hominis* and *Iodamoeba bütschlii* were found. These intestinal parasites are indicators of fecal contamination because their means of transmission are similar to that of pathogenic protozoa by fecal-oral route.

Factors of risk infection found in the examined population were makeshift houses, dirt floors, bed-sharing, lack of piped water (protected well or public faucet) and lack of public solid waste collection (open-air pits, incineration or non-sanitary burial). Several studies have demonstrated that the deficient environmental sanitation, inadequate excreta disposal and consumption of water and food contaminated with feces favor the transmission of enteroparasites (Belleza et al., 2015; Samuel et al., 2017). In this regard, Ávila-Rodríguez et al. (2007) showed a relation between giardiasis and houses built with inadequate materials (houses built with uncoated bricks, adobe and cardboard). Likewise, Cañete et al. (2012) reported that drinking untreated water was a risk factor of parasitosis in a population from Cuba. Moreover, Abreu dos Santos et al. (2014) showed that children living in crowded houses were more parasitized. Likewise, according to researchers in Rio de Janeiro (Brazil) found that a higher number of infected participants were observed in the highest levels of deprivation (Faria et al., 2017). Particularly, a previous study performed by our research group stated that a higher index of vulnerability was strongly associated with intestinal parasitoses and especially with *Blastocystis* sp., *G. lamblia* and *Hymenolepis nana* infections in populations from La Plata (Gamboa et al., 2014).

Intestinal parasitosis found did not spread randomly; it was strongly associated with environmental conditions observed in the different classes of land use/cover, showing the highest prevalence in the non-urban area (81.2%). Argentina is one of the most urbanized Latin American countries whose population has grown since 2001 towards peripheral areas lacking in planning and governmental intervention and thus, causing new socio-environmental problems (Oyhenart et al., 2013). This situation is particularly evident in the periurban area of La Plata, where non-urban area was inhabited by a large number of participants living in deficient sanitary conditions and being more susceptible to acquiring parasitic infections. In the same way, more than 70% of the participants that lived within less than 200 m from watercourses or permanent water bodies were parasitized. Therefore, being in close contact with the source of infection favors parasitic infections, especially due to the frequent floods that contaminate the environment spreading the different parasitic forms (Juárez & Rajal, 2013). The consequences of floods may even be more severe to populations that are socially, economically and geographically marginalized (Lal et al., 2013). In this context, the analyzed area that was affected by the severe flood represents a worrying epidemiological scenario with a high risk of infection of parasitosis.

This study gives account of the existing relationship between intestinal parasitoses and socio-economic and environmental factors in vulnerable populations. It also adds to the knowledge of epidemiology of enteroparasitosis since a spatial analysis allowed us to obtain detailed information about the distribution of these infections considering land use/cover classes during the studied period. The administration of antiparasitic treatments is not enough to control of these infections and an access to water, sanitation and hygiene (WASH) becomes essential for future elimination of NIDs (Freeman et al., 2013). Although the impact of WASH is difficult to measure, a recent study showed that hygiene and sanitation interventions (e.g. latrine use, hand washing and shoe wearing) added benefit of WASH to sustain the gains made by antiparasitic treatments, such that these may be scaled down or even stopped altogether (Coffeng et al., 2018). In addition, awareness activities in schools, health care centers and at home to mitigate the negative effects of parasitic infections on human health are a challenge to the community. These aspects can be planned in the One Health approach which emphasizes integration among different disciplines to improve health and well-being through the mitigation of disease risks that originate among humans, animals and environment (Ryan et al., 2016). The One Health approach is a worldwide strategy to ensure the diagnosis and surveillance of parasitosis and to tackle zoonotic diseases as well as to encourage the development of sanitary and educational programs sustainable over time.

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Risk factors for intestinal parasitoses among children and youth of Buenos Aires, Argentina

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Declarations of interest: none

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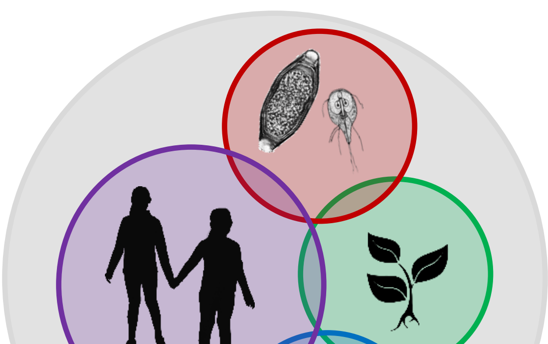
Intestinal parasitoses are still a serious public health problem and that they are strongly associated with socio-economic conditions and land use/cover.



Highlights

- More than 70% of children and youth were parasitized.
- 12 parasitic species were identified.
- *Blastocystis* sp., *Giardia lamblia* and *Enterobius vermicularis* were the most prevalent species.
- Intestinal parasitoses are strongly associated with socio-economic conditions.
- Land use/cover was an important infection risk.