Geographical and socioeconomic factors relating to the distribution of *Schistosoma mansoni* infection in an urban area of north-east Brazil

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A study was carried out in Santo Antonio de Jesus, a town in Bahia State, north-east Brazil, to determine the relationship between various biological, socioeconomic, behavioural, and geographical factors and the prevalence and intensity of Schistosoma mansoni *infection. The town's population was around 45 000 and the study was targeted at all children born in 1970–71 who were living in the town at the time of the survey (August–November 1984). An extensive questionnaire was used to collect information on each child and on family and household conditions; samples of stools were also taken for examination (Kato–Katz method). A survey of water snails was also carried out and information on the distribution of their breeding sites was plotted on a map of the area. The overall prevalence of* S. mansoni *infection was 31.0%. Several variables that reflected different aspects of the population's way of life were strongly associated with the prevalence and the intensity of infection. Some of the findings are valuable for understanding the mechanisms involved in the occurrence of schistosomiasis and its distribution in urban locations as well as for defining high-risk groups, all of which are important for planning control strategies.*

Introduction

The diversity and complexity of the mechanisms involved in the transmission of schistosomiasis are well recognized (*1*). The role played by various socioepidemiological factors in the transmission of the disease and on levels of infection has been studied in various locations using a variety of methods. Among such factors are the following: distance from the transmission site, migration and the emergence of new foci, urbanization, socioeconomic status, sanitation, water supply patterns, and level of faecal contamination of water sources. Information about these factors permits generalizations to be made about the epidemiology of schistosomiasis and identifies the control measures that can be made for specific conditions. However, only a few epidemiological studies have investigated schistosomiasis as a multifactorial phenomenon, focusing on the role and activities of human populations. Such studies are those in the Philippines (*2*) and in Egypt (*3, 4*), where emphasis was given to holistic explanations for the occurrence of the disease. The objective of the present study was to assess the relationship between certain biological, socioeconomic, behavioural, and geographical factors and the prevalence and intensity of *Schistosoma mansoni* infection in an urban environment in Brazil.

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Methods

Study site and population

The study was carried out in Santo Antonio de Jesus, a town situated in Bahia State in the North-east Region of Brazil. The climate is hot and semihumid (*5*). In 1980 the total population of the municipal district was 51 580. Of these, 33 741 (65.4%) lived in the town itself and the remainder in the surrounding rural areas (*6*).

Selection of the study children

The children selected for the study were born between January 1970 and December 1971 and lived in San Antonio de Jesus at the time of the survey. The survey itself was conducted between August and November 1984, when the children were aged between 12 years 8 months and 14 years 11 months. This sampling scheme was chosen for the following reasons: in north-east Brazil schistosomiasis mansoni has its peak prevalence among 10–20-year-olds; and the peak intensity of infection occurs among 10–14-year-olds (*7, 8*). Since the prevalence and intensity of *S. mansoni* vary widely with age, use of a narrow age group reduces the confounding effect of age on the results.

Field work and questionnaire

With the help of a 1 : 4000 map every building in the town was identified and visited to check whether it comprised a household. The names of any children born during the defined period were recorded for each household. For each child identified, a specific questionnaire was completed. This consisted of two pairs—the first dealing with the family's living conditions and the second with the children themselves. The family questionnaire collected data on the household possessions, the income, education level and occupation of the head of the household, as well as on the latrine and water supply facilities in the household. The individual questionnaire collected the following information about each child: age, sex, position in the household, migratory history, schooling, jobs, history of stool examinations, history of *S. mansoni* infection and antischistosomal treatment, and water contact activities. The distribution of *S. mansoni* infection was plotted cartographically.

Stool examination

When a target child was identified, a marked container was supplied for the collection of the faecal sample. Stool examination was performed using the thick smear (Kato) technique (*9*) with a commercially available kit.[a] Two thick smears were prepared from each sample and each was read by a different microscopist. The individual egg count was taken to be the mean of that on the two slides, while the intensity of infection was defined as the geometric mean egg excretion of infected individuals.

Snail survey

Surveys were conducted at two different times to investigate the presence of biomphalaria snails in open bodies of water. Streams were surveyed, starting at their source and thereafter at every 100 m. At each collection point a sieve was dragged along the bottom and towards the shore, searching for snails (*10*). All the snails found were collected, classified according to species, and examined for the presence of cercarial infection (*11*). The distribution of snails in the study area was plotted cartographically.

Analysis of data

Cross-tabulations and χ^2 tests, geometric means and their related one-way analysis of variance or linearity (trend) tests (*12*) were carried out using the SPSS-X software package (*13*). Trend tests for proportions (*14*) and calculation of odds ratios and 95% confidence limits (*15*) were performed using EPISTAT epidemiological analysis software. One-tailed *P*-values were used whenever there was evidence to suggest that an association was in a particular direction, e.g., in tests for trend. Otherwise, two-tailed tests were carried out.

[a] Boehringer Mannheim Bioquimica SA, Rio de Janeiro, Brazil.

Maps were drawn using a GIMMS geocartographic system package (*27*).

Results

General characteristics of the study population

A total of 1765 children who were born between January 1970 and December 1971 and who lived in San Antonio de Jesus were identified through a door-to-door search. Of these children, 1701 (96.4%) provided one stool sample for examination (797 males and 904 females). *S. mansoni* eggs were identified in 527 of the children (prevalence, 31.0%). Among those who were positive, the geometric mean number of eggs excreted per gram of stool was 93. The prevalence of eggs among males was higher than that among females (38.8% and 24.1%, respectively), but the mean egg counts were similar for both sexes (91 and 96 eggs per gram of stool, respectively).

The data shown in Table 1 indicate that the prevalence of *S. mansoni* infection was lower among children who were members of a nuclear family than those who were not. The peak prevalence occurred among children who were working as household servants (74.6%). Similarly, the mean egg count was lowest among children from nuclear families and highest among those employed as servants.

Migration

Our data confirm that the rate of migration to San Antonio de Jesus was high: only 22.9% (342) of the heads of household who were interviewed were born in the town, and 54.2% (610) were of rural origin. Information about the children's places of birth and their relationship to the prevalence and intensity of *S. mansoni* infection is shown in Table 2. There was a clear association between the time lived in a rural environment and the prevalence and intensity of infection. The prevalence and intensity of infection among children who had always lived in San Antonio de Jesus were significantly lower than those who had lived previously in rural areas.

Socioeconomic characteristics of the study families

The minimum wage in Brazil is around US$ 60 per month. In the study population 34.8% of the families had a monthly wage lower than this. Family income was strongly associated with the risk of becoming infected with *S. mansoni*, since the prevalence increased with decreasing income, from 17.2% among families whose income was greater than or equal to seven minimum wages, to 34.8%

Table 1: **Prevalence and intensity of *Schistosoma mansoni* infection according to the relationship of the study children to the head of the household**

Relationship	No. of children	% prevalence	Mean number of eggs/g stool	Odds ratio
Child, stepchild, or grandchild	1498 (88.1)[a]	29.7	84: *75–95* [b]	1.0
Other relative	92 (5.4)	30.4	188: *108–326*	1.0: *0.6–1.7*
Without kinship	63 (3.7)	37.1	88: *48–160*	1.3: *0.8–2.4*
Household servants	48 (2.8)	74.6	206: *115–369*	7.2: *3.6–14.7*
	$P < 0.0001$		$P < 0.001$	
Total	1701 (100.0)	31.0	93: *87–98*	

[a] Figures in parentheses are percentages.
[b] Figures in italics are 95% confidence limits.

Table 2: **Prevalence and intensity of *Schistosoma mansoni* infection among study children according to their place of birth and time lived in rural areas**

	No. of children examined	% prevalence	Mean number of eggs/g stool	Odds ratio
Place of birth:				
San Antonio de Jesus	919 (54.0)[a]	27.4	74: *64–86* [b]	1.0
Another town	338 (19.9)	28.5	89: *66–120*	1.1: *0.8–1.4*
Rural areas	444 (26.1)	40.5	130: *104–162*	1.8: *1.4–2.3*
	$P < 0.0001$		$P < 0.0001$	
No. of years lived in rural areas:				
0	1083 (63.7)	25.7	77: *66–89*	1.0
0–4	214 (12.6)	32.2	97: *71–133*	1.4: *1.1–1.9*
≥5	404 (23.7)	44.6	122: *98–153*	2.3: *1.8–3.0*
	$P < 0.0001$		$P < 0.001$	

[a] Figures in parentheses are percentages.
[b] Figures in italics are 95% confidence limits.

among those earning less than one minimum wage. A similar trend was observed for mean egg excretion, but this was not as consistent as that exhibited by the prevalence of infection (Table 3). An increase in the education level of the head of the household (father, grandfather or stepfather) was strongly associated with a decrease in the prevalence and intensity of infection.

Sanitation and water supply

The majority of the children lived in houses equipped with a flush (66.2%) or pit latrine (19.1%), and 92.6% lived in households with piped water. Children from households with piped water and sewage disposal systems had similar prevalences of *S. mansoni* infection but a lower mean egg excretion rate than those from households that were served by ponds; however, the prevalence among children from households with piped water but no wastewater disposal facilities was greater than both the groups. The worst conditions were associated with households that were supplied from open water sources. Children from such households had a prevalence of infection of 52.5% and mean egg excretion of 107 eggs per gram of stool (Table 4).

Water contact activities

Table 5 shows the relationship between the four variables involving contact with water or defecation activities, together with the prevalence and intensity of *S. mansoni* infection. Among the other variables covered in the questionnaire were those associated with washing and occupational activities, but their frequency was too low to be considered in the analysis. Almost 92% of the children reported having played or swum in bodies of water at some time. The few who denied this kind of activity had a very low prevalence of *S. mansoni* infection (9.2%). A lower mean egg excretion was also observed for this group, but the difference was not significant at

Table 3: **Prevalence and intensity of *Schistosoma mansoni* infection according to the education level of the head of the household and family income**

	No. of children examined	% prevalence	Mean number of eggs/g stool	Odds ratio
Family income:[a]				
<1	290 (20.1)[b]	34.8	113: *86–140*[c]	2.6: *1.4–4.9*
1	452 (31.3)	32.3	88: *72–108*	2.3: *1.3–4.3*
2–3	408 (28.3)	28.4	62: *50–78*	1.9: *1.0–3.6*
4–6	199 (13.8)	25.6	81: *56–116*	1.7: *0.9–3.3*
≥7	93 (6.4)	17.2	95: *48–189*	1.0
	$P < 0.001$		$P < 0.025$	
Education level:[d]				
None	444 (29.6)	35.8	99: *80–123*	5.0: *1.4–16.3*
Low	865 (57.8)	28.6	81: *69–95*	3.6: *1.0–12.5*
Medium	158 (10.6)	22.8	59: *39–90*	2.7: *0.7–11.1*
High	30 (2.0)	10.0	42: *27–64*	1.0
	$P < 0.0001$		$P < 0.025$	

[a] Expressed as multiples of the minimum wage in Brazil (about US$ 60)
[b] Figures in parentheses are percentages.
[c] Figures in italics are 95% confidence limits.
[d] None = never been to school; low = primary school; medium = secondary school; high = high school or university.

Table 4: **Prevalence and intensity of *Schistosoma mansoni* infection according to sanitation and water supply conditions in the study households**

	No. of children examined	% prevalence	Mean number of eggs/g stool	Odds ratio
Latrine:				
Flush with sewage disposal	936 (62.7)[a]	26.1	79: *67–93*[b]	1.0
Flush without sewage disposal	53 (3.5)	32.1	60: *30–119*	1.4: *0.7–2.5*
Pit	285 (19.1)	34.4	94: *72–121*	1.9: *1.3–2.4*
None	220 (14.7)	38.2	92: *70–122*	1.8: *1.3–2.4*
	$P < 0.0001$		$P > 0.10$	
Water supply:				
Piped with wastewater disposal	671 (44.8)	24.3	81: *73–89*	1.0
Piped without wastewater disposal	716 (47.8)	33.8	82: *76–90*	1.6: *1.2–2.0*
Pond	49 (3.3)	22.4	134: *99–181*	0.9: *0.4–1.9*
Open bodies of water	61 (4.1)	52.5	107: *89–128*	3.4: *2.0–6.1*
	$P < 0.0001$		$P > 0.10$	

[a] Figures in parentheses are percentages.
[b] Figures in italics are 95% confidence limits.

the 5% level. Children who reported playing in water or swimming during the previous month exhibited twice the prevalence and a considerably higher intensity of *S. mansoni* infection than other children. Fishing was closely associated with an increased risk of infection with *S. mansoni*. The prevalence and intensity of *S. mansoni* infection decreased sharply as the frequency of day-to-day contact with water fell off. For children who reported frequent contact with water, the prevalence of *S. mansoni* infection was 60.6% and the mean egg count was 177 eggs per gram of stool.

Previous stool examinations and antischistosomal treatment

In San Antonio de Jesus there were four laboratories at the time of the study: one state owned, a FUNRURAL (state insurance scheme for agricultural workers), and two privately owned. A total of 54.5% of the study population stated that a sample of their stools had been examined at least once (Table 6). A higher prevalence of infection with *S. mansoni* was observed for those who had not had their stools examined, but the mean egg count was

Table 5: **Prevalence and intensity of *Schistosoma mansoni* infection among study children according to their activities involving contact with water**

	No. of children examined	% prevalence	Mean number of eggs/g stool	Odds ratio
Playing in water or swimming (ever):				
No	141 (8.3)[a]	9.2	53: *32–89*	1.0
Yes	1559 (91.7)	33.0	94: *84–106*	4.8: *2.6–8.3*
	$P < 0.0001$		$P > 0.10$	
Playing in water or swimming (past month):				
No	1314 (86.0)	26.3	87: *75–100*	1.0
Yes	338 (20.5)	51.2	109: *88–134*	2.9: *2.3–3.8*
	$P < 0.0001$		$P < 0.05$	
Fishing:				
No	1442 (86.0)	28.0	84: *74–95*	1.0
Yes	234 (14.0)	49.6	136: *103–181*	2.5 *1.9–3.4*
	$P < 0.0001$		$P < 0.001$	
Frequency of contacts with water:				
None	1264 (74.9)	25.3	78: *73–84*	1.0
Sporadic	264 (15.6)	39.8	83: *74–92*	1.9: *1.5–2.6*
Frequent	160 (9.5)	60.6	177: *132–273*	4.5: *3.2–6.5*
	$P < 0.0001$		$P < 0.0001$	

[a] Figures in parentheses are percentages.
[b] Figures in italics are 95% confidence limits.

Table 6: **Prevalence and intensity of *Schistosoma mansoni* infection among the study children according to previous stool examinations and antischistosomal treatment**

	No. of children examined	% prevalence	Mean number of eggs/g stool
Previous stool examination:			
Yes	924 (54.5)[a]	27.1	96: *81–114*
No	770 (45.5)	35.7	91: *78–107*
	$P < 0.001$	$P > 0.10$	
No. of previous stool examinations:			
1	347 (37.6)	31.7	113: *88–146*
2–4	368 (39.8)	26.3	100: *76–132*
⩾5	98 (10.6)	16.3	39: *23–65*
Didn't know	111 (12.0)	—	—
	$P < 0.01$	$P > 0.10$	
Time since last stool examination (years):			
<1	237 (25.6)	24.9	100: *69–143*
1–2	325 (35.2)	23.7	99: *71–139*
⩾3	353 (38.2)	31.7	92: *73–116*
Didn't know	9 (1.0)	—	—
	$P < 0.05$	$P > 0.10$	
History of *S. mansoni* infection:			
Yes	80 (8.7)	40.0	116: *68–198*
No	698 (75.5)	26.2	87: *72–106*
Didn't know	146 (15.8)	—	—
	$P < 0.025$	$P > 0.10$	
Antischistosomal treatment:			
Yes	71 (88.8)	39.4	113: *65–197*
No	8 (10.0)	50.0	137: *42–444*
Didn't know	1 (1.3)	—	—
	$P > 0.10$	$P > 0.10$	

[a] Figures in parentheses are percentages.
[b] Figures in italics are 95% confidence limits.

not significantly different from that of children whose stools had been examined previously.

Only 80 (8.7%) of those whose stools had been examined previously reported that the result had been positive for *S. mansoni* eggs. This group was diagnosed to have a prevalence of 40.0% compared with 26.2% for individuals who had had no *S. mansoni* infection in the past. Use of antischistosomal drugs was reported by 71 (88.0%) of those with a history of positive infection with *S. mansoni* and 8 (10.0%) reported receiving no treatment at all. Because of the small number of cases involved, however, comparison of these two sets of individuals was not possible.

Distribution of snails and schistosomiasis prevalence

The topography surrounding San Antonio de Jesus consists of flat valleys and small hills. Considerable inequalities of wealth distribution exist, with better-off areas often juxtaposed with very poor areas. In the town the only snail that is host to *S. mansoni* is *Biomphalaria glabrata*. These were found at various places; however, some degree of aggregation in their distribution was observed (Fig. 1). A total of 625 snails were collected and 19.5% of these were infected. The rate of infection, depending on collection point, varied from 0% to 100%.

The prevalence and intensity of *S. mansoni* infection varied from 70.5% in census tract 1 to 13.6% in census tract 14. The spatial pattern of the prevalence in the various tracts is shown in Fig. 2. There were two geographically defined groups of tracts where the prevalence was greater than 30%, which made it possible to define three zones where the prevalence of infection and mean egg counts were as follows: 50.4% and 100 eggs/g of stool (zone 1); 34.4% and 77 eggs/g of stool (zone 2); and 23.8% and 80 eggs/g of stool (zone 3). In zone 1, where 15.0% of the study population lived, 29.9% of subjects excreted more than 400 eggs/g of stool.

Discussion

The results presented here show that schistosomiasis mansoni was moderately prevalent in children in the study area. While the study was not intended to test a model of the multicausal relationships leading to infection, the results suggest that the distribution of the disease follows a pattern related to the complexity of the urban infrastructure. Several variables that are related to different aspects of the population's way of life were strongly associated with the prevalence and the intensity of infection. The results are useful for understanding the mechanisms involved in the occurrence and distribution of schistosomiasis in an urban setting and for identifying high-risk groups.

One important finding was the role played by migration in determining the levels of schistosomiasis infection. The prevalence and intensity of infection were significantly lower among children born in San Antonio de Jesus and those who had lived there for a long time. The duration of residence in rural areas was strongly associated with the level of infection (Table 2). *B. glabrata* snails were found that had a high rate of schistosome infection in

Fig. 1. **Map of Santo Antonio de Jesus, showing census tracts, water sources and snail breeding sites; ★ = infected snails; ☆ = uninfected snails.**

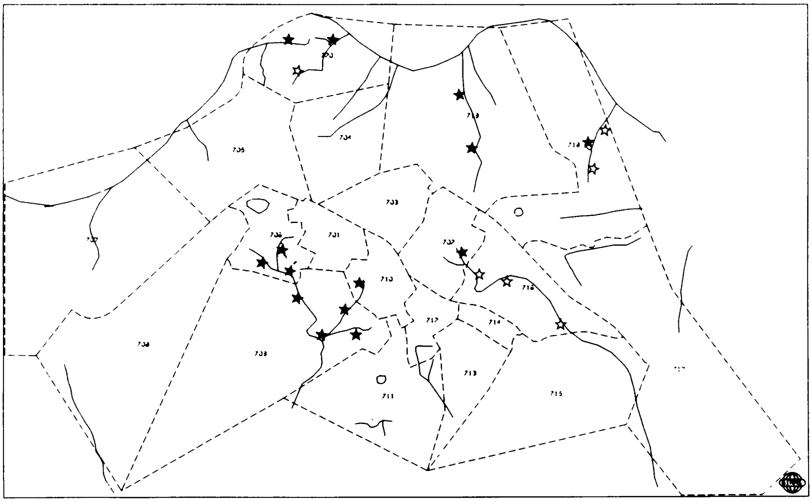
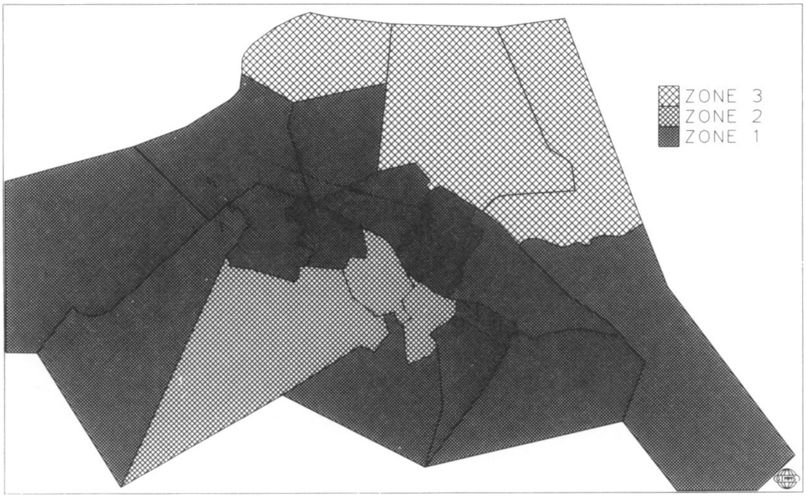


Fig. 2. **Map of Santo Antonio de Jesus, showing the three zones formed by the aggregation of the census tracts according to the prevalence of *Schistosoma mansoni* infection; zone 1, prevalence <30%; zones 2 and 3, prevalence >30%.**



several bodies of water in various parts of the study area (Fig. 1). Taken together, these findings emphasize that *S. mansoni* infection is transmitted locally, but at a low level of intensity and that immigration, mainly from rural areas, is an important and permanent source of new stocks of infected subjects. In Brazil, such migration is a direct consequence of an enduring land tenure system that deprives most people of land and agricultural income, while leaving large rural areas unused (*16*). On the other hand, the development of industries, businesses, and services in some urban settings attracts landless individuals from rural areas. Cities and towns have grown more rapidly than compatible infrastructures, creating unhealthy peripheral areas that favour the focalization of many transmissible diseases, whether or not they are carried by rural migrants. For example, epidemics of malaria and leishmaniasis have occurred in this way (*17*).

The negative association reported here between the prevalence and the intensity of infection and socioeconomic status is consistent with the findings of other workers (*4, 18*).[b] Although such variables have no direct bearing on the transmission of *S. mansoni*, they are closely linked with characteristics such as migration status, sanitation, water supply facilities and contact with water, all of which are more directly associated with the transmission.

Other variables, such as sanitation and water supply conditions, should play a major role in the transmission of schistosomiasis and, as might be expected, the absence of a safe source of water supply in households was associated with high levels of infection. Also, a high prevalence of infection occurred among children from households that had no kind of sewage disposal system (Table 4). Our data suggest that at the individual level the lack of a supply of water is more serious than the absence of a latrine in the household. While a small number of people reported that there was no sewage disposal system in their household, there was no guarantee that some of the existing cesspits were safe enough to prevent faecal contamination of the environment. The high percentage of snails that were infected with *S. mansoni*, especially in certain locations, suggested that such contamination was very frequent (*19, 20*).

Among the human activities identified, those associated with water were the most immediate link in the causal network of schistosomiasis transmission. Association between such activities and the level of infection has been shown previously, not only qualitatively but also quantitatively through dose–response relationships (*21, 22*).[c] Because our survey was restricted to a specific age group, the strong associations between activities related to

[b] **Loureiro, S.** [*Epidemiological variables in schistosomiasis mansoni.*] Thesis. Federal University of Bahia, Brazil, 1973 (in Portuguese).

[c] **Loureiro, S.** *Schistosomiasis mansoni in children—an epidemiological study of patterns of water exposure using path analysis.* PhD thesis, University of Texas, 1978.

contact with water and the prevalence and intensity of *S. mansoni* infection may have been favoured, and are similar to findings for Brazilian schoolchildren (*23*). The results of the present and several other studies emphasize the importance of playing in water or swimming on the level of *S. mansoni* infection in the population, in general, particularly among schoolchildren (*24*). The process of self-evaluating the extent of contact with open bodies of water proved to be useful for identifying individuals with high levels of infection, since those who reported frequent contact with water on a day-to-day basis had high prevalences and intensities of infection with *S. mansoni*. Fishing was also associated with the highest prevalence and intensity of infection (*25*).

The health services infrastructure in San Antonio de Jesus is considerable and if properly used it could have an impact on several aspects of the health status of the population. Although a high proportion of children reported that they had previously undergone a stool examination, this had a low impact on the level of infection. A check on the validity of the findings from these examinations was not possible; however, the following evidence offers some safeguards: the prevalence and intensity of *S. mansoni* infection decreased as the number of stool examinations reported in the past increased; and the prevalence was higher among those who reported that their last stool examination had been at least 3 years ago. Despite the availability of free drugs for treatment, the high prevalence of intestinal helminths in the study population must be due to very high rates of reinfection, perhaps associated with an inefficient local health system. As far as *S. mansoni* infection is concerned, 8.7% of those examined reported a prior infection, while 15.8% reported that they did not know their infection status. A total of 88.8% of those who reported a positive stool examination also reported having received antischistosomal treatment, but these individuals had a higher prevalence and intensity of infection than those who reported no previous history of infection. Antischistosomal drugs are expensive and not freely available in the study area.

Comparison of the census tracts shows that there were large variations in the prevalences and mean egg excretion. The geographical pattern of *S. mansoni* infection in San Antonio de Jesus indicates that the tracts with the highest prevalence had a tendency to form clusters; by using a prevalence of 30% as a cut-off point three zones could be delimited (Fig. 2). Superposition of Fig. 1 and 2 shows that the two zones with high prevalence of *S. mansoni* infection have a large number of streams flowing through them. This observation is supported by other findings. For example, of the 25 collection points where *B. glabrata* were found, 18 were situated in the two high prevalence zones, while the remainder were situated close to their borders. These findings highlight the important role played by snail foci in the transmission of schistosomiasis and their constraint on the geographical distribution of infection in San Antonio de Jesus (*26*).

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Résumé

Facteurs géographiques et socio-économiques associés à la distribution des infections par *Schistosoma mansoni* dans une région urbaine du nord-est du Brésil

Une étude a été effectuée à Santo Antonio de Jesus, une ville de l'Etat de Bahia, dans le nord-est du Brésil, pour connaître les relations entre divers facteurs biologiques, socio-économiques, comportementaux et géographiques, et la prévalence et l'intensité des infections dues à *Schistosoma mansoni*.

La population de la ville était d'environ 45 000 habitants et l'étude était centrée sur tous les enfants nés en 1970 et 1971 et qui vivaient dans la ville au moment de l'enquête (août-novembre 1984). Un questionnaire très complet a été utilisé pour recueillir les informations sur chaque enfant et sur ses conditions de vie familiale; des échantillons de selles ont été également examinés (méthode Kato-Katz). Une enquête sur les mollusques dans la région a été également effectuée et des informations sur la distribution de leurs sites de reproduction ont été marquées sur une carte.

Un total de 1765 enfants qui satisfaisaient aux conditions de l'étude ont été identifiés par une visite porte à porte. La prévalence totale des infections

dues à *S. mansoni* était chez eux de 31,0%. Plusieurs variables qui reflétaient différents aspects du mode de vie de la population étaient fortement associées à la prévalence et à l'intensité de l'infection: l'immigration—les immigrés constituaient 46,0% de la population et ce groupe avait les taux les plus élevés de prévalence et d'intensité des infections; la situation socio-économique—34,8% des familles avaient un revenu mensuel inférieur au salaire minimum national (US$60), et la prévalence chez les enfants de ce groupe était deux fois supérieure à celle des enfants de familles aisées; l'alimentation en eau—92,6% des habitants avaient une alimentation en eau par canalisation; cependant, les enfants des 7,4% d'habitants restants avaient un taux élevé d'infection; l'hygiène—66,2% des foyers avaient des toilettes avec chasse d'eau mais certains de ces foyers n'avaient aucune installation d'évacuation des eaux usées, ce qui favorise la contamination des étendues d'eau locales; les activités supposant un contact avec l'eau—ces activités, déjà signalées, sont fortement associées à la prévalence et à l'intensité de l'infection par *S. mansoni*, et l'auto-évaluation des contacts avec l'eau a été utile pour identifier les enfants ayant des taux élevés d'infection; services de santé—bien que 54,5% des enfants aient signalé que leurs selles avaient été examinées au moins une fois, les données obtenues laissent à penser que cela n'a qu'un faible impact sur les taux d'infection. Les résultats de cette étude ont été utiles pour comprendre les mécanismes impliqués dans l'apparition et la distribution de la schistosomiase dans un milieu urbain, et aussi pour identifier les groupes à haut risque. Les résultats de l'étude font également penser que la distribution de la schistosomiase est influencée par la complexité de l'infrastructure urbaine.

References

1. **Feachem, R. et al.** *Sanitation and disease: health aspects of excreta and wastewater management*. Chichester, John Wiley, 1983.
2. **Pesigan, T.P. et al.** Studies on *Schistosoma japonicum* infection in the Philippines. 3. Preliminary control experiments. *Bulletin of the World Health Organization,* **19**: 223–261 (1958).
3. **Farooq, M. et al.** The epidemiology of *Schistosoma haemotobium* and *S. mansoni* infections in the Egypt–49 project area. 2. Prevalence of bilharziasis in relation to personal attributes and habits. *Bulletin of the World Health Organization,* **35**: 293–318 (1966).
4. **Farooq, M. et al.** The epidemiology of *Schistosoma haematobium* and *S. mansoni* infections in the Egypt–49 project area. 3. Prevalence of bilharziasis in relation to certain environmental factors. *Bulletin of the World Health Organization,* **35**: 319–320 (1966).
5. **Clima, N.E.** In: *Geografia do Brasil 2. Regiao Nordeste.* Rio de Janeiro, FIBGE, 1977 (in Portuguese).
6. **Fundacao Instituto Brasileiro de Geografia e Estatistica**. *IX. General Census of Brazil 1980.* Vol. 2, Tome 3. Bahia, Rio de Janeiro, FIBGE, 1983 (in Portuguese).
7. **Barbosa, F.S.** [Schistosomiasis morbidity.] *Revista Brasileira de malariologia e doencas tropicais*, (special issue) 3–159 (1966) (in Portuguese).
8. **Lehman, J.S. Jr. et al.** The intensity and effects of infection with *Schistosoma mansoni* in a rural community in northeast Brazil. *American journal of tropical medicine and hygiene*, **25**: 285–294 (1976).
9. **Katz, N. et al.** A simple device for quantitative determination of *Schistosoma mansoni* eggs in faeces examined by the thick-smear technique. *Revista do Instituto de Medicina Tropical de São Paulo*, **14**: 394–400 (1972).
10. **Olivier, I.T.** Techiques. In: Ansari, N., ed. *Epidemology and control of schistosomiasis (bilharziasis).* Basel, Karger, 1973.
11. **Paraense, W.L. et al.** [Distribution of planorbids and the prevalence of *Schistosoma mansoni* in Estado do Espirito Santo.] *Memorias do Instituto Oswaldo Cruz,* **78**: 373–384 (1983) (in Portuguese).
12. **Blalock, H.M. Jr.** *Social statistics.* Auckland, McGraw Hill, 1981.
13. *SPSS–X user's guide*. New York, McGraw Hill, 1983.
14. **Armitage, P.** *Statistical methods in medical research.* Oxford, Blackwell, 1971.
15. **Breslow, N.E. & Day, N.E.** *Statistical methods in cancer research. Volume 1: the analysis of case–control studies.* Lyon, International Agency for Research in Cancer, 1980.
16. **Singer, P.** [*Political economy of urbanization*.] São Paulo, Brasiliense, 1976 (in Portuguese).
17. **Marques, A.C.** [Internal migrations and major endemics.] *Revista Brasileira de malariologia e doencas tropicais,* **31**: 137–158 (1979) (in Portuguese).
18. **Costa, M.F.F.L. et al.** Water contact patterns and socioeconomic variables in the epidemiology of schistosomiasis mansoni in an endemic area in Brazil. *Bulletin of the World Health Organization,* **65**: 57–66 (1987).
19. **Bayer, F.A.H.** Schistosome infection of snails in a dam traced to pollution with sewage. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* **48**: 347–350 (1954).
20. **Paulini, E.** [Contributions by sanitary engineering to the proliferation of schistosomiasis and their value from the epidemiological point of view.] *Revista Brasileira de malariologia e deoncas tropicais,* **18**: 163–174 (1964) (in Portuguese).
21. **Dalton, P.** A sociological approach to the control of *Schistosoma mansoni* in St. Lucia. *Bulletin of the World Health Organization,* **54**: 587–595 (1976).
22. **Dalton, P.R. & Pole, D.** Water contact patterns in relation to *Schistosoma haematobium* infection. *Bulletin of the World Health Organization,* **56**: 417–426 (1978).
23. **Guimaraes, M.D.C. et al.** [Clinical-epidemiological study of schistosomiasis mansoni in schoolchildren in Ilha, Arcos county, Mines Gerais, Brazil.] *Revista de saude*

publica de São Paulo, **19**: 8–17 (1985) (in Portuguese).
24. **Barreto, M.L.** [Cause versus prediction: bathing as a risk factor and predictor of *Schistosoma mansoni* infection.] *Revista de saude publica de São Paulo,* **21**: 305–309 (1987) (in Portuguese).
25. **Tayo, M.A. et al.** Malumfashi endemic disease research project, XI. Water contact activities in the schistosomiasis study area. *Annals of tropical medicine and parasitology,* **74**: 347–354 (1980).
26. **Kloos, H. et al.** Water contact behaviour and schistosomiasis in an upper Egyptian village. *Social science and medicine,* **17**: 545–562 (1983).
27. **Waugh, T.C. & McCalden, J.** *GIMMS reference manual,* release 4.5. Edinburgh, Gimms, 1983.