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SCHISTOSOMIASIS MANSONI IN THE "BAIXADA OCIDENTAL MARANHENSE", STATE OF MARANHÃO, BRAZIL: CROSS-SECTIONAL STUDIES PERFORMED IN 1987 AND 1993

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SUMMARY

A cross-sectional study on the prevalence of schistosomiasis mansoni in three sites of the "Baixada Ocidental Maranhense" was carried out in 1993 in: Alegre (in the municipality of São Bento), Aliança (in Cururupu) and Coroatá II (in the municipality of São João Batista). Results were compared to those of another study performed at the same sites and in similar conditions, in 1987.

The entire population of the three sites, with few exceptions, was submitted to fecal tests using the Kato-Katz method and immediate intradermal tests for schistosomiasis in both studies. Subjects with positive results in one of these tests were clinically evaluated by a physical examination.

In 1993, the total of 827 subjects were submitted to fecal examination and 826 to intradermal test. *Schistosoma mansoni* eggs were found in the feces of 154 (18.6%) subjects, while 478 (57.9%) subjects presented a positive intradermal test. Stool examination was carried out in 367 subjects in Alegre with a positivity rate of 14.9%; the intradermal test, performed in 366 subjects, was positive in 47.5% of the cases. In Aliança, 277 subjects had their feces examined and were submitted to an intradermal test, with a positivity rate of 34.4% and 70.7%, respectively. Finally in Coroatá II, 183 inhabitants submitted to fecal and intradermal tests had positivity rates of 2.2% and 59.0%, respectively. When the present data were compared to those obtained in the survey performed in 1987, a significant decrease in the prevalence of infection by *S. mansoni* was observed in Alegre and Coroatá II, and a prevalence increase in Aliança.

KEYWORDS: Schistosomiasis; *Schistosoma mansoni*; Prevalence; Maranhão State.

INTRODUCTION

The first cases of mansoni schistosomiasis in the state of Maranhão were described in the cities of São Luís and Cururupu in 1920. Years later, MACIEL[23] acknowledged transmission in the southeast of Maranhão.

In 1950, a national helminthologic survey, carried out by PELLON & TEIXEIRA[28], found a prevalence of 0.86% of schistosome infection for the state of Maranhão. A prevalence above 4%, however, was found in Cururupu and São Bento, located in the "Baixada Ocidental Maranhense". The rate was considered high enough at the time to characterize indigenous transmission.

Annual reports from the Coordination of Public Health Campaigns (Superintendência de Campanhas de Saúde Pública - SUCAM) in the state of Maranhão show progression of the schistosome endemic in the region. There were 18 cities with a prevalence above 4% in 1977; in 1986, 30 cities had the same scenario, 14 of which on the "Baixada Ocidental Maranhense" [25,26]. Actually, the importance of the western coast in terms of schistosomiasis in the state of Maranhão had already been observed by ALVIM[1], who pointed out how easily the endemic was disseminating in the region.

In 1987, in view of the relevance being acquired by the endemic, its occurrence was studied in the communities of Alegre, Aliança and Coroatá II respectively, belonging to the municipalities of São Bento, Cururupu and São João Batista, in the "Baixada Ocidental Maranhense" [8,10]. Sites were chosen due to their high prevalence of infection before the introduction of the Schistosomiasis Control Program (Programa Especial de Controle de Esquistossomose – PECE) in the region, and due to the different socioeconomic and environmental features among them. At the time, infection rates were evaluated through fecal parasitologic tests (Kato-Katz method) and intradermal reaction. The distinct clinical forms were studied by physically examining patients.

The present study reevaluated the same parameters for the same communities six years later, and compared the results to those obtained by the previous evaluation.

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MATERIAL AND METHODS

As in 1987, the entire population, with few exceptions, of Alegre, Aliança and Coroatá II, respectively belonging to the municipalities of São Bento, Cururupu and São João Batista, in the "Baixada Ocidental Maranhense", was examined (Table 1). A census and mapping of the three sites, fecal and immediate intradermal tests, as well as a physical examination of individuals with one or both tests positive for schistosome infection, were performed during the two studies. On both occasions, all individuals eliminating *Schistosoma mansoni* eggs in feces were treated with oxamniquine (15 mg/kg of weight for adults and 20 mg/kg for children). In 1993, apart from the items mentioned, the inhabitants of the three communities answered a standardized socioeconomic questionnaire and were surveyed in relation to contact with water collections.

TABLE 1
Distribution of existing and examined population in Alegre, Aliança and Coroatá II, "Baixada Ocidental Maranhense, in 1987 and 1993

Year	Site	Existing Pop.	Pop. Examined No.	Pop. Examined %
1987	Alegre	407	403	99.0
	Aliança	268	256	95.5
	Coroatá II	175	170	97.1
	Total	**850**	**829**	**99.5**
1993	Alegre	407	367	90.1
	Aliança	281	277	98.6
	Coroatá II	185	183	98.9
	Total	**873**	**827**	**94.7**

Before beginning the survey, the objective of the study was explained to the inhabitants of the three sites, asking for their consent to carry out tests.

Feces were examined by the Kato-Katz technique [20], and results expressed in terms of number of eggs per gram of feces (EPG). In 1987, 829 samples were examined: 403 in Alegre, 256 in Aliança, and 170 in Coroatá II (10). In 1993, 827 samples were examined with the following distribution: 368 in Alegre, 276 in Aliança and 183 in Coroatá II.

The immediate intradermal test for schistosomiasis was performed according to the KAGAN et al.[19], using antigen obtained from adult specimens of *S. mansoni* (schistosomine), provided by the Department of Parasitology of the Federal University of Minas Gerais.

In 1987, intradermal tests were performed in 824 individuals: 398 in Alegre, 256 in Aliança, and 170 in Coroatá II [10]. In the survey carried out in 1993, 826 individuals were submitted to intradermal tests as follows: 366 in Alegre, 277 in Aliança and 183 in Coroatá II.

The comparison of the population examined in 1987 with the one studied in 1993 showed that 72.4% of the cases were the same subjects (Table 2).

TABLE 2
Distribution by sites of the 827 individuals examined in 1993, as well as the number and percentage of individuals already examined in 1987, at the same sites

Sites	Total examined in 1993	Examined in 1987 No.	Examined in 1987 %
Alegre	367	285	77.6
Aliança	277	185	66.8
Coroatá II	183	129	70.4
Total	827	599	72.4

The physical examination of patients with one or two positive tests for schistosome infection was carried out at patients' homes, and always by the same examiner. The examination was performed with the patient in the supine and Schuster position. Collateral circulation was sought first, and then the presence of an enlarged liver and/or spleen was verified through percussion and palpation. When palpable, consistence of the organs was also evaluated, to classify them as soft, hardened or hard. The criteria defined by BARBOSA[3] were adopted to classify clinical forms.

In 1987, 474 individuals were submitted to clinical examination (195 in Alegre, 185 in Aliança, and 94 in Coroatá II); in the 1993 evaluation, 488 individuals were examined: 175 in Alegre, 205 in Aliança, and 108 in Coroatá II.

The results obtained were processed by Epi-info 6 and the statistical analysis adopted the minimum significance level of 95% ($p< 0.05$), using the Chi-square and Fisher tests, according to circumstances.

RESULTS

Of the 827 persons examined in 1993 in the three communities included in the present study, all were submitted to fecal examination, and 826 to intradermal test. *S. mansoni* eggs were found in the feces of 154 (18.6%) individuals, and 478 (57.9%) had a positive intradermal test. Table 3 shows the prevalence of infection determined by two techniques, and according to the gender and age group of individuals examined in the three sites.

TABLE 3
Prevalence of *Schistosoma mansoni* infection in Alegre, Aliança and Coroatá II, in 1993, determined by fecal tests and intradermal tests, according to age group and gender

Examined	Fecal tests No.	Fecal tests Posit.	Fecal tests %	Intradermal reaction No.	Intradermal reaction Posit.	Intradermal reaction %
Age:						
< 15 years	367	34	9.3	368	112	30.4
> 15 years	460	120	26.1*	458	366	79.9*
Sex:						
Male	438	108	24.6	438	313	71.5
Female	389	46	11.8*	388	165	42.5*
Total	827	154	18.6	826	478	57.9

* $p<0.05$

TABLE 4

Results of fecal tests performed in Alegre, Aliança and Coroatá II in 1987 and 1993, according to age group and gender

Examined	1987			1993		
	Tests performed	Positive	%	Tests performed	Positive	%
Alegre:						
- Age						
< 15 years	195	25	12.8*	149	6	5.0*
> 15 years	208	60	29.1**	218	49	22.5**
- Sex						
Male	198	75	37.9*	194	50	25.8*
Female	205	10	4.9**	173	5	2.9**
Total	403	85	21.0*	367	55	15.0*
Aliança:						
- Age						
< 15 years	118	6	5.1*	114	28	24.5*
> 15 years	138	13	9.4*	163	67	41.1*
- Sex						
Male	140	7	5.0*	153	55	35.9*
Female	116	12	10.3*	124	40	32.2*
Total	256	19	7.4*	277	95	34.3*
Coroatá II						
- Age						
< 15 years	104	9	8.6*	104	0	-*
> 15 years	66	13	19.7*	79	4	5.1*
- Sex						
Male	82	8	9.7**	91	3	3.3**
Female	88	14	15.9*	92	1	1.1*
Total	170	22	12.9*	183	4	2.2*

*p<0.05
**p>0.05

TABLE 5

Results of intradermal tests performed in Alegre,Aliança and Coroatá II in 1987 e 1993, according to age group and gender

Examined	1987			1993		
	Tests performed	Positive	%	Tests performed	Positive	%
Alegre:						
- Age						
< 15 years	194	43	22.2**	150	26	17.3**
> 15 years	204	141	69.1**	216	148	68.5**
- Sex						
Male	195	127	65.1**	194	131	67.5**
Female	203	57	28.1**	172	43	25.0**
Total	398	184	46.2**	366	174	47.5**
Aliança:						
- Age						
< 15 years	118	52	44.1**	114	50	43.5**
> 15 years	138	127	92.0**	163	146	89.5**
- Sex						
Male	140	106	75.7**	153	121	79.1**
Female	116	73	62.9**	124	75	60.5**
Total	256	179	69.9**	277	196	70.7**
Coroatá II:						
- Age						
< 15 years	104	43	41.3**	104	36	34.6**
> 15 years	66	52	78.8**	79	72	91.1**
- Sex						
Male	80	51	63.7**	91	61	67.0**
Female	90	44	48.9**	92	47	51.1**
Total	170	95	55.9**	183	108	59.0**

**p>0.05

TABLE 6

Intensity of infection and clinical forms of schistosomiasis in individuals examined in Alegre, in 1987 and 1993, according to age group and gender

Parameters evaluated	1987								1993							
	< 15 years		> 15 years		Male		Female		< 15 years		> 15 years		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
EPG:*																
< 100	18	72.0	40	66.7	44	58.7	6	60.0	4	66.7	27	55.1	28	56.0	2	40.0
> 100	7	28.0	20	33.3	31	41.3	4	40.0	2	33.3	22	44.9	22	44.0	3	60.0
Average No.	33		41		69		23		83		81		81		77	
Clinical Forms:																
type I	21	84.0	34	56.7	45	60.0	10	100.0	6	100.0	35	71.4	36	72.0	5	100.0
type II	4	16.0	26	43.3	30	40.0	0	-	0	-	14	28.6	14	28.0	0	-
Total	25		60		75		10		6		49		50		5	

* EPG= number of eggs eliminated by gram of feces

1. Alegre:

In 1993, Alegre, located in the municipality of São Bento, with 407 inhabitants had 367 and 366 subjects, respectively submitted to fecal examination and intradermal test using schistosomine. Fifty-five subjects (14.9 %) presented *S. mansoni* eggs in feces and the intradermal test was positive for 174 subjects (47.5 %). Tables 4 and 5 show the distribution of positive fecal tests and intradermal tests, according to the age and gender of subjects, comparing present results with those obtained in 1987.

Of the 174 inhabitants of Alegre with a positive intradermal test and/or positive fecal test result, that were submitted to a physical examination, 142 (81.6 %) presented an intestinal form (type I), 20 (11.5 %) a hepatointestinal form (type II), and 12 (6.9 %) a hepatosplenic form (type III). Considering only the subjects which were positive for *S. mansoni* eggs on both occasions, there were 85 and 55 inhabitants of Alegre submitted to physical examination in 1987 and 1993, respectively. Table 6 shows the distribution of the clinical forms of schistosomiasis for both groups, as well as the infection intensity assessed by the number of *S. mansoni* eggs per gram of feces (EPG).

2. Aliança

Aliança, in the municipality of Cururupu, had 281 inhabitants in 1993, 277 of which were submitted to fecal tests and intradermal tests with schistosomine. We registered 34.4% and 70.7% positive fecal tests and positive intradermal tests, respectively. The distribution of subjects rendered positive for both tests, according to age and gender in 1993 and 1987, is shown in Tables 4 and 5.

In Aliança, 196 subjects were positive for feces and/or intradermal test for schistosomiasis infection in 1993. Physical examination showed that 187 (95.4%) had an intestinal form (type I), and 9 (4.6%) a hepatointestinal form (type II).

When we only analyzed the subjects positive for *S. mansoni* eggs in feces, the positivity rates were 7.4 % and 34.3%, respectively, in 1987 and 1993. Table 7 describes the distribution of clinical forms of schistosomiasis and infection intensity (EPG) for each group.

TABLE 7

Intensity of infection and clinical forms of schistosomiasis in individuals examined in Aliança, in 1987 and 1993, according to age group and gender

Parameters Evaluated	1987								1993							
	< 15 years		1> 15 years		Male		Female		< 15 years		> 15 years		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
EPG:*																
< 100	4	66.7	5	38.5	4	57.1	7	58.3	13	59.1	33	45.2	24	43.6	22	55.0
> 100	2	33.3	8	61.5	3	42.9	5	41.7	9	40.9	40	54.8	31	56.4	18	45.0
Average No.	25		35		46		69		78		133		122		107	
Clinical Forms:																
type I	5	83.3	13	100.0	7	100.0	11	91.7	21	95.4	69	94.6	53	96.4	37	92.5
type II	1	16.7	0	-	0	-	1	8.3	1	5.4	4	5.4	2	3.6	3	7.5
Total	6		13		7		12		22		73		55		40	

*EPG= number of eggs eliminated by gram of feces

3. Coroatá II:

This community, belonging to the municipality of São João Batista, had 185 inhabitants in 1993, of which 183 (98.9 %) were submitted to fecal and intradermal tests aiming at schistosome infection. We recorded positive result rates for fecal tests and intradermal tests in 2.2 % and 59. 0 %, respectively.

Tables 4 and 5 describe the distribution of subjects with positive fecal and intradermal tests performed in the community in 1987 and 1993, according to age and gender.

In Coroatá II, in 1993, 108 subjects were positive for *S. mansoni* infection according to fecal and/or intradermal tests. From these subjects we could draw 106 (98.1 %) intestinal forms (type I), and 2 (1.9 %) hepatointestinal forms (type II). We observed only four subjects with *S. mansoni* eggs in feces. All four had intestinal forms of schistosomiasis, and when the intensity of infection was assessed, one subject eliminated less than 100 eggs per gram of feces, and three more than 100 eggs.

DISCUSSION

In the present paper the oportunity of comparing the results obtained in 1993 with those recorded in 1987 by one of the authors (8,10), in the same communities, using comparable methods, should be emphasized. It is also important to stress that 72.4 % of the population assessed in the three communities remained the same during both studies (Table 2), allowing us to follow the evolution of the schistosome endemic in the region.

The diagnosis of *S. mansoni* infection was performed in this study and in the previous one [10] by means of fecal and intradermal tests with schistosomine. The latter technique, although more sensitive than stool examination, tends to remain positive even after treatment and parasitological cure of patients [5]. Fecal tests, performed according to the Kato-Katz technique, allow assessing infection activity, and permit evaluating the intensity of the infection by means of the quantity of *S. mansoni* eggs shed in feces [5,20].

Considering the total number of subjects assessed in the three communities, we observed a prevalence of 18.6% of *S. mansoni* infection in 1993 (Table 3). Nevertheless, the intradermal test disclosed a positive result in 57.9 % of the subjects examined (Table 3) . Although the intradermal test tends to continue positive even after successful specific treatment, the high discrepancy between results of fecal tests and intradermal tests suggests that the former underestimates the true level of prevalence, a fact that has already been considered before [13].

The study performed in the same communities in 1987 showed a prevalence of 15.3% of *S. mansoni* infection detected by fecal tests, and 55.6% by intradermal tests [10]. It is important to mention that there were no significant prevalence changes when the three communities were analyzed together, nonetheless the adoption of mass treatment with oxamniquine on different occasions between 1987 and 1993 [27]. This can be explained by the decrease in the prevalence of infection in the communities of Alegre and Coroatá II, compensated by the increase observed in Aliança.

When we analyze the distribution of the rate of infection in the three communities, considering the age and gender of subjects examined, we can observe a higher prevalence within the group over 15 years, and in males (Table 3), suggesting activities related to work and leisure as possible risk factors. Similar results were recorded in other Brazilian regions [7,11,24] and in other countries [12,14].

When each community is analyzed separately, some differences are worth mentioning.

In Alegre and Coroatá there was a significant decrease in the prevalence of infection, mainly in the second community (Table 4). Regarding the community of Aliança, the rate of positive results in feces changed from 7.4% in 1987, to 34.3% in 1993 (Table 4).

In Alegre, the decrease in the prevalence of schistosome infection resulted basically from the drop in the rate of infection among children and male adults (Table 4). On the other hand, in Coroatá II, we observed a prevalence decrease, regardless of the age of the subjects analyzed. Nevertheless, when gender was taken into account, only women presented a significant decrease in the prevalence of infection (Table 4).

When analyzing the community of Aliança, the comparison between data collected in 1987 and 1993, revealed a significant increase in the prevalence of schistosome infection in both sex and age groups studied. (Table 4).

In the three communities, specific treatment for schistosomiasis was given during the period between both studies. According to data from the Ministry of Health, four mass treatments were carried out during this period in Aliança and Coroatá II. In Alegre, on the other hand, only two treatments occurred [27]. It is possible that the lower number of treatments in Alegre may have led to the less significant fall in prevalence of schistosomiasis, when compared to the results observed in Coroatá II, where transmission was virtually interrupted. We must consider, however, the possibility of permanent breeding of planorbids in Alegre, and temporary breeding conditions in Coroatá II [9].

Concerning the community of Aliança the widespread administration of oxamniquine, seemingly did not have the same effect upon the prevalence of schistosomiasis. In this neighborhood, aside from the existence of permanent breeding of *Biomphalaria glabrata*, all age groups are engaged in harvesting "juçara". This agricultural activity involves frequent and continuous contact with water reservoirs [9]. This scenario could explain the increase of prevalence in both sex and age groups, despite the policy of maintaining programs of large scale treatment.

The amount of *S. mansoni* egg shedding in feces of infected subjects is a highly valuable variable for assessing schistosome focus. Many authors, after the results obtained from field studies and experimental models, have associated the elimination of large amounts of eggs per gram of feces with infections of high intensity and morbidity [2,4,6,12,16,17,21].

In Alegre and Aliança, mainly in the latter community, we observed an increase in the mean number of eggs of *S. mansoni* shed per gram of feces in all groups studied (Tables 6 and 7), suggesting a possible increase in the intensity of parasitosis . It was not possible to calculate the geometric mean of the number of eggs shed in feces, in Coroatá II, due to the considerable decrease observed in the prevalence of the infection.

Often, when assessing the dynamics of transmission in an endemic area, we can observe large amount of eggs in the feces of the younger part of the population, suggesting that children and adolescents have greater contact with transmission focus, mainly if they are located near houses [3,12,17,18,21]. The results obtained in Alegre and Aliança differ partially, because the distribution of age of infection, with a higher prevalence and intensity of infection (number of eggs per gram of feces) in the older group, suggest that transmission near houses is not very important, but that there is a stronger relationship with professional activity, mainly in Aliança (Table 7)

When we assessed morbidity of schistosomiasis in Alegre and Aliança by physical examining subjects who had positive fecal tests and/or intradermal tests, we observed a clear predominance of less severe clinical forms of the disease (type I or intestinal form), chiefly in Aliança. As a trend towards an increase in the geometric mean of the number of eggs of *S.mansoni* shed in feces was observed in the community in 1993, in comparison to the results obtained in 1987, we could imagine a more recent increase, not leaving enough time for the clinical expression with an increase in morbidity.

It is worth to mention that there was no significant influence of age or gender on the prevalence of severe forms of schistosomiasis in Aliança. More aggressive forms, however, were observed in Alegre (type II or hepatointestinal form) in the over 15 years age group and in males, reinforcing the role of work as a risk factor in this site.

In brief, the analysis of the occurrence of schistosomiasis mansoni in three communities in a same ecosystem ("Baixada Ocidental Maranhense"), showed that small local differences may result important differences in responses and control attempts through large-scale treatment. Thus, the need for learning more about the epidemiological reality of micro-regions, to adequately implement control programs [22].

RESUMO

Esquistossomose mansoni na Baixada Ocidental Maranhense, Estado do Maranhão, Brasil: estudos transversais realizados em 1987 e 1993

Realizou-se, em 1993, estudo transversal acerca da ocorrência de esquistossomose mansoni em três localidades da Baixada Ocidental Maranhense: Alegre (município de São Bento), Aliança (município de Cururupu) e Coroatá II (município de São João Batista). Os resultados foram cotejados aos de outro estudo, efetuado nas mesmas localidades e em condições semelhantes, em 1987.

Em ambos os estudos, salvo poucas exceções, toda a população das três localidades foi submetida a exame parasitológico de fezes, pelo método de Kato-Katz e a intradermorreação para esquistossomose. Os indivíduos que apresentaram resultado positivo em algum desses exames foram avaliados clinicamente, por meio de exame físico.

Em 1993, ao todo, 827 pessoas foram submetidas a exame de fezes e 826 a intradermorreação. Nas fezes de 154 (18,6%) encontraram-se ovos de *Schistosoma mansoni* e 478 (57,9%) apresentaram reação intradérmica positiva. Em Alegre o exame parasitológico de fezes foi realizado em 367 indivíduos, com índice de positividade de 14,9% e a intradermorreação, efetuada em 366 indivíduos, foi positiva em 47,5% dos casos. Em Aliança, 277 indivíduos foram examinados por exame de fezes e intradermorreação apresentando taxas de positividade de, respectivamente, 34,4% e 70,7%. Finalmente, em Coroatá II 183 moradores submetidos a exame de fezes e intradermorreação revelaram índices de positividade de 2,2% e 59,0%, respectivamente. Quando estes dados foram cotejados aos obtidos em inquérito efetuado em 1987 observou-se queda significativa da prevalência de infecção por *S. mansoni* nas localidades de Alegre e Coroatá II e aumento da prevalência em Aliança.

REFERENCES

1. ALVIM, M.C. - A esquistossomose mansônica no Maranhão. **Hiléia méd. (Belém), 2**: 151-157, 1980.

2. ARAP SIONGOK, T.K. ; MAHMOUD, A.A.F.; OUMA, J.H. et al. - Morbidity in schistosomiasis mansoni in relation to intensity of infection. Study of a community in Machakos, Kenya. **Amer. J. trop. Med. Hyg., 25**: 273-284, 1976.

3. BARBOSA, F.S. - Morbidade da esquistossomose. **Rev. bras. Malar., 18**(no. esp.): 3-159, 1966.

4. CHEEVER, A.W.; KAMEL, I.A.; ELWI, A.M.; MOISMAN, J.E. & DANNER, R. - *Schistosoma mansoni* and *S. haematobium* infections in Egypt. II. Quantitative parasitological findings at necropsy. **Amer. J. trop. Med. Hyg., 26**: 702-716, 1977.

5. CHIEFFI, P.P. & KANAMURA, H.Y. - Diagnóstico laboratorial da esquistossomose mansônica. **Rev. bras. Malar., 30**: 70-97, 1978.

6. COOK, J.A.; BAKER, S.T.; WARREN, K.S. & JORDAN, P. - A controlled study of morbidity of schistosomiasis mansoni in St. Lucian children, based on quantitative egg excretion. **Amer. J. trop. Med. Hyg., 23**: 625-633, 1974.

7. COSTA, M.F.F.L.; ROCHA, R.S.; LEITE, M.L.C. et al. - 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.

8. CUTRIM, R.M.N. - **Aspectos clínicos e epidemiológicos da esquistossomose mansoni em três localidades da Baixada Ocidental Maranhense.** Rio de Janeiro, 1987. (Dissertação de Mestrado - Instituto Oswaldo Cruz).

9. CUTRIM, R.M.N. - **Aspectos epidemiológicos e clínicos da esquistossomose mansoni em três localidades da Baixada Ocidental Maranhense (1987 - 1993).** São Paulo, 1995. (Tese de Doutoramento - Escola Paulista de Medicina).

10. CUTRIM, R.M.N. & COURA, J.R. - Aspectos clínicos e epidemiológicos da esquistossomose mansoni em três localidades da Baixada Ocidental Maranhense. **An. Acad. Nac. Med., 152**: 145-150, 1992.

11. DIAS, L.C.S.; MARÇAL JR., O.; GLASSER, C.M.; KANAMURA, H.Y. & HOTTA, L.K. - Control of schistosomiasis mansoni in a low transmission area. **Mem. Inst. Oswaldo Cruz, 87** (supl. 4): 233-239, 1992.

12. ELTOUM, I.A.; SULAIMAN, S.M.; ELTURABI, H.; MAHGOUB, E. & HOMEIDA, M.M. - Infection with *Schistosoma mansoni* in two different endemic areas: a comparative population-based study in Elziedab and Gezira-Managil irrigation schemes, Sudan. **J. trop. Med. Hyg., 96**: 100-106, 1993.

13. ENGELS, D.; SINZINKAYO, E. & GRYSEELS, B. - Day-to-day egg count fluctuation in *Schistosoma mansoni* infection and its operational implications. **Amer. J. trop. Med. Hyg., 54**: 319-324, 1996.

14. FAROOQ, M. & NALLAH, H.M.B. - The behavioural pattern of social and religious water-contact activities in the Egypt-49 bilharziasis project area. **Bull. Wld. Hlth. Org., 35**: 377-387, 1966.

15. FULFORD, A.J.C.; MBUGUA, G.G.; OUMA, J.H. et al. - Differences in the rate of hepatosplenomegaly due to *Schistosoma mansoni* infection between two areas in Mackakos District, Kenya. **Trans. roy. Soc. trop. Med. Hyg., 85**: 881-888, 1991.

16. GRYSEELS, B. & POLDERMAN, A.M. - The morbidity of schistosomiasis mansoni in Maiema (Zaire). **Trans. roy. Soc. trop. Med. Hyg., 81**: 202-209, 1987.

17. GUIMARÃES, M.D.C.; BARROS, H.I. & KATZ, N. - A clinical epidemiologic study in a schistosomiasis mansoni endemic area. **Rev. Inst. Med. trop. S. Paulo, 27**: 123-131, 1985.

18. GUNDERSON, S.G.; BIRRIE, H.; TORVIK, H.P. & SCHERBAUM, H. - Control of *Schistosoma mansoni* in the Blue Nile Valley of Western Ethiopia by mass chemotherapy and focal snail control: a primary health care experience. **Trans. roy. Soc. trop. Med. Hyg., 84**: 819-825, 1990.

19. KAGAN, I.G.; PELLEGRINO, J. & MEMÓRIA, J.M.P. - Studies on the standardization on the intradermal test for the diagnosis of bilharziasis. **Amer. J. trop. Med. Hyg., 10**: 200-207, 1961.

20. KATZ, N.; CHAVES, A. & PELLEGRINO, J. - A simple device for quantitative stool thick-smear technique in schistosomiasis mansoni. **Rev. Inst. Med. trop. S. Paulo, 14**: 397-400, 1972.

21. KLOETZEL, K. - **Aspectos epidemiológicos da esquistossomose em uma população de Pernambuco.** São Paulo, 1962. (Tese de Doutoramento - Faculdade de Medicina da Universidade de São Paulo)

22. KLOETZEL, K.; CHIEFFI, P.P. & CARRILHO, F.J. - Environmental intervention as a tool for control of schistosomiasis. Suggestions from a field study in Northeast Brazil. **Cadern. Saúde públ. (Rio de J.), 10** (supl. 2): 337-344, 1994.

23. MACIEL, H. - O tratamento da schistosomose intestinal no Hospital da Marinha. **Scienc. méd., 7**: 20-24, 1929.

24. MARÇAL JR., O.; PATUCCI, R.M.J.; DIAS, L.C.S.; HOTTAR, L.K. & ETZEL, A. - Schistosomiasis mansoni in an area of low transmission. I. Impact of control measures. **Rev. Inst. Med. trop. S. Paulo, 33**: 83-90, 1991.

25. MINISTÉRIO DA SAÚDE. Superintendência de Campanhas de Saúde Pública (SUCAM). Diretoria Regional do Maranhão. São Luis, 1977. [Relatório Anual de Atividades].

26. MINISTÉRIO DA SAÚDE. Superintendência de Campanhas de Saúde Pública (SUCAM). Diretoria Regional do Maranhão. São Luís, 1986. [Relatório Anual de Atividades]

27. MINISTÉRIO DA SAÚDE. Fundação Nacional de Saúde (FNS). Diretoria Regional do Maranhão. São Luís, 1992. [Relatório Anual de Atividades]

28. PELLON, A.B. & TEIXEIRA, I. - **Distribuição geográfica da esquistossomose no Brasil.** Rio de Janeiro, Divisão de Organização Sanitária, 1950.

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