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SCHISTOSOMIASIS MANSONI IN AN AREA OF LOW TRANSMISSION. II. RISK FACTORS FOR INFECTION.(1)

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SUMMARY

Risk factors for **Schistosoma mansoni** infection were identified using a 1:1 matched case-control design. The work was conducted in the municipality of Pedro de Toledo, São Paulo State, Brazil, an area where the snail host is **Biomphalaria tenagophila**. Information on water contact patterns, knowledge, attitudes and pratices (kap), socioeconomic and sanitary conditions were obtained by mean of questionnaires. The crude odds ratio estimates and the adjusted odds ratio estimates using the logistic regression model are presented. Most of the examined individuals admitted recent water contacts (90.6% of the cases). The most frequent reason for contact was swimming, playing and fishing and the preferential site of contact was the river. According to the logistic regression technique, the main risk factors for infection were: a) water contact through swimming, playing and fishing; b) fording; c) bad hygiene. We concluded that recreational activities are the main reasons for schistosomiasis transmission in Pedro de Toledo and leisure alternatives should be offered to the local population.

KEY WORDS: Schistosomiasis transmission; **Schistosoma mansoni**; Risk factors; Water contact pattern.

INTRODUCTION

Ecological and sociological factors play a fundamental role in human[11,20,21] schistosomiasis. Indeed, there is no transmission without man's exposure to the sources of infection and this condition depends mainly on the communities' way of life. Studies from different endemic areas have shown that water contact patterns and socioeconomic factors are strikingly correlated and both variables are key determinants in schistosome infections[3,8,14,15,17,18].

In 1987, MARÇAL Jr. et al.[16] evaluated some aspects which could explain the persistent residual human prevalence for **Schistosoma mansoni** in the municipality of Pedro de Toledo, an area of low transmission located in southeastern Brazil, and where **Biomphalaria tenagophila** is the sole intermediate host. Among other results, the authors showed that aggregated distribution of autochtonous cases of schistosomiasis was closely associated with human water contact sites and breeding places of the snail host. However, they did not determine the reasons for water contacts or their relevance for the transmission in the area.

This report complements a previous communication of results from the same investigation[16] by establishing the risk factors for **S. mansoni** infection in relation to water contact patterns and other selected variables.

MATERIALS AND METHODS

Study Area

A detailed description of the studied area was presented elsewhere[5]. We emphasize that the

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landscape is hilly; the climate is hot and wet, and there are many streams in the rural and urban zones, where several breeding places of **B. tenagophila** can be found.

Case-control Study

The association between ecological factors and schistosomiasis was evaluated through a matched case-control study (1:1). The infected persons were established by stool examination, which was performed in 1987[16], and their controls were matched for sex, age and place of residence.

From August 1987 to January 1988, a standard questionnaire, after pre testing, was given to each selected individual by a single researcher, who had no knowledge of the faeces examination or match proceeding. Authochtonous and non-authochtonous cases were interviewed, but only former were used to determine the risk factors.

The water contacts were classified by reason: bathing, laundering, dish-washing, playing, swimming, fishing I (entering the water, e.g. net-fishing), fishing II (rod-fishing), fording and others. The nature of contact was also established as: recreational, domestic, professional and fording. Only water contacts inside the Pedro de Toledo boundaries were considered. The frequency of contact was classified as daily (at least one contact a day), weekly (at least one contact a week), monthly (three contacts a month or less) and seasonal (only summer contacts). An overall score was established according to reason, frequency and degree of contact[13]. Within this system, 60 points define the limit between degrees I and II, the latter being more important for transmission. The sites of contact were divided into three categories: river (streamlets and falls), lake and ditch. Water contacts in the vicinity of the household, up to the limit of 50 meters, were considered in order to evaluate the importance of this contact pattern.

The illness perception was established by scoring the answers on knowledge, attitudes and practices[15].

Social and sanitary conditions were assessed at the individual level by literacy (ability to read and write), education (level of schooling) and occupation (student, domestic, agricultural and others); and at the residential level by type of dwelling (according to materials employed in its construction), source of water and waste disposal. Hygiene was evaluated by personal and domestic cleanliness.

Statistical analysis

The crude odds ratio estimates were done using the COX[2] and KRAUS'[12] methods. A logistic model was fitted to the data according to the methodology proposed by HOLFORD et. al.[9], BRESLOW & DAY[1] and SCHLESSELMAN[19].

RESULTS

Ninety six case control pairs were investigated to determine the risk factors for **S. mansoni** infection in Pedro de Toledo. The majority of them (90.6% of cases and 78.1% of controls) admitted some type of water contact during the months prior to the interview. The main reason for contact was swimming, playing and fishing I (68.8% and 54.2% for cases and controls, respectively). Fording was the least frequent reason (18.7% of cases and 7.3% of controls' responses). When only the most frequent contacts were taken into account we noted that recreational contact was the principal class (54.2% of the responses). Infected individuals showed higher frequencies of daily (33.3%) and seasonal contacts (25.0%). On the other hand, controls showed higher monthly frequency of water contact (33.3%). The river was the preferential place for contact in the studied area (76.0% of cases and 78.6% of controls). Most water contacts (90.0%) occurred within 500 meters from dwellings, but only 25.0% were classified as contacts in the vicinity of the households. No significant difference was found in relation to illness perception and socioeconomic variables.

Table 1 presents a summary of the results, the crude odds ratio estimates and the hypothesis tests. The following factors were statistically significant at 5% level: a) water contact; b) water contact during fording; c) daily water contact; d) degree II of water contact and e) bad hygiene. The factor water contact for swimming, playing and fishing (into water) was significant at 10.0% level.

Table 2 presents the estimates of the logistic model, the coefficients and their respectives standard errors and p-values. The table also presents the estimates of the adjusted odds ratio.

TABLE 1

Frequency of exposure among 96 case-control pairs according to water contact, socio-economic variables and illness perception in the municipality of Pedro de Toledo, 1987, and their respective crude odds ratio estimates.

VARIABLES	CASE E AND CONTROL NE	CONTROL E AND CASE NE	ODDS 1,2 RATIO	95% IC
Water contact	18	6	3.00*	1.19 — 7.56
Reason for contact:				
Bathing, dish-washing or laundering	5	8	0.62	0.20 — 1.89
Swimming, playing or fishing I	28	16	1.75°	0.95 — 3.23
Fording	16	5	3.20*	1.17 — 8.73
Fishing II	14	25	0.56	0.29 — 1.08
Others	3	1	3.00	0.31 — 28.80
Frequency of contact:				
monthly	4	6	1.00	(reference)
weekly	6	1	6.00	0.72 — 49.84
seasonal	6	1	6.00	0.72 — 49.84
daily	8	1	8.00*	1.00 — 63.96
Contact in the vicinity of the household	16	10	1.60	0.73 — 3.53
Site of contact:				
River	20	11	1.82	0.87 — 3.80
Ditch	13	8	1.62	0.67 — 3.91
Lake	7	3	2.33	0.60 — 3.15
Degree II of water contact	32	13	2.46*	1.29 — 4.69
Illiteracy	5	8	0.62	0.20 — 1.89
Basic schooling or none	11	11	1.00	0.43 — 2.30
Student	18	12	1.50	0.72 — 3.11
Houses of type II or type III	17	17	1.00	0.51 — 1.96
Bad hygiene	18	6	3.00*	1.19 — 7.56
Inadequate source of drinking water	14	14	1.00	0.48 — 2.10
No-safety waste disposal	19	10	1.90	0.88 — 4.09
Ignorance about schistosomiasis	4	3	1.33	0.30 — 5.94
Do not know cause	17	16	1.06	0.54 — 2.10
Do not know cure	15	13	1.15	0.55 — 2.42
Do not know prophylaxis	26	24	1.08	0.62 — 1.88
Unsatisfactory illness perception	25	18	1.39	0.76 — 2.55

E = exposed; NE = not exposed
1 - Kraus estimates
2 - Mc'Nemar test: *$p < 0.05$; °$p < 0.10$

TABLE 2
Estimation and results of the logistic model

VARIABLE	estimate(*)	std error	p-value	odds ratio	odds ratio 95% IC
REASON FOR CONTACT:					
Swimming, playing and fishing I	0.90	0.36	0.01	2.46	1.21 - 4.98
Fording	1.22	0.57	0.03	3.39	1.11 - 10.36
Bad hygiene	1.30	0.53	0.01	3.67	1.30 - 10.37

(*) estimate of regression coefficient.

DISCUSSION

No variables left outside the selected model gave a p-value smaller than 0.20 showing that there was no statistical evidence that an important variable was left outside the model. The goodness of fit likelihood test with a p-value equal to 0.75 indicates a good adjustment; this result was supported by the Pearson's statistical test which gave a p-value larger than 0.75[9].

According to the model, the following variables are important: water contacts for swimming, playing and fishing I; water contacts for fording; and bad hygiene. Water contact, daily contacts and degree II of contact were statistically significant when the odds ratio were estimated without adjustment, but they were not considered statistically important when the other variables were taken into account. Notice that these variables had a strong correlation with recreational motives for water contacts.

Swimming, playing and fishing I was the most commom reason for water contact. All are typical leisure activities involving broad corporal exposition and often occuring in the hottest time of day and with long duration[6,15]. On the other hand, fording was the least frequent reason for contact and it was associated with occupational tasks which produces little body exposition, such as cattle conduction.

In previous work DIAS et al.[4] suggested that schistosomiasis transmission occurs during recreational and domestic activities in Pedro de Toledo. In our study the second variable was not considered statistically significant after taking into account the first reason. Notice again the strong correlation between the variables. This result emphasizes the previous findings on focality of the schistosomiasis transmission in the same area[16]. Both data sug gest that transmission is mainly taking place in very well defined sites of contact for leisure.

The relationship of the socioeconomic and cultural variables to schistosomiasis have been established in various endemic areas[3,10,13,18]. We believe that bad hygiene was considered a risk factor, because it was the best variable representing the tenous socioeconomic differences presented in Pedro de Toledo. This result also seemed to us very consistent with a recreational pattern of transmission.

The present work showed that risk factors for **S. mansoni** infection in our low endemic study area were very similar to the factors described in other Brazilian areas[13,14,17] with high endemicity. Nevertheless, symptomatic cases were never found in Pedro de Toledo[4] and probably this fact is due to the host-parasite relations in the area, where the **S. mansoni** strain presents low pathogenicity[7] and the snail has low susceptibility to the sympatric worm[8].

We conclude that water contact for recreational motives is the main risk factor for **S. mansoni** infection in Pedro de Toledo an area with low transmission. Therefore, leisure alternatives should be offered to the local population to reduce human exposure.

RESUMO

Esquistossomose mansônica em área de baixa transmissão. II. Fatores de risco para infecção

A partir de um estudo de caso-controle por pareamento (1:1) foram determinados os fatores de risco para infecção por **Schistosoma mansoni.**

O trabalho foi desenvolvido no município de Pedro de Toledo, São Paulo, Brasil, área onde **Biomphalaria tenagophila** é o hospedeiro intermediário. Por meio de questionários foram obtidas informações sobre o padrão de contato com águas naturais; percepção da doença e condições sanitárias e socio-econômicas. Os fatores de risco foram estimados individualmente e através de modelo logístico. A maioria dos pesquisados admitiu contatos recentes com águas naturais (90,6% dos casos). O motivo mais freqüente para estes contatos foi nadar, brincar e pescar. O rio representou o principal local de contato com águas naturais. De acordo com a técnica de regressão logística, os principais fatores de risco foram: a) contato com água para nadar, brincar, pescar; b) vadear; c) más condições de higiene. Concluímos que as atividades recreativas são as principais responsáveis pela transmissão da esquistossomose em Pedro de Toledo e alternativas de lazer devem ser oferecidas a esta população.

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REFERENCES

1. BRESLOW, N.E. & DAY, M.E. — **Statistical methods in cancer research: the analysis of case control studies IARC scientific.** Lion, International Agency for Research on Cancer, 1980. (Publication nº 32)
2. COX, D.R. - Two further applications of a model for binary regression. **Biometrika, 45:** 562-565, 1958.
3. DALTON, P.R. - A socioecological aprroach to the control of **Schistosoma mansoni** in St. Lucia. **Bull. Wld. Hlth. Org., 54:** 587-595, 1976.
4. DIAS, L.C.S.; GLASSER, C. M.; ETZEL, A.; KAWAZOE, U.; HOSHINO-SHIMIZU, S.; KANAMURA, H.E.; CORDEIRO, J.A.; MARÇAL Jr., O.; CARVALHO, J.F.; GONÇALVES Jr., F.L. & PATUCCI, R. - The epidemiology and control of schistosomiasis mansoni where **Biomphalaria tenagophila** is the snail host. **Rev. Saúde públ. (S. Paulo), 22:** 462-463, 1988.
5. DIAS, L.C.S.; KAWAZOE, U.; GLASSER, C.M.; HOSHINO-SHIMIZU, S.; KANAMURA, H.Y.; CORDEIRO, J.A.; GUARITA, O.F. & ISHIHATA, G.J. - Schistosomiasis mansoni in the municipality of Pedro de Toledo (São Paulo, Brazil) where the **Biomphalaria tenagophila** is the snail host. I — Prevalence in human population **Rev. Inst. Med. trop. S. Paulo, 31:** 110-118, 1989.
6. FAROOQ, M. & MALLAH, M.B. - The behavioural patterns of social and religious water-contact activities in the Egypt-49 Bilharziasis Project Area. **Bull. Wld. Hlth. Org., 35:** 377-387, 1966.
7. FIGUEIREDO, A.C. - Study of biological and morphological characteristics of **Schistosoma mansoni** strain from the Ribeira Valley. **Rev. Soc. bras. Med. trop., 24:** 125-126, 1991.
8. FIGUEIREDO, A.C.; DIAS, L.C.S. & MARQUES, E.H.F. - Biological and morphological characteristics of **Schistosoma mansoni** from Ribeira Valley, State of São Paulo, Brazil. I - Susceptibility of **Biomphalaria tenagophila** snail to sympatric **S. mansoni** strain. **Rev. Inst. Med. trop. S. Paulo, 34:** 199-203, 1992.
9. HOLFORT, T.R.; WHITE, C. & KELSEY, J.C. - Multivariate analysis from matched case-control studies. **Amer. J. Epidem., 107:** 245-256, 1978.
10. HUSTING, E.L. - Sociological patterns and their influence on the transmission of bilharziasis. **Cent. Afr. J. Med., 16** (suppl.): 5-10, 1970.
11. JORDAN, P. & WEBBE, G. - **Schistosomiasis: epidemiology, treatment and control.** London, William Heinemann Medical Book, 1982.
12. KRAUS, A.S. - Comparison of a group with disease and a control group from the same families, in the search for possible etiologic factors. **Amer. J. publ. Hlth., 50:** 303-311, 1960.
13. LIMA E COSTA, M.F.; MAGALHÃES, M.A.; ROCHA, R.S.; ANTUNES, C.M.F. & KATZ, N. - Water-contact patterns and socio-economic variables in the epidemiology of schistosomiasis mansoni in an endemic area in Brazil. **Bull. Wld. Hlth. Org., 65:** 57-66, 1987.
14. LIMA E COSTA, M.F.; ROCHA, R.S.; LEITE, M.L.C.; CARNEIRO, R.G.; COLLEY, D.; GAZZINELLI, G. & KATZ, N. — A multivariate analysis of socio-demographic factors, water contact patterns and **Schistosoma mansoni** infection in an endemic area in Brazil. **Rev. Inst. Med. trop. S. Paulo, 33:** 58-63, 1991.
15. LIPES, J. K. & HIATT, R. A. - Determinants of human water contact patterns in urban Puerto Rico with special reference to schistosomiasis. **Bol. Asoc. méd. P. Rico, 69:** 35-44, 1977.
16. MARÇAL JÚNIOR, O.; PATUCCI, R.M.J.; DIAS, L.C.S.; HOTTA, L.K. & ETZEL, A. - Schistosomiasis in an area of low transmission. I — Impact of control measures. **Rev. Inst. Med. trop. S. Paulo, 33:** 83-90, 1991.
17. MOTTA, E. & SLEIGH, A. C. - Water-contact patterns and **Schistosoma mansoni** infection in a rural community in northeast Brazil. **Rev. Inst. Med. trop. S. Paulo, 29:** 1-8, 1987.
18. PIMENTEL, D.; GERHARDT, C.E.; WILLIANS, E.R.; WHITE, P.C. & FERGUSSON, F.F. - Aspects of schistosomal endemicity in three Puerto Rican watersheds. **Amer. J. trop. Med. Hyg., 10:** 523-529, 1961.
19. SCHLESSELMAN, J.J. - **Case-control studies: design, conduct, analysis.** Oxford, Oxford University Press, 1982.
20. WARREN, K.S. - Regulation of the prevalence and intensity of schistosomiasis in man: Immunology or Ecology? **J. infect. Dis., 127:** 595-609, 1973.
21. WORLD HEALTH ORGANIZATION Workshop on the role of human/water contact in schistosomiasis transmission. Document. Geneve, 1979. (TDR/SER-HWC/79.3).

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