Original article

Schistosoma mansolii infection in Jiga town, Gojam Administrative Region

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Summary: The impact of socioeconomic status and water use patterns on Schistosoma mansoni infection was studied in Jiga town in Gojam Administrative Region: Questionnaire interviews and parasitological surveys were made in a 10% randomly selected household sample covering 106 households with 505 individuals. The household surveys showed that use of stream water continued after installation of the piped water system in 1983, due to the high cost of piped water and frequent breakdown of the pump. Simple and multiple regression and correlation analyses of the relationship between S.mansoni infection and socioeconomic, water use and environmental variables at the individual and household levels revealed that intensity of infection was not related to the amount of water used in the home ($r=-0.33$, $p<0.05$) and income ($r= -0.37$, $p<0.05$). Infection rate was positively correlated with level of education ($r = 0.34$), students being the most affected ($r = 0.30$) .Mapping of mean egg counts and water sources used failed to reveal any travel distance effect on infection. The potential use of geographic mapping of individual and household infection and behavioral data in tropical disease research is discussed.[Ethiop. J. HealthDev.1995;9(1):1-6]

Introduction

Understanding of social, economic and human behavioral factors in relation to water use has repeatedly been emphasized as a prerequisite for the implementation of schistosomiasis control programs (1-3). Although more than 200 communities in Ethiopia have been found to be endemic for Schistosoma mansoni(4), fewepidemiological studies have been carried out to evaluate socioeconomic and behavioral factors (5-7).

This study examines the role of socioeconomic and water use variables in schistosomiasis occurrence in Jiga town in Gojam Administrative Region. Results of S.mansoni transmission dynamics, human water contact, community participation and intersectoral collaboration in the local pilot schistosomiasis control project have been presented elsewhere (8-11).

Jiga is a typical Ethiopian road side town with about 5,000 inhabitants located on the road from Addis Ababa to Gondar at 1,850 meters altitude. Detailed description of the study community has been given elsewhere (8, 11). - Jiga was chosen for the pilot schistosomiasis control project by the Institute of Pathobiology because of a) the high prevalence of schistosomiasis, b) the suitable population size and relative stability of the population, with little emigration and immigration, c) the presence of well defined water contact sites at

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the local stream and reservoir, d) the fact that Jiga is a typical highland community with a representative social organization, political structure and stream transmission pattern, and e) the completion of the town's first water supply system in November 1983 (11) .

The control project, developed by the Institute of Pathobiology in collaboration with various local, regional and national institutions, was implemented with community participation between 1985 and 1986 following baseline sociological, demographic and epidemiological studies in 1983 and 1984 (8, 11) .The water supply system was installed by the Ethiopian Water Supply and Sewerage Authority (WSSA) as part of the National Community Water Development Program, with labour input from Jiga community.

Methods

Census and mapping: All households were cnumcrated and mapped and a census was carried out il) 1984. The town was mapped at an approximate scale with the aid of a compass and the use of a project car measuring distances along roads and between households and the various stream water sites.

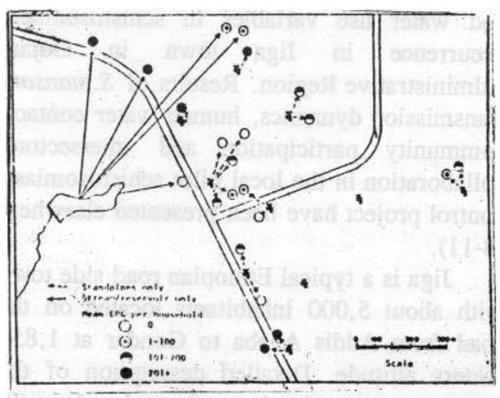

Figure 1: **Mean EPG of households using public standpipes and stream/reservoir only.**

Socioeconomic and water use survey : The survey carried out in 1986 covered 106 households with 505 individuals. The households were selected by systematic random sampling and every tenth house was visited for questionnaire interviews. Questions about the etiology, prevention and symptomology of schistosomiasis mansoni, socioeconomic status, demographic and environmental situations of households were directed to male household heads. Five local high school students and graduates trained by one of the investigators (FS) carried out all household interviews.

Parasitological study: The residents of the 106 selected households were subjected to parasitological examination in 1986. Stool was processed for microscopic examination using the Kato thick smear technique and two slides were prepared from a single stool specimen. Geometric means was used to estimate intensity of infection (expressed as eggs per gram of stool, EPG) for the individual and household level.

Analysis of data: Simple and multiple regression and correlation analyses were employed. For binary data on some socioeconomic variables, each observation was coded either "0" or" 1" by the regression model as described by Johnston (12). Knowledge scores were calculated to examine the knowledge of household heads relating to schistosomiasis etiology and symptomology vis-a-vis S.mansoni infection. Scores of "0" were given to those who did not know about "bilharzia" (the local term for schistosomiasis), " 1 " for those Who claimed to know but failed to describe etiological and symptomological facts accurately, "2" for those who provided partial correct answers and "3" for those who provided all answers. The logs of prevalence of infection per household (+ 1) was added to include households and individuals free of S.mansoni infection in the analysis. The F test was employed to test for statistical significance of the relationships between variables.

Results

Prevalence and intensity: Schistosoma mansoni infection was identified in 80 (75%) of the households, but the overall prevalence in the sample population was 37.7%. Mean intensity of infection per household (Geometric mean egg count/gm of stool per household) ranged from 0 to 525 (Fig. I). The age and sex specific distribution of infection showed bimodal peaks for both males and females, with prevalence peaks in the 10-14 and 33-39 age groups.

Water use: Most households used more than one water source for cooking, drinking and washing utensils. Only 5(4.7%) and 17(16.0%) of the households reported using exclusively stream water and public taps, respectively. The latter, however, admitted that they used stream water whenever the standpipes broke down
several times a year for several days. The remaining 84(79.2%) used piped water intermittently, even when it was available. Of the 106 households studied, 73(68.9%) claimed to use stream water for washing clothes while the remaining 33(31.1 %) said that they used only public and private taps for this purpose.

Reasons for the choice of water source varied considerably. Of the 73 households that used stream water for laundering 38(52.1 %) named high price of piped water, and 33(54.2%) stated that they could wash clothes more cleanly at the stream as their most important reason. The remaining two households named nearness of the stream to their homes as the decisive factor. This difference in water use were not, however, associated with mean intensity of infection at the household level. This was in spite of the fact that the number of water contact with the local stream had significantly decreased, especially for fetching water and washing clothes, between 1983 and 1987 (the end of the water contact study at the stream (10). The inadequacy of safe water in 1986 is also indicated by the fact that nearly 50% of all households continued to use rain water collected from roofs of their houses. The

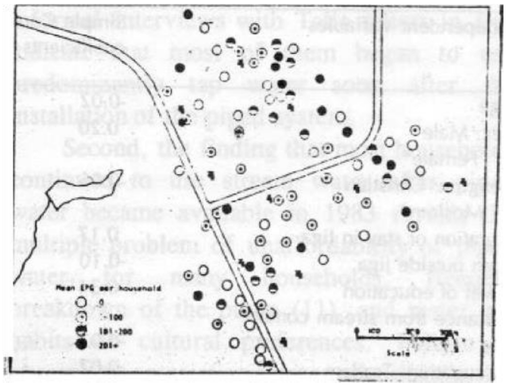

Figure 2: **Mean EPG of households using more than one source of water** .

amount of water consumed by households at home was found to vary between one and six madgas (an earthen container about the size of a bucket) per day. The negative correlation (r=0.33) between prevalence of S.mansoni infection and the amount of water consumed per household, regardless of source, suggests that increasing consumption of water at home can contribute to reducing infection levels. Knowledge and education: Variation in the knowledge about schistosomiasis among household heads failed to significantly predict S.mansoni prevalence in households (r=0.12). Both prevalence and intensity of infection were as positively correlated with level of formal education (4 =0.34 and 0.29, respectively; $p<0.05$). The correlation results remained positive (r=0.18 and 0.25) even when only individuals above 14 years of age were included in the analysis.

Socioeconomic level: Income of the study households was reportedly low. Fifty percent of the households surveyed had monthly incomes of less than 50 birr (US $10), and 71 % earned less than 100 birr .The low
income and poverty of the population is also indicated by the harsh living conditions and

Table 1: **simple and multiple correlation coefficients between differences in egg-counts and socio-economic, demographic and environmental variables among 505 individuals**

Independent variables	Simple correlation coefficients	Multiple r	Multiple r^2
Age	-0.02	0.92	0.00
Sex: Male	0.20	0.12	0.01
Female*			
Religion: Christian	-0.06	0.14	0.2
Moslem*			
Duration of stay in Jiga	-.17	0.27	0.07

born outside Jiga	-0.10	0.27	0.07
Level of education	0.34+	0.41	0.17
Distance from stream contact site	-0.03	0.41	0.17
Occupation: Traders	-0.02	0.37	0.14
Government employees	-0.04	0.44	0.19
Craftsmen	-0.07	0.44	0.19
Talla sellers	0.08	0.44	0.19
Housewives	-0.05	0.44	0.19
Students	0.30+	0.47	0.22
Daily labourers and enemployed	0.06	0.47	0.22
Family size	0.07	0.47	0.22

Multiple 4 = 0.47+ + Significant at 0.05 Multiple r^2 = 0.22
Standard error of estimate = 0.71 * Not included in the multiple regression analysis and low educational status

low educational achievement. Eighty eight of the 106 (83%) surveyed households had only one or two rooms with dirt floors and mud walls, 76(72%) had pit latrines, many of them of the makeshift type and out of use. Only four households could afford to have private standpipes installed, 18% of the individuals above seven years were illiterate and 20% had attended only the government literacy campaign.

Given the small income difference among households, the absence of positive correlation (r=-0.37, p <0.05) between prevalence of infection and monthly income suggests that with growing income, infection may decrease considerably. Occupational prevalence of infection was the highest (55.6%) in craftsmen (mainly weavers), followed by students (49.7%), daily labourers and unemployed (45.8%) and housewives (34.4%). The lowest infection rate was observed among Talla sellers (22.2%) and government employees (23.5%).

Except for students, very low correlation I'npfficients were observed among occupational groups. There was statistically significant association between students aged 6-18 years and egg counts which could be due to intensity of water contact activity and/or lack of immunity (Table 1). Regression and Correlation Analysis:
Coefficients obtained from the various regression and correlation analyses between prevalence of S.mansoni infection and independent variables are presented in tables 1 and 2. These results

indicate that the contribution of each variable to infection, both at the household and individual level was small but variable. Nevertheless, the overall multiple correlation coefficients (r=0.58 and 0.47, at the household and individual levels, respectively) were statistically significant ($p < 0.05$) .The partial correlation coefficients were very low for all variables, showing that the strength of each variable in explaining infection was dependent largely on its association with the other variables.

Discussion

Most socioeconomic and water use variables were weakly associated with S.mansoni infection and in this study, apparently due to a combination of the narrow range of socioeconomic level among households, the
usual problem of obtaining reliable information on income in rural Ethiopia (5) and the likelihood of preexisting infection prior to the introduction of piped water in 1983. Nevertheless, the results of this study have several implications for schistosomiasis epidemiology and control. First, the inverse relationship between household income and infection corroborates with findings elsewhere in Ethiopia(13, 14) .Traders and government employees, the two most affluent groups, had some of the lowest infection rates among adults in Jiga. But talla sellers a high risk group of females in rural villages in Gondar Region and in Tensae Berhan in Arsi (13, 14), were found to have the lowest rates of infection among occupational groups in Jiga.

Informal interviews with Talla sellers in Jiga indicate that most of them began to use predominantly tap water soon after the installation of the piped system. Second, the finding that most households continued to use stream water after piped water became available in 1983 reveals the multiple problem of unaffordability of piped water for many households, frequent breakdown of the pump (11), and water use habits or cultural preferences. Failure to observe an association between the distribution of S.mansoni infection and water use pattern in 1986, three years after installation of the piped system, appears to be due to a combination of continued exposure at the stream.

Third, the correlation between prevalence and intensity of infection and education appears

Table 2: **Simple multiple and partial correlation coefficients between differences in egg counts and socio-economic, demographic and environmental variable among 106 households in Jiga**

Independent variables	F value	Simple r	Multiple r	Multiple r^2	Partial correl. Coefficients
Age: Below 5 years	17.14	0.38+	0.38	0.14	0.06
5-19	0.02	0.11	0.38	0.14	0.01
20+	3.89	0.32	0.42	0.18	-0.01
Sex: Males	0.01	0.25	0.42	0.18	-0.01
Females	0.02	0.25	0.42	0.18	-0.01
Household income	7.66	-0.37+	0.48	0.24	-0.16
Daily household water use (no. of madga)	4.47	-0.33+	0.52	0.27	-0.14
Latrine use (months)	2.34	-0.25	0.54	0.29	-0.15

Distance from stream contact site	1.0	0.01	0.54	0.29	-0.14
Religion: Christian	3.52	0.09	0.57	0.32	-0.05
Moslem	0.05	0.07	0.57	0.32	0.01
Knowledge of schistosomiasis	0.32	-0.12	0.57	0.32	0.05
Occupation of head of household					
Traders	0.07	0.16	0.57	0.32	0.09
Government	0.07	-0.18	0.57	0.33	0.06
Craftsmen	1.56	0.19	0.58	0.34	0.11
Talla sellers	0.09	0.14	0.58	0.34	0.05
Daily labourers and unemployed	0.65	0.02	0.58	0.34	0.09
Others	0.17	-0.02	0.58	0.34	-0.04

Multiple r - 0.58+ + Significant at 0.05 Multiple r^2
Standard error of estimate = 0.1

be influenced by location of Jiga Elementary school which is adjacent to the stream resulting in frequent contact during school hours. However, it is not known if the general health consciousness of older students associated with school teaching resulted in higher water contact, a situation described by Polderman in Lake Tana area (13).

Fourth, absence of a significant correlation between egg counts and knowledge about "bilharzia" among household heads further indicates the difficulties encountered by the community health education program in Jiga, described by Abebe et al (11). It is generally recognized that health education has traditionally been neglected and remains one of the least effective control measures in schistosomiasis control. Only in few countries, particularly Egypt, could effective health education programs be developed at the national level (15, 16).

The mapping of epidemiological parameters such as water use and infection constitutes an important but neglected research tool in schistosomiasis and other infectious diseases. Several spatial studies have been able to identify both high risk groups and schistosomiasis transmission sites in Egypt and Kenya (17, 18). If carried out longitudinally, they may contribute to monitoring changes in transmission, relevant human behaviour and socioeconomic indicators and thus assist in the evaluation of control programs.

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