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BRIEF COMMUNICATION

INTESTINAL PARASITOSES AND ENVIRONMENTAL FACTORS IN A RURAL POPULATION OF ARGENTINA, 2002-2003

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SUMMARY

We evaluate the prevalence of intestinal parasites in 504 people and the degree of association between environmental variables and parasites found in population, soil and water in a rural area of Argentina during 2002-2003. A structured survey was used to evaluate the environmental variables and fecal-human, soil and water samples were analyzed. The prevalence of parasites was 45.4%. Most prevalent protozoa were *Blastocystis hominis* (27.2%) and *Giardia lamblia* (6.9%), while the most prevalent helminth was *Ascaris lumbricoides* (3.8%). The analyzed environmental variables showing association ($p < 0.05$) with presence of parasites in population were: cardboard-tin or wooden house, dirt floor, home or communal water pump, faucet outside the house or public faucet and cesspool or latrine. Parasite forms were found in 82.3% of the soil samples and in 84.2% of the water samples. In both samples we found parasites that were also found in people. In this study we have found deficient sanitary conditions associated with presence of parasites in population and we have evidenced that contaminated soil and water were the source of these parasites.

KEYWORDS: Intestinal parasites; Rural population; Soil; Water; Argentina.

Intestinal parasite infections produced by protozoa and helminths constitute one of the main worldwide causes of human morbidity and mortality[1]. From an ecological perspective, they are considered environmental diseases, susceptible of interpretation as an interaction between the etiological agent, the host and the environment. The transmissible stages (eggs, larvae, cysts and oocysts) can be found in the environment, either in soil, water or food, as a consequence of direct or indirect contamination with human or animal feces[4,7]. The potential contamination of the environment depends on several factors, such as the number of infected hosts, number of transmissible stages eliminated into the environment, agricultural practices, contact with animals, activity and behavior of the host, migrations of human populations, social, cultural and ethnical differences of the individuals; drinking water quality, source of food supply, body-waste disposal, home garbage disposal, geographical distribution, climate and hydrogeology of the area[2,4,9].

The environmental factors turn out to be an inevitable link between parasites and host, and can make survival, development, distribution and transmission of infective forms either difficult or easy for the host. Parasite endemics are quite sensitive indicators of the environmental factors previously described[7,13].

In developing countries, the high prevalence of intestinal parasitoses reflects, besides the existence of favorable natural, ecological factors, the deficiencies in basic sanitation, general standard of living and hygiene[8,14].

Sanitary policies including environmental sanitation programs, health care, and sanitary education have been inadequate in Argentina for the control of intestinal parasitoses[2,6,7,13].

The objective of the present study was to evaluate the prevalence of intestinal parasites and the degree of association between environmental variables and the intestinal parasites found in the population, in the soil and in the water, in the town of General Mansilla, Province of Buenos Aires, Argentina (2002-2003).

The present study was carried out in the period 2002-2003. The study area was the rural town of General Mansilla, located at 96 km from the City of Buenos Aires. According to the municipal census of 1999, the people inhabit in a central zone (CZ) with a population density of 20 inhabitants per square km and in the peripheral zone (PZ) with six inhabitants per square km. In CZ there were 325 households and in PZ there were 236.

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The whole of the population in the CZ is supplied with chlorinated water from the Puelche Aquifer. The rest of the population obtains the water they consume from individual wells 15 to 20 m deep. Some of the inhabitants in the CZ have sewer facilities while the rest, like the total population, pour their waste in individual latrines or cesspools, some of them built with a septic chamber.

The soils in the area have hydromorphic problems in general, and halomorphic problems in some cases, due to the characteristics of the relief (plain, downward and low) and to the materials rich in fine particles, slime and clay.

To carry out this study, human fecal samples were analyzed, as well as environmental variables and samples of soil and water.

The sample was 504 people, with a distribution of n = 292 in the central zone (CZ) and n = 212 in the peripheral zone (PZ). To select the individuals, the following criteria were taken into account: children (< 15 years old) or adults (≥ 15 years old) with permanent residence in the study area and one person for household. Each of 504 persons collected a fecal sample per day during five consecutive days (one pool of fecal sample for each person). Each pool was placed in a container with formaldehyde 5%. The qualitative coproparasitologic analyses were done by modified Telemann technique[9]. Briefly, 5 mL of fecal samples were mixed with 5 mL ClNa 5%, filtered by gauze and centrifuged at 200 g during five minutes. The supernatant was discarded and the pellet was observed at light microscopy.

A personal, structured survey was carried out so as to learn the environmental variables in each of the 504 individuals studied, such as: type of water supply (running water, home pump, communal pump, well with windmill); location of water supply faucet (inside or outside the house or public faucet); body waste disposal (sewage system, well with septic chamber, cesspool, latrine); garbage disposal (open-sky, burning, burial or home collection); characteristics of the house: type of construction (cardboard-tin, wood, fibrocement and masonry); type of ground (dirt, cement, other); and terrain flooding (never, sometimes, frequently).

Due time and costs reasons, it was decided to randomly analyze the soil from 12% households involved in the study. Therefore, 35 CZ and 25 PZ samples had to be taken. But in some PZ households it was no possible to take samples. A total of 51 samples of soil were collected from inside and/or outside the houses of the selected individuals who consented that the samples were taken (n = 35 CZ and n = 16 PZ). They were taken from a 400-square cm area and 2 cm deep, after separating the superficial dead leaves. To process them, the DADA & LINDQUIST, 1979 technique was used[5].

Due time and costs reasons, it was decided to randomly analyze the water from 5% households involved in the study. Therefore, 14 CZ and 10 PZ samples had to be taken. But in some CZ households it was not possible to take samples. A total of 19 samples of water were obtained from inside and/or outside the house of the selected individuals who consented that the samples were taken (n = 9 CZ and n = 10 PZ). To process them, the methodology used by DE LUCA *et al.*[6], and BASUALDO *et al.*[2], was employed.

Significant associations were determined using the chi square test and Fisher´test for p values < 0.05. Odds ratios (ORS) were calculated for statistically significant associations. Multivariate analysis was performed using generalized linear models for correlated binary data for each parasite[10]. SPSS software, version 11.5 was used throughout.

The voluntary consent of the participants was obtained to carry out this study.

The prevalence of intestinal parasites in the studied population was 45.4% (229/504), 41.4% (121/292) in the CZ, and 50.9% in the PZ (108/212). Of the individuals belonging to the CZ, 40.7% (119/292) were parasited with protozoa and 7.2% (21/292) with helminths, while in the PZ these values were 47.6% (101/212) and 9.9% (21/212), respectively. The prevalence for intestinal parasites is shown in Table 1. *Blastocystis hominis* was the most frequent parasite, followed by *Giardia lamblia*, both in the CZ and the PZ. Among the commensals of the intestine, which can be used as "indicators of fecal contamination", *Entamoeba coli* and the group known as "commensal amoebae" (other than *E. coli*) were found, with similar values in both populations. The name "commensal amoebae" was given to the protozoa belonging to the order of Amoebida, considered as human non-pathogenic[12], *Entamoeba coli* was excluded, since it was registered separately due to its frequency. Among the metazoan parasites, geohelminths were more frequent in both areas.

The environmental conditions of the population are detailed in Table 2. More than 50% of the people in both areas lived mostly in houses with masonry and cement floors. In the CZ, most people had running water supply with faucet inside the house, while in the rural area the home pump was predominant, with faucet inside the house.

In both populations, between 40 and 50% of the individuals disposed of their body waste through a well with septic chamber and only part of the population in the CZ did so through the sewage system. As regards garbage disposal, house collection predominated in the CZ, unlike in the rural population, where burning was the most frequent way of disposal. Both areas showed few cases of frequent flooding.

When analyzing the environmental variables with the parasites found in the people from the CZ, statistically significant differences were found between wooden house with "commensal amoebae" (OR = 2.55; p = 0.03) and *Giardia lamblia* (OR = 3.53; p < 0.001); dirt floor with "commensal amoebae" (OR = 2.67; p = 0.02); home pump with "commensal amoebae" (OR = 2.79; p = 0.02) and *A. lumbricoides* (OR = 3.24; p = 0.01); faucet outside the house with *G. lamblia* (OR = 2.46; p = 0.03), *E. coli* (OR = 4.55; p < 0.001) and *B. hominis* (OR = 4.95; p < 0.002); public faucet with "commensal amoebae" (OR = 3.30; p = 0.009), *E. coli* (OR = 2.76; p = 0.02) and *B. hominis* (OR = 2.97; p = 0.01) and cesspool with *A. lumbricoides* (OR = 6.29; p < 0.001).

Multivariate analysis identified in this area the following variables as being significantly correlated: wooden house with "commensal amoebae", home pump with *A. lumbricoides*, faucet outside the house with *E. coli* and *B. hominis*, public faucet with *B. hominis* and cesspool with *A. lumbricoides*.

Table 1
Prevalence of intestinal parasites in 504 inhabitants, water and soil of General Mansilla, Argentina, 2002-2003

Parasite	Population					Soil					Water				
	CZ n = 292		PZ n = 212			CZ n = 35		PZ n = 16			CZ n = 9		PZ n = 10		
	prev	%	prev	%	p	prev	%	prev	%	p	prev	%	prev	%	p
PROTOZOA															
Commensal amoebas	34	(11.6)	29	(13.7)	NS	-	2	(12.5)	NS		7	(77.8)	7	(70)	NS
Giardia lamblia	17	(5.8)	18	(8.5)	NS	3	(8.6)	1	(6.2)	NS	1	(11.1)	2	(20)	NS
Coccidian	2	(0.7)	21	(9.9)	0.001	9	(25.7)	6	(37.5)	NS	6	(66.6)	6	(60)	NS
Entamoeba coli	28	(9.6)	28	(13.2)	NS	-		-		-	4	(44.4)	2	(20)	NS
Cryptosporidium spp.	-	1	(0.5)	NS	-	-		-		-	-		-		
Blastocystis hominis	77	(26.4)	60	(28.3)	NS	-		-		-	-		1	(10)	NS
HELMINTHS															
Ascaris lumbricoides	11	(3.8)	8	(3.8)	NS	-		-		-	-		-		-
Hymenolepis nana	2	(0.7)	2	(0.9)	NS	2	(5.7)	1	(6.2)	NS	-		-		NS
Trichuris spp.	8	(2.7)	1	(0.5)	0.001	2	(5.7)	10	(62.5)	NS	-		-		NS
Strongyloides stercoralis	-	1	(0.5)	NS	-	-	-	-	-	-					
Toxocara spp.	-					17	(48.6)	4	(25)	-	-		-		NS

CZ = Central zone; PZ = Peripheral zone; Prev: prevalence; NS = statistically non-significant.

Table 2
Environmental characteristics of the population of General Mansilla, Argentina, 2002-2003

Variable	Central zone population (n = 292)		Peripheral zone population (n = 212)		p
	n	%	n	%	
Type of house					
- cardboard-tin	35	(12)	20	(9.4)	NS
- wood	26	(8.9)	40	(18.8)	< 0.001
- fibrocement	24	(8.2)	33	(15.5)	0.001
- masonry	207	(70.9)	119	(56.1)	NS
Type of floors					
- dirt	12	(4.1)	36	(17)	< 0.001
- cement	195	(66.8)	138	(65.1)	NS
- other	85	(29.1)	38	(17.9)	< 0.001
Water supply					
-running water	268	(91.8)	28	(13.2)	< 0.001
- home pump	20	(6.8)	140	(66.0)	< 0.001
- comunal pump	3	(1.0)	40	(18.8)	< 0.001
- well with windmill	1	(0.3)	4	(1.9)	0.05
Water faucet					
- inside the house	253	(86.6)	144	(67.9)	NS
- outside the house	25	(8.5)	35	(16.5)	0.001
- public	14	(4.8)	33	(15.5)	< 0.001
Body waste disposal					
- sewage system	109	(37.3)	0	(0)	-
- well with chamber	117	(40.0)	107	(50)	NS
- cesspool	51	(17.5)	70	(33.0)	0.001
- latrine	15	(5.1)	35	(16.5)	< 0.001
Garbage disposal					
- open-sky	0	(0)	32	(15.1)	-
- burnt	12	(4.1)	127	(59.9)	< 0.001
- buried	0	(0)	2	(0.9)	-
- garbage collector	280	(95.9)	51	(24.0)*	< 0.001
Flooding					
- never	213	(72.9)	147	(69.3)	NS
- sometimes	72	(24.6)	40	(18.8)	NS
- frequently	7	(2.4)	25	(11.8)	< 0.001

*once a week; NS = statistically non-significant.

In the PZ, these associations were cardboard-tin house with *G. lamblia* (OR = 4.58; p < 0.001), *E. coli* (OR = 3.31; p < 0.001), *B. hominis* (OR = 3.56; p < 0.001) and *A. lumbricoides* (OR = 3.44; p < 0.001); wooden house with *E. coli* (OR = 4.17; p < 0.001); dirt floor with *G. lamblia* (OR = 3.6; p < 0.001), coccidian (OR = 5; p < 0.001), *B. hominis* (OR = 3.68; p < 0.001) and *A. lumbricoides* (OR = 3.10; p = 0.01); home water pump with *A. lumbricoides* (OR = 3.73; p < 0.001); comunal water pump with *G. lamblia* (OR = 5.25; p < 0.001) and *B. hominis* (OR = 2.89; p = 0.01); faucet outside the house with *G. lamblia* (OR = 2.84; p = 0.01) and coccidian (OR = 5.17; p < 0.001); public faucet with: coccidian (OR = 5.43; p < 0.001) and *B. hominis* (OR = 2.88; p = 0.01), body waste disposal by latrine with *G. lamblia* (OR = 3.77; p < 0.001), coccidian (OR = 5.17; p < 0.001), *B. hominis* (OR = 2.67; p = 0.02) and *A. lumbricoides* (OR = 3.22; p = 0.01).

Multivariate analysis identified in this area the following variables as being significantly correlated: cardboard-tin house with *G. lamblia*, *E. coli* and *B. hominis*; wooden house with *E. coli*; dirt floor with *G. lamblia* and *B. hominis*; comunal water pump with *G. lamblia* and *B. hominis*; public faucet with *B. hominis*; body waste disposal by latrine with *G. lamblia* and *B. hominis*.

Parasite forms were found in 82.3% (42/51) of the studied soil samples, with a frequency of 91.4% (32/35) in the CZ and 62.5% (10/16) in the PZ. The protozoa and helminths found are shown in Table 1. When associating the parasites found in the soil samples with those present in humans, a statistically significant correlation (p = 0.01) was only shown in other "commensal amoebae" in the PZ.

The percentage of intestinal protozoa found in water samples was 84.2% (16/19), 78% (7/9) in the CZ and 90% (9/10) in the PZ. The parasites found are shown in Table 1. When the parasites found in water samples and in the population analyzed were correlated, a correlation (p = 0.01) was found only for *E. coli* and other "commensal amoebae" in both areas.

In developing countries, the presence, incidence and prevalence of intestinal parasitic infections in different regions are indicators of the health status of the population[7]. The results obtained in this study revealed about 45% of parasited individuals, with the protozoa/helminths ratio being different in both areas and clear predominance of the protozoa. Studies carried out in different countries report different percentages. In South America, lower prevalence was observed in Brazil by LUDWIG *et al.*[9] and in Argentina by GAMBOA *et al.*[7]. Prevalence higher than those found in this study were informed in Brazil[14] and Chile[16]. In Argentina, in a small suburban village, the prevalence was 89.5%[13] and in a marginal slum it was 73%[7]. Similar values to those found in this study were reported in Chile[11] and, in Argentina, two studies report 50.7%[15] and 54.4%[7].

The differences reported in the above mentioned studies in Argentina would demonstrate the diversity of ecological conditions existing in our country, as a reflection of the diverse geographic and demographic conditions of our region.

Analyzing the surveyed environmental variables in the population, it was observed that both for the CZ and the PZ the absence of correct body waste material disposal and the lack of drinking water or its inadequate supply are risk factors associated to the presence of intestinal parasites. It is difficult to identify these factors specifically as indicators of the presence of a parasite genus or species in the population. However, it was possible to observe in some cases that the presence of a determined factor was associated with one parasite in particular, such as in the case of public faucet and *B. hominis*. This shows that the prevalence of intestinal parasites in the population of General Mansilla is closely related to the deficient sanitary conditions, and corroborates what was expressed by other authors[3,13,15].

Both in the soil samples and in the water samples analyzed, protozoa and helminths potentially parasitic for humans were found. The finding of *Toxocara* eggs and coccidians in soil probably arises from dogs, cats and poultry feces contamination.

A positive correlation between the presence of "commensal amoebae" in soil samples and human feces was demonstrated, as well as between "commensal amoebae" and *E. coli* in water samples and feces. This shows that the contaminated soil and water of the region are a source of infection for the mentioned parasites. In the case of *Giardia* spp. and coccidian, even though no statistical association was observed, their presence in water and/or soil could be linked to the prevalences found in the population.

On the other hand, the high frequency of *B. hominis* both in the urban and rural population was contrasted to its low detection in water and its absence in the soil. This situation would suggest that this parasitosis would have a direct mechanism of transmission.

A. lumbricoides was detected in the population but not in soil samples of the region. Probably geophagia is not the mechanism of transmission of this parasitosis in this population. Taking into account that the wastes from cesspools are used as fertilizer in orchards in this community, this parasite would be transmitted through the contaminated vegetable food.

Approximately one third of the population in the cities of underdeveloped countries lives in environmental conditions favoring the parasite-host relationship[1]. In this study we have found deficient sanitary conditions associated with presence of parasites in population and have evidenced that the contaminated soil and water were the source of these parasites.

RESUMEN

Parasitosis intestinales y factores ambientales en una población rural de Argentina, 2002-2003

Hemos evaluado la prevalencia de parásitos intestinales en 504 personas y el grado de asociación entre las variables ambientales y los parásitos intestinales hallados en la población, el suelo y el agua de una zona rural de Argentina durante 2002-2003. Se utilizó una encuesta estructurada para relevar las variables ambientales y se examinaron muestras fecales humanas, de agua y de suelo. La prevalencia parasitaria fue de 45,4%. Los protozoos prevalentes fueron *Blastocystis hominis* (27,2%) y *Giardia lamblia* (6,9%), mientras que el helminto mas prevalente fue *Ascaris lumbricoides* (3,8%). Las variables ambientales analizadas que mostraron asociación (p < 0,05) con la presencia de

parásitos en la población fueron: casa de cartón-chapa o de madera con piso de tierra, bomba de agua domiciliaria o comunitaria, canilla fuera de la casa o pública y pozo ciego o letrina. Elementos parasitarios fueron hallados en el 82,3% de las muestras de suelo y en el 84,2% de las muestras de agua. En ambas muestras fueron hallados parásitos que también se encontraron en las personas. En este trabajo hemos hallado deficientes condiciones sanitarias asociadas con la presencia de parásitos en las personas y hemos evidenciado que el suelo y el agua contaminada fueron la fuente de esos parasitos.

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