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Prevalence of intestinal parasitosis within three population groups in La Plata, Argentina

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Abstract. The prevalence of intestinal parasites was studied as a function of socioeconomic conditions within La Plata, Argentina. Age, sex, and environmental factors were considered. Thus, from each of three areas within the city – the first a 'marginal' zone, the second a lower-income suburb, the third a middle-income urban district – 100, 101, and 91 children up to 14 years old, respectively, were examined for intestinal parasites. *Giardia lamblia* was the most frequent species found. The respective prevalences of intestinal parasites overall (73, 54.4, and 35.1%), of polyparasitism (61.6, 27.2, and 12.5%), and of helminthic infection (32, 10.9, and 0.0%) were the highest within the population group having significantly inferior sanitary and environmental conditions. A positive statistical association between the prevalence of intestinal parasitosis and age was observed in all three of the neighborhoods. We also noted a correspondence between the frequency of such infections and school attendance in the two suburban districts. Management practices in accordance with the specific characteristics of an urban environmental and sociocultural ecosystem are thus important for the control of intestinal-parasite infection within municipal populations.

Key words: Intestinal parasites, Prevalence, Socioeconomic factors

Introduction

Non-hygienic living conditions give rise to parasitic infections in man, with the prevalence of such pathology, in fact, being one of the best indicators of socioeconomic status [1–5]. Intestinal parasites have adverse effects on the growth and development of children as well as on their nutritional state [6, 7] and are transmitted either directly through the contamination of water, soil, and food by feces [8, 9] or indirectly through poor hygiene and living conditions. Detrimental sociocultural influences within this latter category would include the lack of personal hygienic practices, poor education, food shortages, the absence of proper plumbing facilities, overcrowding in homes, indiscretion in contact with animals, and inadequate refuse disposal [10–14]. These last factors, and thus the proliferation and transmission of intestinal parasites, are enhanced by both urban overpopulation and the formation of suburban settlements of marginal living conditions as a result of constant rural-to-urban migrations [15–17]. Insufficient attention to public-health measures and the failure on the part of responsible authorities to provide sanitation and hygiene-education programs further complicate the situation [4].

Statistical information on this subject is usually garnered from data provided by hospitals and health-care centers. These institutions, however, are not in a position to monitor the specific conditions that promote the appearance and spread of parasites within urban populations, as these phenomena are determined by specific geographical and ecologic factors [6, 18–20]. For this reason we chose to investigate the precise nature of the environmental variables fostering the dissemination and distribution of intestinal parasites within a representative city (i.e., La Plata) through an examination of the prevalence of various intestinal-parasite species within the infant and juvenile populations of three separate urban neighborhoods of well-defined but differing socioeconomic status [2, 21].

Materials and methods

The city of La Plata is located some 54 km to the south of Buenos Aires, the capital of Argentina; its geographical position is 34°55′ south, 57°56′ west. The year-round average temperature and relative humidity for 1995 were 16.5 °C and 78.6%, respectively, while the average annual precipitation level between 1985 and 1994 was 117.8 cm. The city has a population of 500,000 distributed in such a high density in the urban center relative to the peripheral areas that the municipal services have by this time become insufficient in both quality and quantity to extend to the latter zones. In these studies, we analyzed samples of about 100 children (14 years of age or under) from three different neighborhoods within greater La Plata, each of which population group represented residents of a characteristic socioeconomic status: 'La Unión' is a settlement having so-called 'marginal' living conditions, while 'El Churrasco' exemplifies a typical suburban neighborhood, with both these adjacent residential areas being located just outside the northeast limit of the city and separated from the latter by one of the major peripheral avenues. The final population group investigated was an urban one found just southeast of the city center. The acquisition of the data was done by an oral interview of the parents from each one of the families being studied that took place in their own homes and was aimed at identifying the cultural and socioeconomic characteristics of the community. In this manner we were able also to observe the environmental conditions that we were interested in defining [22–24].

The sampling of fecal material was performed once daily for five consecutive days with each proband. The combined material from the entire sampling period for each individual was then subjected to coproparasitic analysis by means of the sedimentation procedure of Carles-Barthelemy and the flotation technique of Willis [25].

Results

Environmental variables

The neighborhood referred to as 'La Unión' is a low-lying region having some 60% of its area covered with natural ponds, leading to a chronically-recurring problem of flooding for the homes therein, while the

Table 1. Demographic features of the three populations surveyed and the educational level of the parents among the families sampled

Demographic data

Variable	'La Unión'	'El Churrasco'	Urban
Total persons surveyed in census	459	956	504
Total persons from families sampled	340	418	217
Housing density[a]:			
Dwellings per hectare	12.3	32.2	36
Dwellings per acre	4.92	12.8	14.4
Number of dwellings within sample	54	74	50
Average persons/dwelling over census	4.6	4.2	3.5
Average persons/dwelling within sample	6.2	5.6	4.3

Parental educational backgrounds

Maximum educational level attained[b]	'La Unión'		'El Churrasco'		Urban	
	F (n = 57) %	M (n = 61) %	F (n = 63) %	M (n = 70) %	F (n = 46) %	M (n = 51) %
Illiteracy	16	18	1.6	0	0	0
Primary not completed	19	28	11	13	2.1	1.9
Primary completed	53	41	54	41	17	16
Secondary completed	12	13	33	46	76	80

Educational level of father or mother between any pair of neighborhoods: $p < 0.01$

[a] 1 hectare equals about 2.47 acres.

[b] F = father; M = mother.

terrain itself is used as a landfill-creating refuse-dumping site. The streets are of dirt; the electrical power is weak; and there is no central gas or sewage system, no street lighting, and no garbage-collection facility. The inhabitants are of a low educational and socioeconomic level, while the dwellings are, for the most part, jerry-built of flimsy, makeshift materials affording only a bare minimum of comfort and protection from the elements.

By contrast, the neighborhood 'El Churrasco', although contiguous with the former, exhibits significant differences from 'La Unión' with respect to the physical, biological, and socioeconomic characteristics of its ecosystem. Its more distinctly urban infrastructure includes better road conditions, adequate electrical power, central gas, sewers, street lighting, and trash pick-up. Moreover, the educational and socioeconomic level of its residents is superior to that of 'La Unión', while the dwellings are of a varied quality of construction, ranging from those of flimsy and impermanent materials such as corrugated-iron sheeting, through those solidly-built and of either simple or more elaborate design, up to those of careful architectural planning and excellent craftsmanship.

Table 2. Environmental variables within the three municipal subpopulations studied in La Plata, Argentina

Variable	'La Unión' (n = 55 homes)		'El Churrasco' (n = 75 homes)		Urban (n = 50 homes)		*p*
	No.	%	No.	%	No.	%	
Available water supply							<0.001
Brought in from remote source	7	13	0	0	0	0	
Running, outside the home	35	64	16	21	0	0	
Running, inside the home	13	24	59	79	50	100	
Mode of excrement disposal							<0.001
None	3	5.5	0	0	0	0	
Latrine	18	33	5	6.7	1	2.0	
Pipeline draining into pond	19	35	0	0	0	0	
Cesspool	15	27	55	73	6	12	
Sewer	0	0	15	20	43	86	
Mode of garbage disposal							<0.001
Elimination outdoors	55	100	0	0	0	0	
Municipal collection system	0	0	75	100	50	100	
Socioeconomic level[a]							<0.001
Poverty	8	15	0	0	0	0	
Lower middle class	44	80	21	28	0	0	
Lower upper class	3	5.5	42	56	13	26	
Middle class	0	0	12	16	37	74	
Home-construction material							<0.001
Corrugated iron, wood	45	82	23	31	5	10	
Standard	10	18	52	70	45	90	
Floor of home							<0.001
Dirt	22	40	6	8	0	0	
Cement	33	60	69	92	50	100	
Overcrowding index[b]							<0.001
Applicable	40	73	27	36	5	10	
Not applicable	15	27	48	64	45	90	

[a] *Socioeconomic level:* In order to define the three socioeconomic strata below middle class, 13 variables were evaluated quantitatively for each family, and the family was assigned to the class corresponding to the numerical range within which the total score fell. To this end, the socioeconomic parameters assessed were the following: Inhabitants: family size, presence of the father, parents' educational level, work activity of the head of the household, medical-insurance status of the head of the household; Living conditions: occupancy status of the dwelling (i.e., ownership, rental, etc.), type of house, sleeping promiscuity (number of persons per bed), water supply, mode of excrement disposal, mode of garbage disposal, independent kitchen, outfitting of home with appliances.

[b] Defined as: No. of persons/No. of rooms when >3.

Table 3. Prevalence of parasite species in children 14 years of age or under screened within three neighborhoods in La Plata, Argentina

Species[a]	'La Unión' (n = 100)		'El Churrasco' (n = 101)		Urban (n = 91)		*p*
	No.	%	No.	%	No.	%	
Protozoans							
Giardia lamblia	34	34	21	21	9	9.8	$p < 0.05$
Blastocystis hominis[b]	48	48	32	32	23	25	$p < 0.05$
Entamoeba coli[c]	18	18	6	5.9	3	3.3	$p < 0.01$
Enteromonas hominis[c]	1	1.0	3	3.0	2	2.2	$p < 0.05$
Iodamoeba butschlii[c]	1	1.0	0	0	0	0	–
Helminths							
Ascaris lumbricoides	22	22	8	7.9	0	0	$p < 0.01$
Hymenolepsis nana	15	15	4	4.0	0	0	$p < 0.01$
Trichiuris trichiura	9	9.0	0	0	0	0	–
'Uncinaria' (hookworms)	2	2.0	1	1.0	0	0	$p < 0.05$

Techniques employed: sedimentation after Carles-Barthelemy and flotation after Willis [25].
[a] Number of children found with indicated parasite – n.b., more than a single species might be present in a given individual.
[b] Controversial commensal.
[c] Confirmed commensal.

Finally the urban neighborhood benefits from far better public services than those found in the two peripheral localities: the streets are paved and lit; and there is electricity, central gas, a sewage system, and periodic rubbish collection. The educational level of the residents is the highest of the three areas, while some 90% of the dwellings are of solid and lasting construction involving standard building materials such as timber, concrete, and brick.

For a summary of the demographic features of the three populations sampled as well as the educational levels of the relevant parents within each of the districts, consult Table 1, while Table 2 summarizes the variables exhibiting statistically significant differences among those three residential ecosystems.

Prevalence of intestinal parasitic infections

Of the nearly 100 children of age 14 years or under from 'La Unión', 'El Churrasco', or the La Plata urban neighborhood who were analyzed for intestinal parasites, some 73, 54.4, and 35.1% within those three respective sites were found to be harboring intestinal infections with either pathogenic or nonpathogenic forms. Table 3 shows the numbers and percent distributions of the various species of organisms that were found in this screening. Here we noted a predominance of infections with intestinal commensal agents in all instances, with these species being present at frequencies of 68, 41, and 31%, respectively, within the three districts. In 'La Unión' this prevalence was followed by the presence of helminths (48%) and protozoans (of which the most prevalent was *Giardia lamblia* at a frequency of 34%). In 'El Churrasco', however, the prevalence of helminth infection (13%) was markedly lower than in 'La Unión', though the frequency of parasitism by protozoans (21%) was notably less so. By contrast, in the urban neighborhood, we found no helminths in any of the samples, and the occurrence of protozoan infections was diminished to 9.8%. In all three neighbourhoods, the most common single parasitic species was *Giardia lamblia*.

Table 4 summarizes the frequency of infection with two or more species of parasites as compared to that of the presence of a single contaminant in the children from the three neighborhoods studied. The cases of

Table 4. Number of distinct intestinal-parasite species in children 14 years old or under within three neighborhoods in the city of La Plata, Argentina

No. of species detected	Frequency (%)		
	'La Unión' (n = 73)	'El Churrasco' (n = 55)	Urban (n = 32)
1	38	73	88
2	32	20	9.3
3	21	5.4	3.1
4	6.8	1.8	0
5	1.3	0	0
6	1.3	0	0
Total polyparasitosis	61.6	27.2	12.5

$p < 0.05$ between all three pairs of neighborhoods in each row.

multiple infection were notably more prevalent in 'La Unión' than in either 'El Churrasco' or the urban district, where in both locales the incidence of a single infection greatly predominated. In this regard, the most commonly occurring single parasitic species was *Blastocystis hominis* in all three areas. With respect to the occurrence of biparasitism within the three neighborhoods, the pairs of species most commonly found together were either *Giardia lamblia* or *Ascaris lumbricoides* in combination with *Blastocystis hominis*. Likewise, the most frequent form of triparasitism involved either the simultaneous presence of all three of these species together ('El Churrasco') or the concurrence of *Giardia lamblia* + *Blastocystis hominis* + *Entamoeba coli* (the other two neighborhoods). Among the cases of higher polyparasitism, the combinations most frequently observed with four, five, and six coparasites were *Ascaris lumbricoides* + *Blastocystis hominis* + *Hymenolepsis nana* + *Trichiuris trichiura* for four; these same four + *Entamoeba coli* for five; and *Blastocystis hominis* + *Entamoeba coli* + *Iodamoeba butschlii* + *Giardia lamblia* + *Trichiuris trichiura* + uncinarias (hook worms) for six concurrent species, respectively.

Table 5 presents the age distribution of intestinal-parasite infection in the children of the three districts; where the 0- to 4-, 5- to 9-, and 10- to 14-year-olds have been grouped together. These data revealed a positive association between child age and the frequency of infection in all three neighborhoods; only in the two suburban ones, however, did this relationship reach statistical significance ('La Unión': $\chi^2 = 9$, $p < 0.05$; 'El Churrasco': $\chi^2 = 5.78$, $p < 0.05$; the urban locale: $\chi^2 = 4.96$, $p > 0.05$). In this regard, the prevalence of parasitosis increased progressively with host age in 'La Unión', whereas the value essentially plateaued at the middle age range and above in 'El Churrasco'. By contrast, we found no association between infection frequency and the sex of the children when we examined this relationship with the chi-squared test corrected according to Mantel–Haenszel. We did, however, observe a direct association between the presence of intestinal parasites and the frequency of school attendance within the two suburban neighborhoods, but not within the urban district (Table 6).

Table 5. Age ranges of children under 14 infected with one or more parasite species within three neighborhoods in the city of La Plata, Argentina

Neighborhood		Age range (years)		
		0–4	5–9	10–14
'La Unión'	Nº. examined	48	35	17
$p < 0.01$	No. infected	30	26	17
	% infected	63	74	100
'El Churrasco'	No. examined	38	41	22
$p < 0.05$	No. infected	15	27	13
	% infected	39	66	59
Urban	No. examined	42	40	9
$p > 0.05$	No. infected	10	17	5
	% infected	24	43	56

Discussion

In 'La Unión' the majority of the families lacked running water within the home; garbage was disposed outdoors; the latrines were primitive in nature; and the houses had dirt floors. Such living conditions readily facilitated contamination of the soil by human feces, which in combination with a high degree of overcrowding, a low income level, and a lack of education resulted in a population with not only scant resources but also a high likelihood of transmission intestinal parasites. This situation was in contrast to the circumstances characterizing the other two districts, where 'El Churrasco' had significantly improved living conditions over those of 'La Unión' and where the urban community enjoyed the highest level of municipal services and socioeconomic benefits among the three neighborhoods studied (Table 2). Thus the variables under consideration here in each of those latter areas pointed to the existence of societal ecosystems that

Table 6. Relationship between intestinal parasitosis and school attendance in children 14 years old or under within three neighborhoods in the city of La Plata, Argentina

School attendance	Number of children		
	Parasitized	Non-parasitized	Total
'La Union'			
Yes	44	7	52
No	29	19	48
Total	73	26	100
Mantel–Haenszel corrected χ^2: 7.34; $p < 0.01$			
'El Churrasco'			
Yes	46	31	77
No	9	15	24
Total	55	46	101
Mantel–Haenszel corrected χ^2: 3.61; $p < 0.05$			
Urban district			
Yes	29	47	76
No	3	12	15
Total	32	59	91
Mantel–Haenszel corrected χ^2: 1.79; $p > 0.05$			

were more favorable for human health and less conducive to parasitic transmission.

In keeping with this decline in parasitosis-promoting living conditions in 'El Churrasco' and the urban district relative to the circumstance in 'La Unión', although we documented a widespread occurrence of intestinal parasite infections within the latter neighborhood, we found a progressively diminishing frequency of such cases in the other two sites, respectively. Indeed, with the sole exception of *Enteromonas hominis*, the prevalence of infection with all individual intestinal-parasite species (helminths as well as protozoans) declined in those areas relative to the corresponding data for 'La Unión' (Table 3).

With respect to the two areas outside the urban district, the pronounced drop in the prevalence of helminth parasitism as well as the lower occurrence of intestinal protozoans (both pathogenic agents and commensals) in 'El Churrasco' relative to the situation in 'La Unión' (Table 3) would imply a lower level of soil, water, and food contamination within that neighborhood from the release of infectious forms of those parasites into the environment via the feces from human hosts. Indeed, in such instances, the eggs or cysts are, in turn, reintroduced into the residential population through the vehicle of contaminated soil, water, and food, with the end result that susceptible individuals contract the infection through either contact with or inadvertent ingestion of the polluted material in question [27, 28].

In contrast to both of these more peripheral neighborhoods, the absence of any cases of helminthiasis in the urban area and the greatly reduced presence of protozoan species in the samples analyzed from there (Table 3) would be consistent with the above-mentioned higher standard of living within that socioecosystem [9, 11, 29, 30].

The prevalence of polyparasitosis was also markedly diminished in general outside of 'La Unión' (Table 4). Nevertheless, although the data for the frequency of infection with only a single parasitic species were comparable among the children of 'El Churrasco' and the urban district, the figures for the copresence of two different species within the stool samples from 'El Churrasco' fell between the values obtained with the specimens from the other two neighborhoods. With regard to polyinfection by three or more types of parasites, however, the data from 'El Churrasco' and the urban locale once again segregated from those of 'La Unión' in parallel (Table 4).

The differing incidence of intestinal-parasite infection among these three residential sections of La Plata, as revealed by these variables as a whole, is thus seen to correlate well with what would be predicted from a consideration of the physical, social, and cultural aspects of each of the three individual societal ecosystems [15, 23, 24, 31, 32].

The results from our studies further indicated the existence of a statistically significant positive association between the prevalence of parasitic infection and host age in the two suburban neighborhoods (Table 5). Another notable finding was a significant relationship between the frequency of parasitosis and the regularity of school attendance among the children surveyed (Table 6), which would suggest that the school environment itself is in some way facilitating the transmission of these parasites.

A comparison of these three residential ecosystems with respect to their physical, biological, and sociocultural characteristics lends strong support to the notion that a widespread occurrence of intestinal-parasite infection is one of the most faithful indicators that a neighborhood under consideration should be classified as 'marginal'.

On the basis of these results, we conclude that there is at present an urgent need both to develop holistic, interdisciplinary sanitation programs and sanitary-education curricula involving community participation as well as to implement practices for the management and control of intestinal-parasite infection in accordance with the environmental and sociocultural characteristics of each municipal ecosystem. Finally, the correlation revealed between the incidence of intestinal parasites and school attendance would further oblige us to formulate and execute long-term measures aimed at juvenile-hygiene education as well as the eventual treatment of specific forms of such parasitoses within the schools themselves.

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