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MORBIDITY DUE TO HEAVY *SCHISTOSOMA MANSONI* INFECTIONS IN A RECENTLY ESTABLISHED FOCUS IN NORTHERN SENEGAL

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Abstract. A study of morbidity due to *Schistosoma mansoni* infection was carried out in Ndombo, a recently established but intense focus in northern Senegal. A random population sample (n = 422) was examined by repeated egg counts, standardized interviews, and clinical examinations. Egg counts were positive in 91%, with more than 1,000 eggs per gram of feces in 41% of the subjects. Abdominal discomfort was reported by 60% of the subjects, diarrhea by 33%; 17% of the stools were liquid upon inspection. Hepatomegaly was mostly mild and found in 7% of the subjects, mainly in males less than 20 years of age. Splenomegaly was detected in only 0.5% of the people examined. There was no significant correlation between the frequency of complaints or symptoms and egg counts. The remarkably mild morbidity in spite of the intense level of many infections may be explained by the recent nature of the focus; more severe chronic morbidity may develop in the future.

Patterns of morbidity due to *Schistosoma mansoni* infection in sub-Saharan Africa vary considerably from one focus to another.[1–3] This variation is partly explained by different intensities of infection, but other factors such as concomitant infections and immunogenetic predisposition may also play a role.[4–6] Age-related patterns and observations in migrant populations indicate that the history of infection and exposure may also be important.[5,7] We have assessed morbidity in a community in northern Senegal, where *S. mansoni* was probably introduced only 3–4 years ago, but has since spread rapidly and intensely.[8–10] This situation provides a unique opportunity to measure the morbidity impact of heavy infection in the early stages of endemicity, when duration of infection has been relatively short and nearly independent of age.

SUBJECTS, MATERIALS, AND METHODS

The area has been described in detail elsewhere.[8,10] The new focus has emerged in the area of Richard-Toll, a city on the Senegal River about 100 km from its mouth. Over the past decade, a sugar cane company has attracted a large population (approximately 50,000) from surrounding sahelian areas. Most of the inhabitants obtain domestic water from the irrigation canals. Due to various ecologic changes, these have been invaded in recent years by *Biomphalaria pfeifferi*, leading to an epidemic outbreak of intestinal schistosomiasis.[8,10–12] The present study was performed in August 1991 in Ndombo, a village close to Richard-Toll. The population (approximately 4,000) consists mainly of Wolof, one of the most prominent ethnic groups in Senegal, and depends on the same canals as the urban population for its water supply.

After a preliminary census and information meetings with the villagers, a random 10% sample of households was drawn. All selected families agreed to participate, resulting in a study population of 422 subjects. Each individual was interviewed (information was obtained on age, sex, occupation, and family status) and each gave two stool samples within a two-week interval from which fecal egg counts were made, with each sample being examined in duplicate (25 mg) on Kato slides.[13,14] The sum of the egg counts in the four slides was multiplied by 10 to obtain eggs per gram of feces (epg). The nature of each stool sample was inspected visually and classified into five categories: formed, formed-to-mushy, mushy, mushy-to-liquid, and liquid. Liquid and mushy-to-liquid fecal samples were considered as diarrheic.

A standardized medical interview was conducted in the local language and focused on the presence of (bloody) diarrhea in the past two

TABLE 1

Age-related prevalences and intensities of infection with Schistosoma mansoni *in Ndombo, Senegal*

Age range (years)	% of subjects excreting eggs						n
	>0	1–100	101–400	401–1,000	1,001–4,000	>4,000	
0–4	60	19	13	17	9	1	75
5–9	99	4	16	20	44	16	71
10–14	98	5	11	14	48	21	63
15–19	96	4	15	19	48	10	48
20–29	100	12	19	31	35	3	68
30–39	98	14	21	29	29	5	42
>40	93	26	24	26	15	4	55
Total	91	12	17	22	32	9	422

days and the past two weeks, the presence of other symptoms (abdominal pain, fever, etc.), and a history of treatment for schistosomiasis. For children less than five years of age, the mother was interviewed.

A clinical examination was performed that consisted of an abdominal palpation in the supine position for organomegaly, which was recorded in centimeters under the costal arch, midsternal (left liver lobe), right mid-clavicular (right liver lobe), and left mid-clavicular (spleen). The liver was considered enlarged if it extended more than 2 cm under the right costal arch. All palpable spleens were defined as enlarged.

Frequencies of symptoms were statistically compared by age, sex, and egg count groups using the chi-square test.

RESULTS

The age-specific parasitologic results are shown in Table 1. Epidemiologic results are presented in further detail elsewhere.[10] The prevalence of detected infection was 91% overall, and almost 100% above the age of five years. Intensities of infection were extremely high, with 41% of the population and up to 69% in those 10–14 years of age excreting more than 1,000 epg. No significant sex-related differences were found, except in the group 5–9 years of age.

The frequency of reported complaints and of organomegaly is summarized in Table 2. Sixty percent of the population complained of abdominal discomfort, and 33% complained of diarrhea during the two days prior to the interview. Seventeen percent (69 of 411) of the participants had diarrheic fecal samples upon inspection of one of the two specimens obtained: 46% in the group 0–4 years of age, 19% in the group 5–19 years of age, and 6% in those older than 20 years of age. Only 2% of the stool samples were diarrheic at both stool collections. Of those with observed diarrhea in one or both samples, 63% reported having diarrhea in the past two weeks, versus 37% of those with observed normal stool samples. Both reported and observed diarrhea were most frequent in children less than five years old. Bloody diarrhea was reported by 24% of the population, but was observed only in a few cases. Because of this discrepancy, these data are not included in this analysis. Seventeen percent of the stools were extremely hard and therefore difficult to examine with the Kato tech-

TABLE 2

Age-specific and overall frequencies of symptoms in the population studied

	Age range (years)							
	0–4		5–19		≥20		All	
	%	(no.)	%	(no.)	%	(no.)	%	(no.)
Diarrhea (prior two days)	46	(34)	36	(63)	23	(36)	33	(133)
Diarrhea (prior two weeks)	53	(39)	39	(67)	26	(40)	36	(146)
Abdominal pain	49	(36)	64	(110)	62	(96)	60	(242)
Hepatomegaly of the left lobe	11	(8)	10	(18)	1	(1)	7	(27)
Hepatomegaly of the right lobe	1	(1)	2	(3)	0	(0)	1	(4)
Splenomegaly	3	(2)	0	(0)	0	(0)	0.5	(2)
No. examined	74		173		156		403	

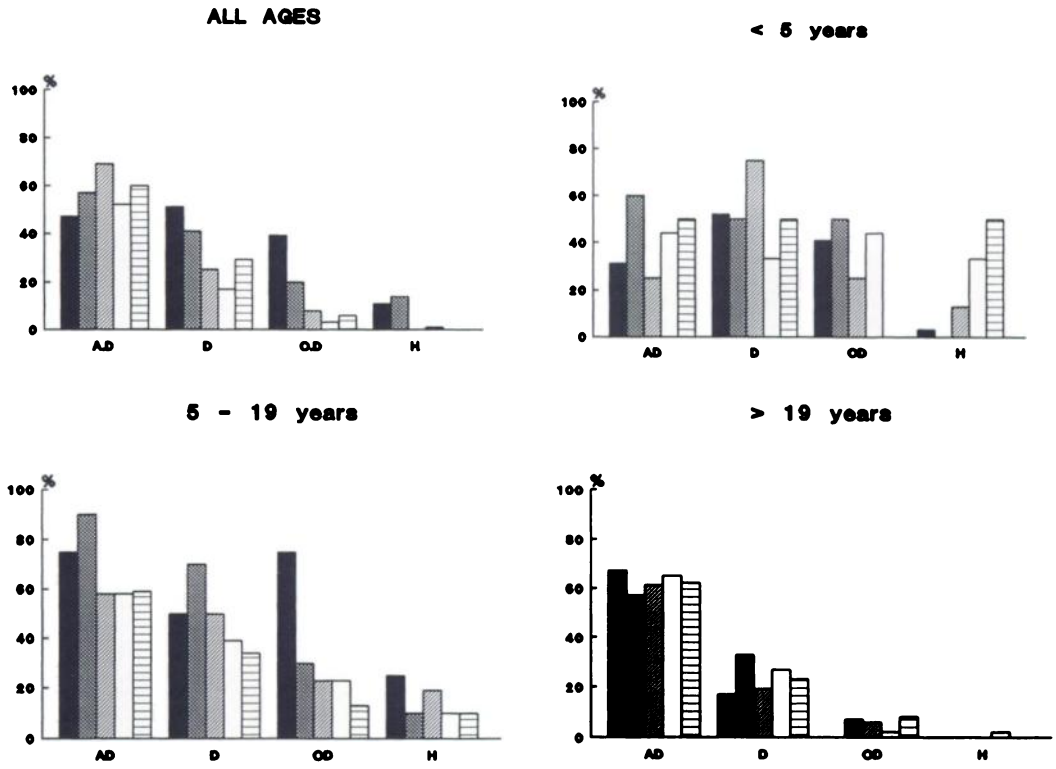

FIGURE 1. Morbidity related to intensity of *Schistosoma mansoni* infection. AD = abdominal discomfort; D = diarrhea; OD = observed diarrhea; H = hepatomegaly > 2 cm under the right costal arch; ■ = negative; ■ = 1—100 eggs per gram of feces (epg); □ = 101–400 epg; □ = 401–1,000 epg; □ = > 1,001 epg.

nique. These specimens required additional glycerine to clear the feces.

Only 7% of the population showed hepatomegaly; most cases were mild and seen in children. The liver extended 5 cm or more under the costal arch in only five boys. Right lobe enlargement was uncommon, and splenomegaly was seen in two children less than five years of age. Hepatomegaly was significantly more frequent in males (16%) than in females (7%) in the groups less than 20 years of age ($P < 0.001$). There were no further sex-related morbidity differences.

Figure 1 shows the overall and age-specific frequencies of symptoms as related to egg counts; no significant correlation could be found in any group for any symptom. Eighteen percent of the population had been treated with praziquantel since 1988, most within 12 months before this survey. There were no significant differences in morbidity between the treated and untreated population.

DISCUSSION

With respect to prevalences and intensities of infections, Ndombo is one of the most intense foci of *S. mansoni* ever described, comparable only to the west Nile area in Uganda and Maniema in Zaire.[15,16] The frequencies of diarrhea and abdominal discomfort in Ndombo were comparable to the findings in these two other foci, However, although blood in the stools was reported by 24% in Ndombo, the frequent and severe dysenteric syndromes observed by one of us (BG) in Maniema were seen in only a few cases.[17] Indeed, only 2% of the stool samples were bloody upon visual inspection. Nineteen percent of the samples were liquid or mushy-to-liquid, whereas 36% of the people reported diarrhea. It is a general problem of morbidity surveys that questionnaire data may not be fully reliable. However, in Ndombo, people with observed diarrhea did report this condition much more frequently than those without it, giving

some credibility to the data. Undoubtedly, there is considerable intestinal disease in this community, but there is no objective evidence that it is due to infection with *S. mansoni:* frequencies of symptoms did not correlate with egg counts and were actually highest in the least infected age group, that of children less than five years of age. This analysis may to some extent be biased by the dilution of egg counts in diarrheic feces. However, much of the reported diarrhea may also be attributable to bacterial, viral, or parasitic infections. The association of intestinal morbidity to schistosomiasis may be better demonstrated by comparison with nonendemic communities.[17] In the first reports of the schistosomiasis outbreak in Richard Toll, a high frequency of diarrhea and other possible symptoms of acute intestinal schistosomiasis was described, but at that moment these could not be clearly associated with the infection.[8] In the survey reported herein, these observations were not repeated; possibly, an initial epidemic of acute morbidity occurred but had subsided by the time of our study.

The relatively low frequency of liver and spleen enlargement, unrelated to the high intensities of infection, is the most striking observation. It is consistent, however, with the results of a preliminary ultrasound study.[18] It must further be noted that only significant hepatomegaly, extending more than 2 cm under the costal arch, was considered in the analysis. In the Maniema and west Nile foci, the observed high frequencies and intensities of organomegaly could clearly be associated with (intense) *S. mansoni* infection; in west Nile, clinical and even lethal bilharzial portal hypertension is common.[15, 16, 19] Also in most other, less intense foci, hepatomegaly and to a lesser degree splenomegaly can to some extent be correlated with the presence and/or intensity of infection, particularly in children.[1, 3] The virtual absence of serious organomegaly in this intense focus is therefore difficult to explain. One possibility is the low endemicity of malaria, as indicated by the low spleen rates. Thick blood smears were taken during the survey; a quick initial examination showed a positivity rate of 9%, but unfortunately, the slides were destroyed in a car accident before quality control efforts could be carried out. In a followup survey three months later, new blood smears were taken and showed a positivity rate of 7%, indicating low transmission. Therefore, synergetic action with schistosomiasis in the causation of organomegaly described elsewhere may not be important here.[5, 20] However, population-based comparisons between areas with similar endemicity levels of malaria have shown that heavy *S. mansoni* infections can lead on their own to high frequencies of organomegaly, particularly in children and adolescents.[7, 16] Such would be expected in a focus as intense as Ndombo, even if malaria were completely absent.

A second explanation would be that praziquantel treatment in health centers would have reduced morbidity to unnoticeable levels. Although almost 20% of the population had indeed received treatment in the past few years, this seems insufficient to explain the clinical observations, especially since so many intense infections remained and the morbidity patterns in those treated and untreated did not significantly differ.

The most likely explanation may lie in the recent nature of the focus. In most foci, bilharzial organomegaly is most apparent in groups between 10 and 20 years of age. Since this community has been exposed for only a few years, hepatic morbidity may still develop in any age group. In the longer term, severe liver fibrosis can also be expected; the interval between (heavy) infection in adolescents and the appearance of Symmers' fibrosis in young adults has been estimated at 5–10 years.[21] Further followup of morbidity in this new and intense focus, including ultrasound surveys, is essential for our understanding of the development of the disease and its implications for public health and the planning of control measures. Even though serious hepatosplenic disease is not currently observable, rapid intervention during the early and reversible stage of the disease may be needed to prevent the development of severe complications such as periportal fibrosis.

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