Rev. Inst. Med. trop. São Paulo
33 (1): 58-63, janeiro-fevereiro, 1991

A MULTIVARIATE ANALYSIS OF SOCIO-DEMOGRAPHIC FACTORS, WATER CONTACT PATTERNS AND *Schistosoma mansoni* INFECTION IN AN ENDEMIC AREA IN BRAZIL

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SUMMARY

Associations between socio-demographic factors, water contact patterns and **Schistosoma mansoni** infection were investigated in 506 individuals (87% of inhabitants over 1 year of age) in an endemic area in Brazil (Divino), aiming at determining priorities for public health measures to prevent the infection. Those who eliminated **S. mansoni** eggs (n = 198) were compared to those without eggs in the stools (n = 308). The following explanatory variables were considered: age, sex, color, previous treatment with schistosomicide, place of birth, quality of the houses, water supply for the household, distance from houses to stream, and frequency and reasons for water contact. Factors found to be independently associated with the infection were age (10-19 and ≥ 20 yrs old), and water contact for agricultural activities, fishing, and swimming or bathing (Adjusted relative odds = 5.0, 2.4, 3.2, 2.1 and 2.0, respectively). This suggests the need for public health measures to prevent the infection, emphasizing water contact for leisure and agricultural activities in this endemic area.

KEY WORDS: Schistosoma mansoni infection; Epidemiology; Multivariate analysis; Socio-demographic variables; Water contact patterns.

INTRODUCTION

Knowledge of what types of water contact are associated with the transmission of schistosomiasis is important to determine public health measures to prevent the infection.

Descriptive studies on water contact patterns in endemic areas have been extensively reported, but controlled studies to examine what types of contact are related with **S. mansoni** infection are few, and all of them used univariate method of analysis. Results from these studies points out different factors associated with the transmission, depending on particular cha-

This project was sponsored by UNDP/Word Bank/WHO Special Programme for Research and Training in Tropical Disease, and by Financiadora de Estudos e Projetos (FINEP) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazil.

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racteristics of each endemic area. In two areas in Brazil, it was observed that water contacts for household activities (laundry, dish washing, and collecting), body hygiene, and leisure were significantly associated with **S. mansoni** infection, while professional contacts were not[5, 11]. In another endemic area, it was observed that only contacts for professional activities and leisure were associated with the infection[6].

This paper reports data from an endemic area for schistosomiasis in Brazil (Divino), where a controlled study was carried out to examine associations between water contact patterns, socio-demographic factors and infection by **S. mansoni**, using multivariate methods of analysis.

MATERIALS AND METHODS

Study area, census and socio-economic survey

Divino is a village situated at Engenheiro Caldas district in the State of Minas Gerais (Brazil). The district has an area of 217 km^2 and it is situated at 380 km northeast from the State capital, Belo Horizonte. The intermediate host in the transmission of schistosomiasis in the district is **Biomphalaria glabrata** (C. P. René Rachou, not published).

A complete census of the village was conducted in March and April, 1986. The occupants in every household were interviewed, and characteristics of the houses were observed. The questionnaire consisted of three categories of explanatory variables: (i) socio-demographic (age, sex, color, place of birth, quality of the house, water supply for the household and distance from houses to streams); (ii) water contact (frequency and reasons for water contact); (iii) antecedent treatment with schistomicides.

The quality of housing was defined by a score which was based on the type of materials used in the construction, as described elsewhere [10].

Water contact information was given by each individual, helped by the mother or other responsible person in the case of children under 10 years old. Contacts with streams in Engenheiro Caldas district (inside and outside the village limits) during the 6 months prior the interview were considered.

All information was obtained by a trained person without knowledge of individuals' laboratory results.

Stool examination and definition of cases and controls

All population was eligible for stool examinations. Two slides of a stool sample of each individual in the study were examined by the Kato-Katz method[8], being all examinations done by the same technician. Individuals over 1 year of age with **S. mansoni** eggs in the stools were classified as cases, and those without eggs in the stools were classified as controls.

Analysis of data

Statistical analysis was based on Student's t test (for geometric means), and on overall chi-square or continuity adjusted chi-square (for proportions). Crude relative odds was used to determine the strength of the associations between socio-demographic or water contact variables and **S. mansoni** infection, and its confidence interval was determined by Woolf's method. Multivariate logistic regression was used to assess the independent effect of variables[1, 3].

RESULTS

Descriptive results

During the study period, 611 inhabitants (316 males and 295 females) were identified in the village. Information on water contact and socio-demographic variables was obtained for all individuals, and stool examinations were performed in 528 (86.4%) inhabitants.

Prevalence of **S. mansoni** infection was 37.5%, and geometric mean of eggs was 139.8 + 3.5 epg among those infected. Prevalence of infection was higher among males (47.6%) than among females (23.7%) ($p < 0.001$). Geometric mean of eggs was also higher among males (177.7 + 3.6 vs 98.8 + 2.9; $p < 0.001$) (Figures 1 and 2).

Figure 1
Prevalence of S. mansoni infection in Divino, according to age and sex

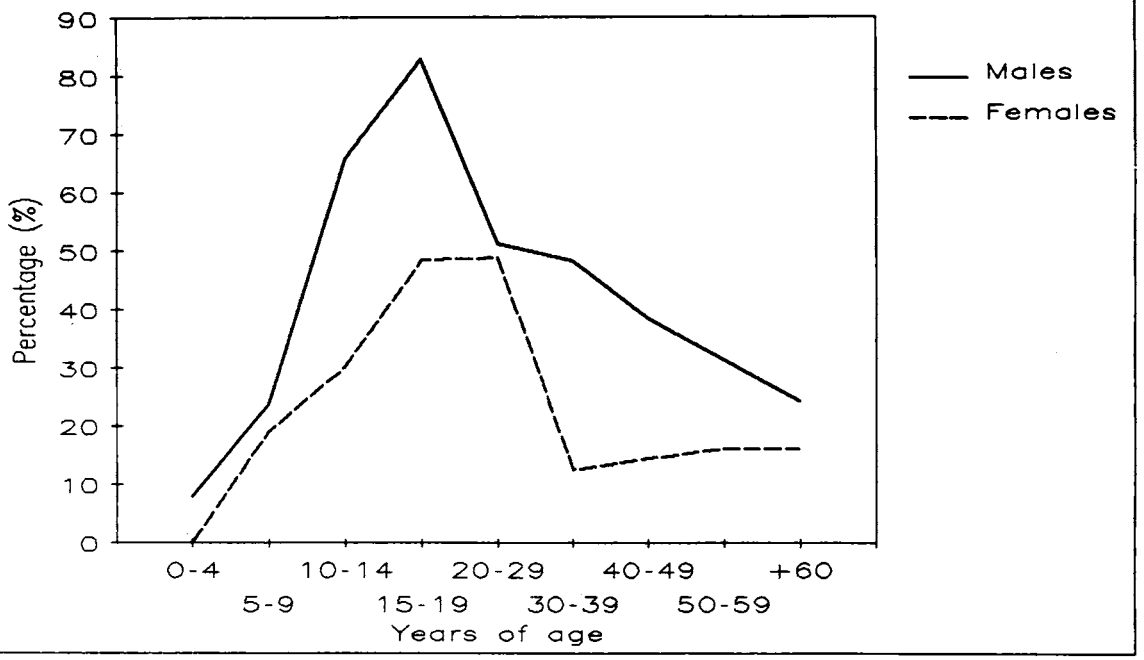
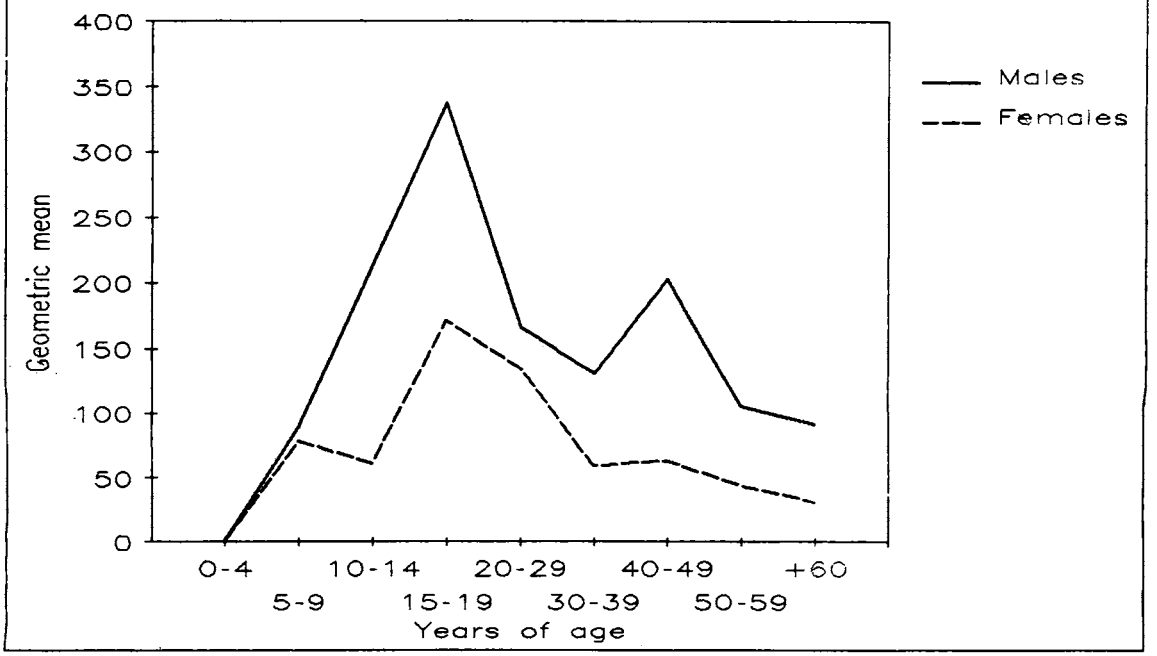


Figure 2
Geometric mean of S.mansoni eggs among those infected in Divino, according to age and sex



Sixty nine per cent of the inhabitants reported water contact in streams during the previous 6 months. Reasons for water contact were: crossing streams (56.1% reported), swimming or bathing (43.4%), fishing (25.9%), collecting water for household (15.2%), laundry (10.8%), and agricultural activities (14.4%). Males reported more water contacts ($p < 0.05$) for swimming or bathing (51.3% of males and 34.9% of females), agricultural activities (21.4 vs 4.1%), and fishing (39.6 vs 11.2%). Females reported more contacts for laundry (1.9% of males and 20.3% of females), and collecting water for household (5.1 vs 26.1%). No significant differences between males and females were found regarding water contact for crossing streams (55.7 vs 56.6%).

Univariate analysis

Associations between **Schistosoma mansoni** infection and socio-demographic variables or water contact patterns were investigated in 506 individuals (87.0% of inhabitants over 1 year of age).

Age, sex and color were found to be significantly associated with the infection in the univariate analysis. No significant associations between the infection and past treatment with schistosomicide, place of birth, quality of the house, source of water for household or distance from household to streams were found (Table 1).

Table 2 shows data regarding water contact. **S. mansoni** infection was associated with frequency of water contact, water contacts for agricultural activities, crossing streams, fishing, and swimming or bathing. No significant association between the infection and contacts for laundry or collecting water for household was found.

Multivariate analysis

Socio-demographic variables significant in the univariate analysis, all reasons for water contact and frequencies of contact were used to develop the multiple logistic regression model. Factors found to be independently associated with the infection by **S. mansoni** were (Table 3): age (10-19 and ≥ 20 yrs old), and water contact for agricultural activities, fishing, and swimming or bathing (Adjusted relative odds = 5.0, 2.4, 3.2, 2.1 and 2.0, respectively).

TABLE 1

Univariate analysis of **Schistosoma mansoni** infection in individuals over 1 year of age, according to age, sex, color, previous treatment with schistosomicides, place of birth, quality of house, water supply for household, and distance of houses from stream.

Variables	Infected (n=198)%	Control (n=308)%	Relative Odds (95% CI)
Age			
2-9	9.6	30.5	1.0
10-19	42.4	15.6	8.7(4.7-15.9)
≥ 20	48.0	53.9	2.8(1.6-4.9)
	p <0.001		
Sex			
Females	35.3	58.4	1.0
Males	64.7	41.6	2.6(1.8-3.7)
	p"<0.001		
Color			
Non-black	83.3	91.2	1.0
Black	16.7	8.8	2.1(1.2-3.6)
	p" = 0.011		
Previous treatment			
No	80.8	82.1	1.0
Yes	19.2	17.9	1.1(0.7-1.7)
	p" =0.794		
Place of birth			
Other	60.6	65.6	1.0
Divino (urban area)	39.4	34.4	1.2(0.9-1.8)
	p" =0.298		
Quality of the house			
Best	55.1	65.6	1.0
Intermediate	31.8	26.0	1.5(1.0-2.2)
Worst	13.1	8.4	1.9(1.0-3.3)
	p =0.045		
Water supply			
Piped	27.8	35.1	1.0
well	40.4	39.9	1.3(0.8-2.0)
none	31.8	25.0	1.6(1.0-2.6)
	p =0.134		
Distance from stream			
≥100 meters	51.0	52.0	1.0
<100 meters	49.0	48.0	1.0(0.7-1.5)
	p" =0.909		

Infected: presence of **S. mansoni** eggs in stools
Control: abscence of **S. mansoni** eggs in stools
p: p value (overall chi-square)
p": p value (continuity adjusted chi-square)

DISCUSSION

In this study we used a simple method to assess factors associated with the infection by **S. mansoni**, aiming at determining priorities for public health measures to prevent **S. mansoni** infection. All efforts were made to reduce possibility of inaccuracies: (i) 87% of the eligible population participated of the controlled study; (ii)

TABLE 2

Univariate analysis of infection with **Schistosoma mansoni** in individuals over 1 year of age, according to frequency and reasons for water contact.

Variables	Infected (n=198)%	Control (n=308)%	Relative Odds (95% CI)
Frequency of water contact			
None	12.1	36.4	1.0
< Weekly	7.1	7.1	3.0(1.3-6.6)
Weekly	80.8	56.5	4.3(2.6-7.0)
	p <0.001		
Reasons for contact:			
Agricultural activities			
No	70.7	94.2	1.0
Yes	29.3	5.8	6.7(3.8-11.8)
	p"<0.001		
Crossing streams			
No	29:3	48.4	1.0
Yes	70.7	51.6	2.3(1.5-3.3)
	p"<0.001		
Fishing			
No	52.5	85.1	1.0
Yes	47.5	14.9	5.1(3.4-7.8)
	p"<0.001		
Swimming or bathing			
No	36.4	66.9	1.0
Yes	63.6	33.1	3.5(2.4-5.1)
	p" < 0.954		
Collecting			
No	82.8	83.4	1.0
Yes	17.2	16.6	1.0(0.6-1.7)
	p" = 0.954		
Laundry			
No	85.9	89.3	1.0
Yes	14.1	10.7	1.4(0.8-2.4)
	p" = 0.310		

Infected: presence of **S. mansoni** eggs in stools
Control: absence of **S. mansoni** eggs in stools
p : p value (overall chi-square)
p": p value (continuity adjusted chi-square)

TABLE 3

Significant results of the multivariate analysis of socio-demographic factors, water contact patterns and **S. mansoni** infection.

Variables	Adjusted Relative Odds (95% CI)*
Age	
10-19 yrs	5.00 (2.87-8.74)
≥ 20 yrs	2.44 (1.41-4.23)
Reasons for water contact	
Agricultural activities	3.16 (1.69-5.92)
Fishing	2.14 (1.50-3.05)
Swimming or bathing	1.97 (1.25-3.10)

*: Adjusted by multiple logistic regression methods (all variables in the table were included in the final model).

socio-demographic and water contact information was obtained through double blind interviews / observations; (iii) period of recall for water contact was restrict to the previous 6 months; (iv) all stool examinations were done by the same technician; and (v) same criteria was used to select cases and controls.

Descriptive data from this study showed that inhabitants from Divino had water contacts for crossing streams, leisure (swimming or bathing, and fishing), household (collecting water and laundry) and occupational activities (agriculture). But results from the multivariate analysis demonstrated that only contacts for agricultural activities, and for leisure (fishing and swimming or bathing) were independently associated with **S. mansoni** infection. This association was reinforced by two other findings: first, source of water supply to household was not associated with **S. mansoni** infection; second, prevalence of **S. mansoni** infection was higher among males, who reported more contacts for leisure and occupational activities, than among females, who reported more contacts for household activities and who are traditionally responsible for these activities.

Another striking aspect was the highest risk observed for 10-19 years old grup. Prevalence of infection is consistently higher in the second decade of life in endemic areas for schistosomiasis in different countries[2, 4, 5, 7, 9, 10, 12].

The results of this study lead up to the following conclusions: (a) in this area, except for age, associations between **S. mansoni** infection and socio-demopgrahic factors disappeared when these variables were adjusted for reasons of water contact; (b) factors found to be independently associated with the infection were age, and water contact for agricultural activities, fishing and swimming or bathing. This suggests the need for public health measures to prevent the infection, emphasizing water contacts for leisure and agricultural activities in this endemic area.

RESUMO

Análise multivariada de fatores sócio-demográficos, padrões de contatos com água e infecção pelo Schistosoma mansoni **em uma área endêmica em Minas Gerais.**

Foi examinada a existência de associação entre fatores sócio-demográficos, padrões de contatos com água e a infecção pelo **Schitosoma mansoni** em uma área endêmica em Minas Gerais (Divino), com o objetivo de determinar medidas prioritárias para prevenir a infecção; 506 indivíduos (87% dos habitantes com mais de 1 ano de idade) participaram do estudo. Aqueles que apresentavam ovos (n = 198) foram comparados aos que não apresentavam ovos de **S. mansoni** nas fezes (n = 308). As seguintes variáveis exploratórias foram consideradas: idade, sexo, cor, tratamento anterior com esquistossomicida, local de nascimento, qualidade da habitação, origem da água para o domicílio distância do domicílio em relação ao córrego, freqüência e motivos de contatos com água. As variáveis que apresentaram associações independentes com a infecção foram: idade (10-19 e ≥ 20 anos), contato com águas para trabalho agrícola, pesca e natação ou banho (Odds relativas ajustadas = 5.0, 2.4, 3.2, 2.1 e 2.0, respectivamente). Estes resultados sugerem que medidas para prevenir a infecção devem priorizar os contatos com águas para o trabalho e o lazer nesta área endêmica.

ACKNOWLEDGMENT

Thanks are due to Miss Maria Aldina Rezende for performing census and socio-economic survey, Dr. Pedro Coura for helpful advice, Sr. Gercy de Souza Morais for technical assistance, and Dr. Mark D. C. Guimarães for reviewing the manuscript.

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Recebido para publicação em 16/5/1990.
Aceito para publicação em 12/7/1990.