ARTIGO ORIGINAL

INTESTINAL PARASITOSES IN SUBURBAN AND RURAL SCHOOLCHILDREN IN ARGENTINA

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ABSTRACT

This study presents the results of the first stage of PROCOPIN (Program for the Control of Intestinal Parasitoses and Nutrition) comparing public health conditions and risk behaviors associated to intestinal parasitoses present in suburban children (SC) versus rural children (RC) from Argentina. Information about individual and public health conditions was collected for each child. A coproparasitological exam and a serial anal scraping were performed to each of the participants. A total of 465 SC and 251 RC were surveyed. In SC, the parasite prevalence rate was 39.1% and in RC 31.1% (p=0.032). *Blastocystis hominis*, *Enterobius vermicularis* and *Giardia intestinalis* were prevalent in both locations. Poor public health conditions in the homes of SC were not a risk factor to be infected; this suggests that the parasite transmission does not occur at home, but probably in the school or other places where a large number of suburban children are congregated. Among the RC, the public health conditions inside and surrounding the homes were risk factors indicating the parasitic transmission occurred primarily there. Thus, social behavior of children should be taken into account along with the public health conditions and personal hygiene as risk factors for parasitoses.

KEY WORDS: Intestinal parasites. Epidemiology. Suburban and rural schoolchildren. Argentina.

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RESUMO

Parasitoses intestinais em crianças em idade escolar de zona suburbana e de zona rural na Argentina

Neste trabalho, são apresentados os resultados da primeira etapa do Programa de controle de doenças parasitárias intestinais e nutrição (PROCOPIN) e comparadas as condições de saúde pública e os hábitos associados a parasitos intestinais em crianças de zona suburbana (SC) e de zona rural (SR) na Argentina. Recolheu-se informação pessoal e sobre as condições de saúde pública. Foram realizados exames parasitológicos de fezes e de esfregaço perianal com gazes seriados. Foram examinadas 465 SC e 251 RC, entre as quais se encontraram os seguintes índices de infecção: em SC, 39,1% e em RC, 31,1%, sendo $p = 0,032$. Os parasitos mais frequentes em ambas as localizações foram: *Blastocystis hominis*, *Enterobius vermicularis* e *Giardia intestinalis*. Más condições de saúde pública nas casas de SC não constituíram fator de risco de a criança ser parasitada, o que sugere que a transmissão desses parasitos não ocorre na casa, mas, provavelmente, em escolas, clubes ou outras áreas de recreação que congregam grande número de crianças. Entre as RC, condições de saúde pública dentro ou no entorno da casa apareceram como fator de risco, indicando que é principalmente ali onde ocorre a transmissão do parasito.. Portanto, o comportamento social das crianças, as condições da saúde pública e os hábitos de higiene das populações devem ser vistos como fatores de risco para a parasitose.

DESCRITORES: Parasitos intestinais. Epidemiologia. Crianças suburbana e rural. Argentina.

INTRODUCTION

Intestinal parasitoses (IP) are worldwide common infections, especially in countries with water contamination problems and poor sanitary conditions (7). IP prevalence rates are related to factors that affect the quality of life. These factors are individual, family and/or community behaviors, and public conditions such as education, basic sanitation and healthcare (10).

IP affect all age groups, but children are the most affected due to their immunologic immaturity and their underdeveloped hygiene habits. That is why, among other problems, IP may lead, within this age group, to a deterioration of growth and development with significant social consequences such as low performance at school and impaired quality of life (4).

Numerous research studies have pointed out the association between poverty and sanitary limitations that is reflected in high parasitic prevalence rates (3, 5, 10, 19, 20). Despite the urbanization in Latin America in the last decades, 75% of the population lives in areas with occurrence of parasitoses, both in rural and urban zones (5). In Peru and Chile, IPs have proven to be more frequent in rural than in urban populations (3, 11). The situation matches the geographical and ecological characteristics specific to each location (19). In Argentina, a movement of the rural population (less than 2,000 inhabitants) toward several urban centers has been taking place since 1950. Most of these "domestic immigrants" are concentrated in the suburbs of booming cities. These suburban settlements are sites of heavy concentration of people living in deficient social and economic conditions. A movement of inhabitants

from bordering countries into both the suburban and rural areas has added to the picture in the last decade. In addition, the financial crisis favored the increase of poverty, which had a negative impact on the standard of living of these populations. In our region, several projects and programs for the control of parasitoses have been developed for a decade as an initiative of the Universidad Nacional de La Plata to reduce the high prevalence rates affecting these vulnerable communities, PROCOPIN being one of them (PROCOPIN is an acronym for the Program for the Control of Intestinal Parasitoses and Nutrition). This Program consists of three stages: in the first stage the analysis of the clinical and epidemiological situation of several communities is developed; in the second stage, the community is intervened in order to revert the diagnosed situation, and strategies for prevention and control of parasitic diseases, anemia and nutritional condition are implemented; and in the third stage, the actions carried out are evaluated. This article presents the results from the analysis in the first stage of the PROCOPIN comparing public-health conditions and risk behaviors associated to intestinal parasitoses present in suburban schoolchildren versus rural children from the province of Buenos Aires, Argentina.

MATERIALS AND METHODS

Populations studied

The study was carried out in two towns located in the Northeast of the province of Buenos Aires: Berisso (suburban district) and Magdalena (rural district). Both towns had different social and public-health characteristics. The suburban district (34° 52' S 57° 52' W) shows a total population of 80,092 inhabitants in an area of 135 square kilometers and a population density of 593 inhabitants per square kilometer. Most homes are small, very close to one another, with more than one family unit cohabiting, no sewer system and the drinking water is obtained through individual illegal connections and not through the corresponding governmental channels. Most people there live from odd jobs or temporary jobs and obtain state social plan assistance. Suburban children remain few hours a day at homes. They spend 5 hours at schools where they also receive lunch. Then, they go to the clubs or are in the streets (most of them begging in the city from an early age). They return to their homes for dinner and sleep. The rural town (34° 04' S 57° 31' W) has 16,603 inhabitants in an area of 1,785 square kilometers and a population density of 9.30 inhabitants per square kilometer. Located in wide plots of land, homes are far apart from one another, usually with only one family living in them. They are made of masonry, are supplied drinking water and dispose of human waste in individual cesspools. The main activities in this town are agriculture and dairy farming. Rural children spend many hours per day at home. After attending the school where they receive lunch, return to their homes where they collaborate with each family activity. Contact with other children outside of school is rare.

Survey

A descriptive, correlational, non-experimental research study was carried out. In this study, 716 school children (3-18 years old) participated. A total of 465, 223 (48%) males and 242 (52%) females suburban children (SC) and 251, 104 (41.4%) males and 147 (58.6%) females rural children (RC) were surveyed. The number of SC included in this study was 315 between 3 and 9 years old and 150 between 10 and 18 years old. For RC, the numbers were 169 between 3 and 9 years old and 82 between 10 and 18 years old. In both towns, the survey was done through the schools, where students' parents/guardians were called to be interviewed in person. The schools were selected by the municipal authorities of each locality to participate in the PROCOPIN. The information gathered was personal (age, sex) and public- health conditions: type of home (cardboard, wood, tin or masonry), type of floors (dirt or concrete), bathroom inside or outside the house, toilet with/without water flushing system, type of household garbage collection (with/without town-provided collection services), type of water supply (network or pump), human-waste disposal (with/without sewer system), overcrowding -when more than three people sleep in a room- (yes/no) and flooding of the house (yes/no).

Data about personal hygiene and recreation habits were included: hand washing before meals and after going to the bathroom, playing practices which included dirt, sand or pets. Each parent/guardian signed an informed consent accepting the inclusion of each participant in the present study. Protocols developed were approved by the committees of the institutions that financially supported this project. Personal information was protected in the research protocol, pursuant to the Declaration of Helsinki (1964), the Nuremberg Code (1947), and National Act #25.326. Written authorization from the school authorities and the pertaining officials in both town halls was also obtained.

Sample collection

A serial coproparasitological exam and a serial anal scraping were performed to each of the participants in both towns in August-December 2010 and March-July 2011. Instructions to collect the samples were imparted orally and in writing to the parents/guardians. For the coproparasitological serial sampling, each individual set daily aside a portion of stools in one jar with formaldehyde (10%). The procedure was followed for five days consecutively. For the serial anal scraping, each individual wiped a folded piece of gauze previously dipped in water over the margins of the anal orifice after waking up in the morning. The samples were collected for five consecutive days and the gauzes were put in one jar with formaldehyde (10%). Parents took the samples to the schools. Weekly, we collected and transported the samples to the parasitology laboratory of PROCOPIN.

Processing

Stools were processed with the modified Telemann technique (17) and the obtained pellets were observed under light microscope after lugol staining (three slides for each one). In addition, stained smears (three slides) the Kinyoun technique for detection oocysts (*Cryptosporidium* spp *and Cyclospora* spp) was performed. The serial anal scraping samples were processed by cutting and homogenization of the gauze pieces with the same formaldehyde from the jar. After decanting the whole content in a centrifuge tube, it was concentrated by centrifugation at 1,000 x *g* for 5 minutes. Finally, the obtained pellet was observed under light microscope (three slides).

Statistical analysis

For the statistical analysis, prevalence rates of total and specific parasitoses were estimated. Associations were analyzed through Chi square test and Fisher test.

RESULTS

The public health conditions of the subjects are shown in Table 1. In relation to hygiene and recreational habits, it was observed that 51.2% (238/465) of SC and 58.9% (148/251) of RC washed their hands before meals; and 52.0% (242/465) and 65.3% (164/251), respectively, washed them after going to the bathroom. Regarding recreational activities, 61% (283/465) of SC played with dirt, 33.4% (155/465) with sand, and 9.0% (42/465) of them played with pets. Among RC, 51.8% (13/251) of them played with dirt and 24.3% (61/251) with sand, while 12.7% (32/251) of them played with their pets.

Among SC, the parasite prevalence rate was 39.1% (182/465) and among RC, 31.1% (78/251), p=0.032. The prevalence of parasitoses in SC from 3 to 9 years of age was 39.7% (125/315) and for 10-18 years old was 38.0 (57/150). Among RC, the prevalence in the group 3-9 years old was 27.2% (46/169) and 39.0% (32/82) in the group 10-18 years old.

In the group of SC, parasite species detected were *Blastocystis hominis* (27.5%), *Enterobius vermicularis* (20%), *Giardia intestinalis* (7.5%), *Hymenolepis nana* (2.2%), *Ascaris lumbricoides* (1.7%), and *Trichuris trichiura* (0.2%). *E. vermicularis* (19.9%), *B. hominis* (11.9%), *G. intestinalis* (9.6 %), and *T. trichiura* (0.8%) were observed in RC. We found cysts of commensal protozoa *Entamoeba coli* (4.1% in SC and 1.2% in RC). Only the prevalence of *B. hominis* had a significant difference between the two groups of students (p=0.000)

Among SC, the percentages of mono-parasite and multi-parasite infected individuals were 54.9% (100/182) and 45.0% (82/182) respectively. While among RC, the mono-parasite infected population was larger (65.4%- 51/78) than the

multi-parasite children (34.6%-27/78) (p= 0.033). The distribution by age group is presented in Table 2.

Table 1. Public health conditions in SC (suburban children) versus RC (rural children), Argentina.

Variable / Categories	SC 465		RC 251		
	n	%	n	%	
Home construction type					p=0.000
Masonry	257	53.3	214	85.3	
Cardboard/ wood /tin	208	46.7	37	14.7	
Floors					p=0.035
Concrete	435	93.5	244	97.2	
Dirt	30	6.5	7	2.8	
Bathroom					p=0.007
Indoors	402	86.5	232	92.4	
Outdoors	63	13.5	19	7.6	
Toilet					p=0.000
With flushing system	233	50.1	209	83.3	
Without flushing system	232	49.9	42	16.7	
Garbage					p=0.018
Town-provided collection	392	84.3	227	90.4	
No town-provided collection	73	15.7	24	9.6	
Water used					p=0.000
City network	339	72.9	189	75.3	
Pump	126	27.1	62	24.7	
Sewer System					p=0.000
With	126	27.1	58	23.1	
Without	339	72.9	193	76.9	
Overcrowding					p=0.003
No	54	11.6	50	19.9	
Yes	411	88.4	201	80.1	
Flooding of the house					p=0.000
No	187	40.2	60	23.9	
Yes	278	59.8	191	76.1	

Table 2. Distribution by age group of mono-parasite and multi-parasite infected SC (suburban children) and RC (rural children), Argentina.

Age group (years old)	Parasite infected SC				Parasite infected RC			
	3-9 (n=125)		10-18 (n=57)		3-9 (n=46)		10-18 (n=32)	
	n	%	n	%	n	%	n	%
Mono-parasite	65	52.0	35	61.4	31	67,4	20	62.5
Multi-parasite	60	48.0	22	38,6	15	32.6	12	37.5

The association between the public health conditions and the parasite prevalence rates in both groups of schoolchildren are shown in Table 3 and 4.

Table 3. Association of public health conditions with parasite-infected populations in SC (suburban children), Argentina.

Variable / Categories	Parasite-infected SC 182/465		p
	n	%	
Home construction type			NS
Masonry (n=257)	102	39.7	
Cardboard/ wood /tin (n=208)	80	38.5	
Floors			NS
Concrete (n=435)	170	39.1	
Dirt (n=30)	12	40.0	
Bathroom			NS
Indoors (n=402)	155	38.5	
Outdoors (n=63)	27	42.8	
Toilet			NS
With flushing system (n=233)	95	40.8	
Without flushing system (n=232)	87	37.5	
Garbage			NS
Town-provided collection (n=392)	160	40.8	
No town-provided collection (n=73)	22	30.1	
Water used			NS
City network (n=339)	131	38.6	
Pump (n=126)	51	40.5	
Sewer System			NS
With (n=126)	46	36.5	
Without (n=339)	136	40.1	
Overcrowding			NS
No (n=54)	16	29.6	
Yes (n=411)	166	40.4	
Flooding of the house			0.0361
No (n=187)	84	44.9	
Yes (n=278)	98	35.3	

[1]OR= 1.498 IC=(1,025; 2,188)

As regards the hygiene and recreation habits surveyed, only the failure to wash hands was related to parasitoses. Among SC, 44.1% (100/227) of those who did not wash their hands before a meal were infected with parasites, while 34.5% (82/238) of those who did were infected (p=0.034, OR=1.498, CI=1.030; 2.178). Among RC, 35.0% (36/103) of those who did not wash the hands before a meal were infected with parasites, while 28.4% (42/148) of those who did were infected (p=0.268). In RC, parasites were found in 39.1% (34/87) of those who did not wash their hands after going to the bathroom and in 26.8% (44/164) of those who did (p=0.046, OR=1.750, CI=1.007; 3.039). Among SC, parasites were found in 42.6% (95/223) of those who did not wash their hands after going to the bathroom and in 36.0% (87/242) of those who did (p=0.142)

Table 4. Association of public health conditions with parasite-infected populations in RC (rural children), Argentina.

Variable / Categories	Parasite-infected RC 78/251		p
	n	%	
Home construction type			0.0041
Masonry (n=214)	59	27.6	
Cardboard/ wood /tin (n=37)	19	51.4	
Floors			0.0022
Concrete (n=244)	71	29.1	
Dirt (n=7)	7	100.0	
Bathroom			NS
Indoors (n=232)	74	31.9	
Outdoors (n=19)	4	21.1	
Toilet			0.0013
With flushing system (n=209)	56	26.8	
Without flushing system (n=42)	22	52.4	
Garbage			0.0354
Town-provided collection (n=227)	66	29.1	
No town-provided collection (n=24)	12	50.0	
Water used			NS
City network (n=189)	62	32.8	
Pump (n=62)	16	25.8	
Sewer System			NS
With (n=58)	16	27.6	
Without (n=193)	62	32.1	
Overcrowding			NS
No (n=50)	19	38.0	
Yes (n=201)	59	29.4	
Flooding of the house			0.0085
No (n=60)	27	45.0	
Yes (n=191)	51	26.7	

[1]OR= 2.773 IC= (1,362; 5,646) [2]OR= 36.40 IC=(2,04; 645,82)
[3]OR= 3.05 IC= (1,529; 5,923) [4]OR= 2.439 IC= (1,043; 5,707)
[5]OR=2.246 IC=(1,231; 4.097)

DISCUSSION

This study revealed that while both communities show different demographic (population density) and geographic characteristics, more than one third of both SC and RC presented at least one parasite. Global prevalence rates are below values reported by other authors in similar populations in Argentina, México and Brazil (1,4,9,13,14,15,16,18).

In the two studied communities, many people lived in masonry homes with concrete floors, had an indoor bathroom and town-provided household garbage collection. All these characteristics constitute "sanitary barriers" for the dissemination of IPs, especially geohelminths (15), which showed very low frequencies in the two groups studied.

The parasites detected more frequently in both populations were *B. hominis, E. vermicularis* and *G. intestinalis,* matching other authors' findings revealing similar populations in Argentina (4, 13, 19, 21). Both in SC and in RC, prevalence rates of *E. vermicularis* and *G. intestinalis* were similar. *B. hominis* showed a difference between the two communities, with RC being the most prevalent. This is consistent with records where *B. hominis* is considered to be the protozoan with the highest prevalence rates in population studies (2, 6, 8, 9, 12, 19). Both SC and RC have close contact with pets, especially dogs that can be reservoirs of *G. intestinalis* and *B. hominis,* as suggested by Londoño et al. (2009) (10). This poses the urgent need to implement programs for the control of zoonosis as another strategy to provide a solution to the current parasitic problem.

Suburban children had a higher overall prevalence (39.1%) and the risk factors among these infected children were only two: failure to wash their hands and flooding houses. On the other hand, rural children had lower parasite prevalence (31.1%) and the risk factors among them were six: failure to wash their hands, flooding houses, cardboard/wood/tin homes, dirt floors, toilets without a flushing system and no town-provided garbage collection.

As observed in Table 1, public health conditions in the suburban population were worse than those in the rural population; however, only the flooding houses factor was related to parasite infection (Table 3), showing that sanitary conditions in the homes is not a risk factor to get infected. On the other hand, in this suburban community with a high population density (about 600 inhabitants per square kilometer), where children spend most of the day with other children in shared areas, the transmission of parasites occurs in the schools, clubs, streets or other recreation spaces.

As to the rural population, in a low-population density community (about 10 inhabitants per square kilometer), sanitary conditions of the homes appeared as risk factors (Table 4), indicating that the transmission of parasites occurs inside and surrounding the houses, where most family activities take place due to the mere nature of rural habits.

The lack of personal hygiene habits (like hand-washing) was evident in both studied populations, indicating the need to improve individual, family and community hygiene practices in the two communities. Our conclusion is that when analyzing risk factors for the transmission of parasites, we should take into account not only the sanitary conditions of a population and the personal hygiene practices but also community social behavior.

The next stage of PROCOPIN is intended to be the implementation of control measures through treatment of the infected people and development of health education programs to intensify the dissemination of hygiene measures. Parasitic diseases, like unattended pathologies, reflect their multi-factor and multi-sector nature –a sphere where interventions require improvement of food-inequity programs, water-quality monitoring and risk-free human-waste

disposal, administration of pharmacological treatments, and health education programs in order to achieve sustainable control.

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PRÓXIMOS EVENTOS NA ÁREA DE PATOLOGIA TROPICAL E SAÚDE PÚBLICA

MEETINGS TO BE HELD ON THE AREA OF TROPICAL PATHOLOGY AND PUBLIC HEALTH

I Encontro Amapaense de Parasitologia, de 25 a 27 de março de 2012, Universidade Federal do Amapá. Informações: www.parasitologia.org.br

The ASEAN Congress of Tropical Medicine and Parasitology, de 15 a 17 de maio de 2012, Manila/Filipinas. Informações: Dr. Lydia R. Leonardo**.** Chair, Organizing Committee of Fifth ACTMP. email address: 5thactmp@gmail.com

64ª. Reunião Anual SBPC, de 22 a 27 de julho de 2012, São Luiz-MA. Informações: http://www.sbpcnet.org.br/saoluis/home/

XVIII International Congress for Tropical Medicine and Malaria and XLVIII Congress of the Brazilian Society for Tropical Medicine, Rio de Janeiro, 23 to 28th September 2012. Informações: http://ictmm2012.ioc.fiocruz.br/index.html

XXVIII Reunião Anual da Sociedade Brasileira de Protozoologia e XXXIX Reunião Anual da Pesquisa Básica em Doença de Chagas, de 1 a 3 de outubro de 2012, Caxambu – MG. Informações: http://www.sbpz.org.br/

XXII Encontro Nacional de Virologia e VI Encontro de Virologia do MERCOSUL, de 23 a 26 de outubro de 2011, Atibaia-SP. Informações: http://sbv.dominiotemporario.com/web2/enc_nac_virologia2011/index.html

XXI Congresso Latino-Americano de Microbiologia - CLAM 2012, de 28/10 a 01/11 de 2012, Santos-SP. Informações: http://www.sbmicrobiologia.org.br/Latino/

X Congresso Brasileiro de Saúde Coletiva de 14/11 a 18/11 de 2012, Porto Alegre – RS. Informações: http://www.abrasco.org.br/noticias/noticia_int.php?id_noticia=725

XXIII Congresso Brasileiro de Parasitologia, de 22 a 27 de outubro de 2013, Florianópolis, SC. Informações: www.parasitologia.org.br