

QUESTIONNAIRES IN THE SCREENING FOR *Schistosoma mansoni* INFECTION: A STUDY OF SOCIO DEMOGRAPHIC AND WATER CONTACT VARIABLES IN FOUR COMMUNITIES IN BRAZIL

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SUMMARY

The use of questionnaires has been recommended for identifying, at a lower cost, individuals at risk for schistosomiasis. In this study, validity of information obtained by questionnaire in the screening for *Schistosoma mansoni* infection was assessed in four communities in the State of Minas Gerais, Brazil. Explanatory variables were water contact activities, sociodemographic characteristics and previous treatment for schistosomiasis. From 677, 1474, 766 and 3290 individuals eligible for stool examination in the communities, 89 to 97% participated in the study. The estimated probability of individuals to be infected, if they have all characteristics identified as independently associated with *S.mansoni* infection, varied from 15% in Canabrava, to 42% in Belo Horizonte, 48% in Comercinho and 80% in São José do Acácio. Our results do not support the hypothesis that a same questionnaire on risk factors could be used in screening for *S.mansoni* infection in different communities.

KEYWORDS: Schistosomiasis; Epidemiology; Validity; Screening.

INTRODUCTION

The use of questionnaires might be a simple tool for identification of areas of risk for schistosomiasis, and for identifying individuals at risk of infection, at a lower cost^{9,10}. High sensitivities and specificities were found for the identification of schools at moderate and high risk for urinary schistosomiasis in Tanzania, using information obtained by questionnaire^{9,10}.

The diagnostic efficiency of the questionnaire approach for *Schistosoma mansoni* infection is still unknown⁹. A consistent association between bloody stools and infection was found in endemic areas in Africa and Brazil, but low levels of sensitivity were obtained^{11,14,18}.

Other studies have shown significant associations between certain sociodemographic characteristics and/or water contact variables and infection, but they did not investigate the validity of these risk factors in screening for *S.mansoni* infection^{1,3,6,7,12,13}. Recently, validity of risk factors for schis-

tosomiasis mansoni diagnosis was assessed in an endemic area in northeast Brazil, using information obtained by questionnaire. The conclusion of the study was that the development of short questionnaires for large-scale screening for *S.mansoni* infection is realistic².

The aim of our study is to assess the validity of certain sociodemographic characteristics, history of treatment and water contact activities for *S.mansoni* screening in four different communities in Brazil.

METHODS

Study areas

The study was performed in four endemic areas situated in the State of Minas Gerais, Southeast Brazil, namely Canabrava, Comercinho, São José do Acácio and Belo Horizonte. The intermediate host in the study areas is *Biomphalaria glabrata*.

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Belo Horizonte is the capital of the State of Minas Gerais which is situated in a highly industrialized area; the city has two million inhabitants. The study was undertaken during 1991-1992 in a district named Gorduras, with around 9,000 inhabitants, located in the northeast of the city³.

Canabrava and São José do Acácio are villages situated in the north of Minas Gerais, at around 700 and 300 Kilometers from Belo Horizonte, respectively. Comercinho is a small town situated in the northeast of Minas Gerais, at 700 Kilometers from Belo Horizonte. Agriculture is the main economic activity in all communities. Data collection was performed during 1990, 1987 and 1981 in Canabrava, São José do Acácio and Comercinho, respectively.

Study population

Methodological procedures to identify participants for the study were the same in all communities. The study areas were mapped and a census was performed. In Canabrava, São José do Acácio and Comercinho all population was eligible for stool examination. In Belo Horizonte, a simple random sample of 658 dwellings was selected; all residents of all ages (n = 3290) were eligible for stool examination. Assumptions for the sample size calculation in the Belo Horizonte study were the following: number of inhabitants = 9480 (5 per dwelling); prevalence of *S.mansoni* infection = 0.20; precision = 0.02; type I error = 0.05; correction for design effect = 2; losses = 0.20; further details were described elsewhere³.

Stool examination

All individuals received a container for collection of stools, labelled with their name and identification number, as well as an identifiable code in case of illiteracy. In Canabrava, São José do Acácio and Comercinho a single stool sample was collected and two slides of each sample were examined. In Belo Horizonte, two separate stool samples were collected and four slides of each sample were examined. Stool examinations were performed by the Kato-Katz method⁸.

Individuals over 2 years of age who presented *S.mansoni* eggs on at least one slide were classified as cases and those over 2 years old without *S.mansoni* eggs on all slides were classified as controls. In Canabrava, Comercinho and São José do Acácio all cases (273, 936 and 178, respectively) and controls (381, 394 and 500, respectively) were selected to participate in the study. In Belo Horizonte, all cases and a simple random sample of controls participated (518 cases and 518 controls); the sample size was sufficient for detecting an odds ratio (OR) of 1.5 with 90% power at 5% level of significance, if the prevalence of exposure was 0.50³.

Sociodemographic, previous treatment and water contact information

Information on age, gender, treatment for schistosomiasis during lifetime and reasons for water contact were obtained through interview. Information on water supply (presence of piped water and/or cistern) was obtained through observation during a visit at the household. All information was obtained without knowledge of individuals' infection status.

A pre-coded questionnaire, concerning reasons for contacts in open bodies of water during the previous 6 months was used. Reasons for water contact included: washing dishes, laundry, bathing (for body hygiene exclusively), fishing, swimming or playing, occupational (agriculture) and other.

Analysis

The probability of infected individuals having a characteristic present (sensitivity), and the probability of non infected individuals having a characteristic absent (specificity) were calculated⁴. The probability that a person having a characteristic is infected (positive predictive value)⁴ was estimated in relation to the prevalence of *S.mansoni* infection in the respective community. Multivariate logistic regression was used to assess the independent effect of variables¹⁶. The criterion for inclusion of variables in each logistic model was association with infection beyond 0.20 significance level in the univariate analysis⁵. Age group, gender, report of previous treatment, water supply in the household (except in Canabrava), and all reasons for water contact were included in the initial logistic model; all variables statistically significant in such model (p < 0.05) were included in the final model. For Comercinho, two logistic models were constructed because it was observed a strong relationship between water supply in the household and report of bathing. Estimated probabilities of individuals to be infected ($p_x = 1 / \{ 1 + \exp [- (- \beta_0 + \beta_1 X_1 + \dots + \beta_p X_p)] \}$)¹⁶ were calculated for the characteristics identified in the multivariate analysis as independently associated with infection. The analysis was performed, using SAS¹⁵ and Egret¹⁷ software packages.

RESULTS

From 677, 1474, 766 and 3290 individuals eligible for stool examination in Canabrava, Comercinho, São José do Acácio and Belo Horizonte, 96.6, 90.2, 88.5 and 92.7% participated, respectively. Proportions of households with piped water and/or cistern were 0.0% in Canabrava, 32.3% in Comercinho, 80.8% in São José do Acácio and 93.0% in Belo Horizonte.

Prevalence of *S.mansoni* infection was 41.8% in Canabrava, 70.4% in Comercinho, 26.2% in São José do

Acácio and 20.0% in Belo Horizonte. Geometric means (standard deviation) of *S.mansoni* eggs per gram of stools were 142.6 (9.0), 333.6 (4.4), 60.3 (4.0) and 70.8 (5.5), respectively.

Validity of age, gender, report of previous treatment and water supply in the household for diagnosis of *S. mansoni* infection are shown in Table 1. Sensitivity for age (10-19 years) ranged from 41.7 to 64.5% and specificity from 47.4 to 83.9% in the study areas. Sensitivity for gender (male) varied from 44.7 to 67.6% and specificity from 55.8 to 59.8. Sensitivity for report of previous treatment (no) varied from 75.4 to 92.5% and specificity from 12.0 to 28.8%. Sensitivity for water supply in the household (absent) ranged from 11.5 to 100.0% and specificity from 0.0 to 91.4%. Highest positive predictive value in Canabrava was found for age group (10-19 yrs), as well as in Comercinho (61.8 and 83.9, respectively). Highest positive predictive value was found

in São José do Acácio for absence of water supply in the household (65.4%) and in Belo Horizonte for absence of previous treatment (43.4%).

Validity of certain reasons for water contact in identifying *S.mansoni* infection are presented in Table 2. Highest sensitivity was found for report of occupational contacts in Canabrava (59.8%), bathing in Comercinho (53.4%), and swimming or playing in both São José do Acácio and Belo Horizonte (34.5 and 34.1%, respectively). Highest specificity was found for report of fishing in Canabrava and Comercinho (98.6 and 97.3%, respectively), report of washing dishes in São José do Acácio (98.9%) and report of occupational contacts in Belo Horizonte (99.8%). Highest positive predictive value was found for report of fishing in Canabrava (60.0%), report of bathing in Comercinho (86.4%), report of fishing in São José do Acácio (44.0%) and report of swimming or playing in Belo Horizonte (37.2%).

TABLE 1

Validity of age, gender, report of previous treatment for schistosomiasis mansoni and water supply in the household for the diagnosis of *Schistosoma mansoni* infection in different endemic areas*

| Variables | Canabrava | | | Comercinho | | | São José do Acácio | | | Belo Horizonte | | |
|------------------------------------|------------------|------------------|------|------------------|------------------|------|--------------------|------------------|------|------------------|------------------|------|
| | Sensi- tivity | Speci- ficity | PPV | Sensi- tivity | Speci- ficity | PPV | Sensi- tivity | Speci- ficity | PPV | Sensi- tivity | Speci- ficity | PPV |
| Age group (10-19 yrs) | 44.9 | 80.1 | 61.8 | 41.7 | 83.9 | 86.0 | 55.4 | 47.4 | 27.2 | 64.5 | 64.9 | 31.5 |
| Gender (male) | 46.5 | 55.8 | 35.6 | 44.7 | 57.0 | 71.3 | 64.3 | 56.6 | 34.4 | 67.6 | 59.8 | 29.5 |
| Report of previous treatment (no) | 87.8 | 23.0 | 45.0 | 92.5 | 25.5 | 74.7 | 78.6 | 28.8 | 28.2 | 75.4 | 12.0 | 43.4 |
| Water supply in the household (no) | 100.0 | 0.0 | 41.8 | 47.5 | 31.2 | 62.1 | 26.8 | 85.8 | 65.4 | 11.5 | 91.4 | 25.0 |

*values are in percentage; PPV: Positive predictive values (estimated for the prevalence of *S.mansoni* infection in the respective endemic area)

TABLE 2

Validity of certain reasons for water contact in the previous six months for the diagnosis of *Schistosoma mansoni* infection in different endemic areas *

| Variables | Canabrava | | | Comercinho | | | São José do Acácio | | | Belo Horizonte | | |
|---|------------------|------------------|------|------------------|------------------|------|--------------------|------------------|------|------------------|------------------|------|
| | Sensi- tivity | Speci- ficity | PPV | Sensi- tivity | Speci- ficity | PPV | Sensi- tivity | Speci- ficity | PPV | Sensi- tivity | Speci- ficity | PPV |
| Report of washing dishes | 37.0 | 74.6 | 51.2 | 42.1 | 81.4 | 84.3 | 1.2 | 98.9 | 27.3 | 29.0 | 73.5 | 21.5 |
| Report of laundry | 2.4 | 97.6 | 41.7 | 26.5 | 86.8 | 82.7 | 2.4 | 98.2 | 31.6 | 16.0 | 79.4 | 16.2 |
| Report of bathing | 57.1 | 69.0 | 57.0 | 53.4 | 80.0 | 86.4 | 13.1 | 93.0 | 39.5 | 28.8 | 75.3 | 22.7 |
| Report of swimming or playing | 11.4 | 87.1 | 39.0 | 28.5 | 81.4 | 78.5 | 34.5 | 81.8 | 40.2 | 34.1 | 85.6 | 37.2 |
| Report of fishing | 2.8 | 98.6 | 60.0 | 4.6 | 97.3 | 80.0 | 29.2 | 86.7 | 44.0 | 4.9 | 97.1 | 30.3 |
| Report of occupational contacts (agriculture) | 59.8 | 60.3 | 52.0 | 4.3 | 95.3 | 68.2 | 19.6 | 86.2 | 33.3 | 0.2 | 99.8 | 20.0 |

* values are in percentage; PPV: Positive predictive values (estimated for the prevalence of *S.mansoni* infection in the respective endemic area)

Final results of the multivariate analysis of the association between *S.mansoni* infection and certain variables are presented in Table 3. In Canabrava, age, report of previous treatment, report of washing dishes, bathing and occupational contacts were independently associated with *S.mansoni* infection. In Comercinho, variables associated with infection were age, report of previous treatment, water supply in the household, report of washing dishes, laundry, bathing and swimming or playing. In São José do Acácio, age, gender, report of previous treatment, water supply in the household and report of

swimming or playing were associated with infection. In Belo Horizonte, age, gender and report of swimming or playing were independently associated with *S.mansoni* infection. Association between infection and report of fishing disappeared in all study areas after adjustments for confoundings.

Figure 1 shows estimated probabilities of individuals to be infected in different endemic areas if they have all characteristics identified in the multivariate analysis as independently associated with *S. mansoni* infection. These prob-

TABLE 3
Final results of the multivariate analysis of the association between *Schistosoma mansoni* infection and certain variables in different endemic areas*

| Variables | Canabrava | Comercinho | | S. José do Acácio | Belo Horizonte |
|---|----------------|----------------|----------------|-------------------|-----------------|
| | | Model 1 | Model 2 | | |
| Age group (yrs) | | | | | |
| 10-19 | 1.4 (0.9, 2.4) | 4.0 (2.6, 6.1) | 4.6 (3.0, 7.0) | 4.9 (2.6, 9.2) | 8.2 (5.2, 12.9) |
| ≥ 20 | 0.6 (0.3, 0.9) | 1.6 (1.1, 2.5) | 1.6 (1.0, 2.3) | 4.6 (2.4, 9.0) | 5.0 (3.1, 8.1) |
| Gender (male) | p > 0.05 | p > 0.05 | p > 0.05 | 2.4 (1.6, 3.5) | 3.1 (2.3, 4.2) |
| Report of previous treatment (no) | 2.4 (1.4, 4.1) | 4.0 (2.6, 6.2) | 4.0 (2.7, 6.1) | 2.3 (1.4, 3.7) | p > 0.05 |
| Water supply in the household (no) | - | - | 2.0 (1.5, 2.7) | 2.7 (1.7, 4.5) | p > 0.05 |
| Report of washing dishes (yes) | 1.6 (1.1, 2.3) | 2.1 (1.5, 3.2) | 2.4 (1.6, 3.5) | p > 0.05 | p > 0.05 |
| Report of laundry (yes) | p > 0.05 | 1.8 (1.1,2.8) | 1.8 (1.1, 2.8) | p > 0.05 | p > 0.05 |
| Report of bathing (yes) | 2.2 (1.5, 3.3) | 2.1(1.8, 2.6) | - | p > 0.05 | p > 0.05 |
| Report of swimming or playing (yes) | p > 0.05 | 2.2 (1.6, 3.1) | 2.1 (1.6, 2.9) | 2.4 (1.5, 3.9) | 2.3 (1.6, 3.2) |
| Report of occupational contacts (agriculture) | 2.9 (1.9, 4.6) | p > 0.05 | p > 0.05 | p > 0.05 | p > 0.05 |

* values are odds ratios (95% Confidence Interval) adjusted by multiple logistic regression or p value (Wald's test); 541, 1159, 592 and 916 individuals participated in the final analysis, respectively

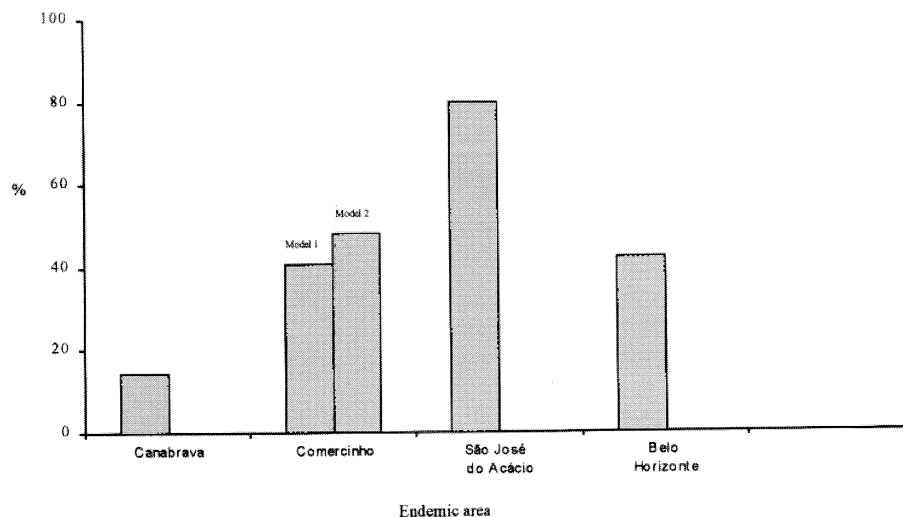


Fig. 1 - Estimated probability (%) of individuals to be infected in different endemic areas if they have all characteristics identified as associated with *Schistosoma mansoni* infection in the multivariate analysis.

abilities varied from 14.5% in Canabrava to 42.3% in Belo Horizonte, 40.9 or 48.0% in Comercinho (Models 1 and 2, respectively) and 80.0% in São José do Acácio.

Figure 2 shows reasons for water contact associated with *S.mansoni* infection, according to the proportion of houses with water supply in the community. Contacts for bathing, washing dishes and/or laundry were associated with *S.mansoni* infection in those areas (Canabrava and Comercinho) where the proportion of houses with water supply was low (0.0 and 32.4%, respectively). Contacts for swimming or playing were associated with *S.mansoni* infection in Comercinho, São José do Acácio and Belo Horizonte. Occupational contacts (agriculture) were associated with infection in Canabrava.

DISCUSSION

Sociodemographic variables and water contact activities associated with *S.mansoni* infection differed among the study areas, as well as their validity for diagnosis of infection. Age was the only variable which was associated with infection in all communities, but high discrepancies among odds ratio estimates were found.

There is some evidence that water contact activities and certain sociodemographic variables associated with infection, such as migration^{2,3}, may vary among endemic areas for schistosomiasis mansoni^{1,3,6,7,12,13}. In a village situated in Southeast of Brazil, water contacts for laundry, bathing and swimming or playing were found to be associated with infection, while occupational contacts were not⁶. Occupational contacts were associated with infection in two other villages situated in the same Brazilian region^{7,12} and contacts for swimming or playing^{1,3} and fishing¹ were associated with infection in other endemic areas in Southeast and Northeast

Brazil. Some limitations in interpreting such data are related with methodological concerns, as follows: each investigation was performed in a single community, target populations were not always on the same age, often questionnaires were different and multivariate methods of analysis were used only in more recent studies^{1,3,13}.

Our results confirm the existence of different factors associated with *S.mansoni* infection, depending on certain characteristics of the endemic area. Differences in relation to water contact activities seems to be related with water supply in the household, as well as on the existence of irrigated agriculture. In communities where few houses had water supply (0 to 32%), contacts for bathing, washing dishes and/or laundry were associated with infection. In those where 80% or more houses had water supply, swimming or playing was the reason for contact which was found to be associated with *S.mansoni* infection. Occupational water contacts (agriculture) was associated with infection in a single community.

With regard to methodological aspects, all precautions were taken to avoid potential sources of bias in this study: internal validity, double blind information, standard stool examinations' technique and use of random procedures when necessary. Nevertheless, some difficulties might arise in comparing communities in our study because of differences in calendar periods, reliability of interviews, and/or number of stool examinations. Field activities were performed in different calendar periods. The observed differences among the communities seem not to be related with calendar period. Canabrava and Belo Horizonte were investigated during a similar period (1990 and 1991-92), but factors associated with *S. mansoni* infection varied among these communities. We did not determine our questionnaire reliability in assessing risk factors. To attenuate information bias, the same questionnaire was applied in all communities and the same

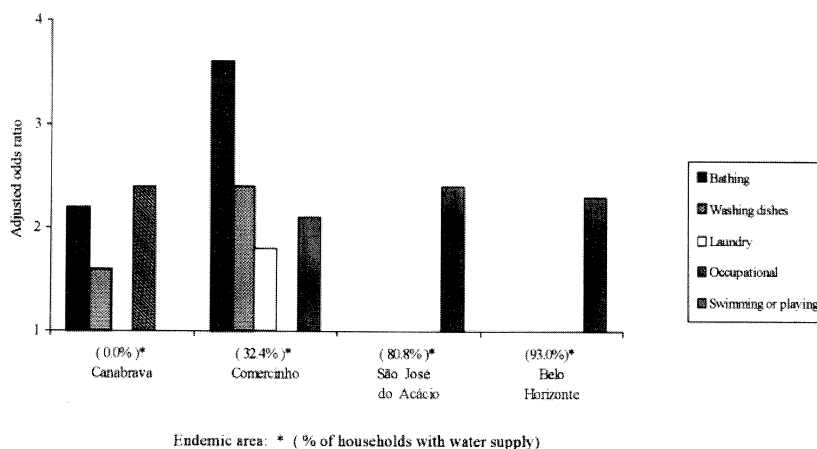


Fig. 2 - Reasons for water contact associated with *Schistosoma mansoni* infection in different endemic areas, according to percentages of households with water supply.

personnel coordinated field activities, including interviewers training. Despite of this, if a bias occurred due to low reliability, it was similar across communities. In Canabrava, Comercinho and São José do Acácio a single stool examination was performed. In Belo Horizonte, area with the lowest prevalence, two separated stool samples were examined in order to improve the sensitivity of the Kato-Katz method⁸. A single stool examination has the conservative effect of biasing the odds ratio estimate toward unity due to nondifferential misclassification^{14,16}; two stool examinations, as performed in Belo Horizonte, may increase the odds ratio estimates. It is unlikely that this may have affected interpretation of data in this study because strong associations between infection and studied variables were found in all communities.

In recent years, validity of information obtained by questionnaire has been investigated to screen population in schistosomiasis mansoni endemic areas, aiming at reducing costs for control programs and/or at primary care level^{2,11,14,18}. The objective of the information is selecting individuals presumably infected to be submitted to a confirmatory test, like stool examination, and to exclude those not infected. Some of the above mentioned studies have consistently shown that sensitivity of bloody stools is low (13 to 17%) and specificity is very high (95 to 98%)^{11,14,18}. To our knowledge, there is a single study investigating validity of information on risk factors obtained by questionnaires in screening for *S.mansoni* infection. The study was conducted among children 12-14 years old in an endemic area situated at Northeast Brazil. Risk factors were first analysed one by one and then aggregated using logistic models. The main conclusion was that the best model to predict infection included migratory status and four variables related to water contact activities².

We studied endemic areas with different levels of *S.mansoni* prevalence and/or intensity of infection in order to find, although these differences, a minimal number of similar characteristics associated with infection. If similar characteristics were found, it would be reasonable generalizing results, permitting adoption of standard questionnaires in the communities. When analyzed one by one (before adjustments for confounders), absence of previous treatment was the most sensible variable in all endemic areas (75 to 93%); after adjustments, association between this variable and infection disappeared in Belo Horizonte. In general, reasons for water contact presented smaller sensitivity than specificity, but reasons for water contact associated with infection were not similar in all communities. When variables were aggregated using logistic models, it was observed that the estimated probability of individuals to be infected, if they have all characteristics associated with infection, varied from 15% in Canabrava, to 41 or 48% in Comercinho, 42% in Belo Horizonte and 80% in São José do Acácio.

In summary, we observed that information obtained by the questionnaire on sociodemographic characteristics, his-

tory of treatment, and reasons for water contact was effective for detecting *S.mansoni* infected individuals in São José do Acácio, moderately effective in Comercinho and Belo Horizonte and ineffective in Canabrava. The results of this study do not support the hypothesis that a same questionnaire on risk factors could be used in screening for *S.mansoni* infection in different endemic areas. Up to now, few studies addressed the question on validity of clinical signs^{11,14,18} or risk factors variables² for diagnosis of *S.mansoni* infection. Further investigations are needed: (1) to define better predictors of infection in schistosomiasis mansoni endemic areas and (2) to examine the cost effectiveness relationship of questionnaire use in screening for *S.mansoni* infection.

RESUMO

Uso de questionários no rastreamento da infecção pelo *Schistosoma mansoni*: um estudo de variáveis sócio demográficas e motivos de contatos com águas em quatro comunidades no Brasil

O uso de questionários tem sido recomendado para identificar, a baixo custo, indivíduos sob risco para a esquistossomose. Neste estudo, a validade de informações obtidas por questionário para rastreamento da infecção pelo *Schistosoma mansoni* foi examinada em quatro comunidades, situadas em Minas Gerais, Brasil. As variáveis independentes foram motivos de contatos com águas, características sócio demográficas e história de tratamento para esquistossomose. Entre os 677, 1474, 766 e 3290 indivíduos elegíveis para a realização de exame de fezes em cada comunidade, 89 a 97% participaram do estudo. As probabilidades estimadas dos indivíduos estarem infectados, se eles possuísem todas as características associadas à infecção na análise multivariada, foram 15% em Canabrava, 42% em Belo Horizonte, 48% em Comercinho e 80% em São José do Acácio. Nossos resultados não confirmam a hipótese de que um mesmo questionário possa ser usado para rastreamento da infecção pelo *S.mansoni* em diferentes comunidades.

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