A NEW FOCUS OF SCHISTOSOMA MANSONI IN YORO VILLAGE, MBAM AND INOUBOU DIVISION, CAMEROON

ROGER MOYOU-SOMO, LYSETTE ELISABETH KOUEMENI, BLAISE NDJAMEN, JEANNE NGOGANG, ROGER DONGLA, VIRGINIE LONGANG-TCHATCHOUANG, AND MOHAMADOU HASSIMI

Institute of Medical Research and Study of Medicinal Plants/Medical Research Center, Yaounde, Cameroon; Faculty of Medicine and Biomedical Sciences, and Faculty of Sciences, University of Yaounde I, Yaounde, Cameroon

Abstract. Investigations on intestinal schistosomiasis were carried out in Yoro, a small village located in the transitional zone between forest and savannah, in the Mbam and Inoubo Division of Cameroon. Four human-water contact points were identified in the village and sampled for snails, and the inhabitants underwent parasitologic and clinical surveys to search for signs and symptoms of intestinal schistosomiasis. The results indicated the presence of two freshwater snails, both potential intermediate hosts of Schistosoma sp: Biomphalaria pfeifferi and Bulinus forskalii. However, only the former species was incriminated in the transmission of the disease, with the prevalence of snail infection being 10% (1 of 10) and 14.3% (2 of 14), respectively, during surveys 1 (in the dry season) and 2 (in the rainy season). The overall prevalence of Schistosoma mansoni eggs in stool samples was 54.4% (98 of 180). The mean ± SD intensity of infection was 100.3 ± 114.7 eggs per gram of stool. Eggs of S. intercalatum were not detected during parasitologic examination of stool specimens. In Cameroon, it appears that unlike the distribution of S. mansoni, which usually follows that of B. pfeifferi, B. forskalii is commonly found where S. intercalatum does not exist due to competitive exclusion through introgressive hybridization. Of the 180 people included in the study, 52.3% reported abdominal pain and 37.5% had bloody stools. Splenomegaly and hepatomegaly were noted in 11.7% and 3.9%, respectively, of the subjects examined. Three foci of S. mansoni were previously described in the Mbam and Inoubo Division, including Bafia town, Makenene, and Kinding Djabi villages. With the present focus in Yoro, the Mbam and Inoubo Division appears to be the most important endemic zone of S. mansoni in southern Cameroon.

INTRODUCTION

Schistosomiasis is one of the most important endemic parasitic diseases in Cameroon, with approximately 1.7 million people affected.1 All three African species (Schistosoma mansoni, S. haematobium, and S. intercalatum) are present, as well as a natural hybrid between S. haematobium and S. intercalatum, Schistosoma mansoni was previously reported in three localities in the Mbam and Inoubo Division, including Bafia town,2 Makenene village,3–5 and Kinding Njabi village.3,5 We conducted a survey on schistosomiasis in Yoro village following reports from the nearby Bokito district hospital that cases of infection with S. mansoni were detected at this hospital, with all the patients coming from Yoro. The study included malacologic, parasitologic, and clinical investigations.

MATERIALS AND METHODS

Study site. The study was carried out in Yoro, a small village located in Mbam and Inoubo Division, approximately 100 km north of Yaounde, Cameroon (4°31'40"N, 11°07'02.5"W). It is situated in the transitional zone between the forest and the savannah at an altitude of 437 meters. The village is composed of four quarters: Yoro center, Bougnangolo, Bougnangagne, and Bongando (Figure 1). Two permanent streams (Assaga and Gindigueldje) pass through the village, the former at Yoro center and the latter between Bougnangagne and Bongando. The major crops grown in the village are cassava, corn, yam, groundnut, cocoa, and palm nut. The village has a population of approximately 1,000 inhabitants, most of whom are members of the Yambassa tribe. The occupations of the villagers include farming, fishing, and extraction of palm oil. The village has only one private primary school situated at Yoro center and no health facility apart from a pharmacists. Despite the existence of a modern public water pump in Yoro center and the Bougnangolo quarter, the sanitary conditions are poor. Most of the houses lack toilet facilities and people relieve themselves in the nearby bushes or in the streams.

Clinical and parasitologic investigations. The study was conducted from May to June 2001. Pupils were seen at the school compound and the other inhabitants were seen at the premises of the chief of the village. Informed consent was obtained from all adult participants and from the parents or legal guardians of minors. The study was reviewed and approved by the Cameroon National Ethics committee. Each participant provided a brief medical history and underwent a clinical examination for signs and symptoms of intestinal schistosomiasis. For small children unable to answer questions, their parents or guardians provided the case history. Thereafter, participants or their parents/guardians were given a small snap-cap plastic container, a thin applicator stick, and some toilet paper. They were instructed to transfer a small quantity of stool into the container and return it to the research team. The fecal specimens were then mixed with a small quantity of sodium azide and transported to the base laboratory in Yaounde, where they were examined using a standard Kato thick smear technique. The intensity of infection was determined by microscopically counting eggs in the fecal specimens, and the number was expressed as eggs per gram (epg) of feces. The infected individuals were treated with praziquantel at the single oral dose of 40 mg/kg of body weight.

Malacologic survey. Two malacologic surveys were conducted in April 2001 (dry season) and June 2001 (rainy season). Four human-water contact points were identified in the village and sampled for snails. Site 1 was located upstream of the Assaga bridge linking Yoro center to Kedia village. This site is approximately 100 meters from the school and human living areas. It is used for bathing and fishing by pupils and the villagers. Site 2 is located approximately 50 meters upstream of site 1 and is used by women for bathing and for extraction of palm oil. Site 3 is located downstream of the Gindigueldje bridge linking the Bougnangagne and Bongando quarters.
This site is 150 meters from human living areas. Site 4 is situated approximately 100 meters upstream of site 3, and both sites 3 and 4 are used for bathing and extraction of palm oil.

The collection and identification of snails were done as follows. Mollusks were picked up by hand or with a long-handle scoop net. Collection was done for 45 minutes to 1 hour at each site. The snails collected were put in a polyethylene container that contained a small quantity of water from the collection sites and transported to the base laboratory at the Medical Research Center in Yaounde. They were then identified using a key provided by Brown and Brown and Kristensen. Thereafter, they were separated according to species and put into a glass aquarium containing water from the various sites and fed with lettuce. The day after collection, each snail was transferred into a petri dish containing mineral water and exposed to intense illumination for one hour. The water in the petri dish was then examined under a dissecting microscope for the presence of cercaria.

Physicochemical parameters (temperature, conductivity, pH, salinity) of the water harboring snail species, which are intermediate hosts of Schistosoma sp., were measured using a waterproof, multiparameter conductivity meter (IP67. 4200/Rev A/05-95) (Conductivity Meter, 4200, Jenway Co., London, UK). The measurements were made at 10:00 AM.

**Statistical analysis.** Statistical analysis was performed with Epi-Info software, version 5.0 (Centers for Disease Control and Prevention, Atlanta, GA). Comparison of groups with normally distributed data was made by analysis of variance after application of Bartlett’s test for homogeneity of variance. Proportions were analyzed by Fisher’s exact test and the chi-square test. $P$ values < 0.05 were considered statistically significant.
Prevalence and number of Schistosoma mansoni eggs per gram of stool and by age and sex in Yoro village Cameroon

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number examined</th>
<th>Number positive</th>
<th>Prevalence (%)</th>
<th>Mean (SD) number of eggs per gram of stool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>Total</td>
<td>M</td>
</tr>
<tr>
<td>&lt;5</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>5–9</td>
<td>12</td>
<td>16</td>
<td>28</td>
<td>7</td>
</tr>
<tr>
<td>10–14</td>
<td>45</td>
<td>48</td>
<td>93</td>
<td>24</td>
</tr>
<tr>
<td>15–19</td>
<td>16</td>
<td>16</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>≥20</td>
<td>15</td>
<td>6</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
<td>87</td>
<td>180</td>
<td>46</td>
</tr>
</tbody>
</table>

RESULTS

Parasitologic and clinical findings. One hundred eighty individuals (93 males and 87 females) underwent clinical and parasitologic investigations. They ranged in age from 1 to 63 years. The overall prevalence of S. mansoni eggs in stool specimens was 54.4% (98 of 180). Females were infected more than males (59.7% versus 49.5%), but the difference was not statistically significant (df = 4, P = 0.21). The global mean ± SD egg count was 103.3 ± 114.7 epg. The difference between the intensity of infection between males (107.8 ± 117.7 epg) and females (93.7 ± 112.7 epg) was not statistically significant (df = 1–96, F = 0.368). Age-stratified intensity of infection showed that the different age groups were equally infected (df = 4–93, F = 1.908) (Table 1).

Eggs of S. intercalatum were not detected in any of the stool specimens examined. Other prevalent helminths detected in the stool specimens included Trichuris trichiura (54.7%), Ascaris lumbricoides (20.3%), and Necator americanus (62.6%).

Of the 180 people included in the study, 52.3% complained of abdominal pain and 37.5% had bloody stools. Splenomegaly and hepatomegaly were noted in 11.7% and 3.9%, respectively, of the subjects examined. No relationship was noted between the presence of S. mansoni eggs in the stool and the presence of blood in the stool (df = 1–131, F = 0.036), abdominal pain (df = 1–131, F = 0.823), hepatomegaly (df = 1–122, F = 0.204), and splenomegaly (df = 1–125, F = 0.005).

Malacologic findings. The following freshwater snail species were identified in Yoro village: Potadoma sp., Biomphalaria pfeifferi, Lymnea natalensis, Bulinus forskalii, and Mytilis mytilus. The distribution and relative abundance of these mollusks are shown in Table 2. Potadoma sp. was the most frequent and abundant species encountered, being found at all four sites. Biomphalaria pfeifferi and B. forskalii, the two snails that are potential intermediate hosts of Schistosoma sp., were found only at site 1. However, only B. pfeifferi was incriminated in the transmission of schistosomiasis in the village. The prevalence of infection with B. pfeifferi was 10% (1 of 10) and 14.3% (2 of 14), respectively, during the dry and rainy season surveys.

Physicochemical parameters of the freshwater samples were determined only at site 1, where B. pfeifferi and B. forskalii were found. These parameters were temperature = 28.2°C, conductivity = 0.326 ms/cm, pH = 7.9 ± 0.5, and salinity = 0.4 g/L.

DISCUSSION

The prevalence (54.4%) and intensity (mean egg count = 100.3 epg) of S. mansoni eggs in stool were high in the study area. Even children less than five years old are becoming infected. Although only a few B. pfeifferi were collected at each survey, some were infected, indicating that the transmission was very high in this zone. This is probably due to the presence in the village of two streams with which there is a very high degree of contact for recreational, occupational, or domestic purposes. There was no relationship between the clinical findings and the presence or the intensity of S. mansoni eggs in stools specimens. In fact, none of the clinical signs or symptoms observed was specific for schistosomiasis. For example, the splenomegaly and hepatomegaly could be due to malaria, a disease that is also endemic in the study zone. Other intestinal parasites (A. lumbricoides, T. trichiura, N. americanus, Strongyloides stercoralis, Entamoeba histolytica), could also induce abdominal pain and/or bloody stools.

The high endemicity of S. mansoni in Yoro village is rather surprising. Recent investigations in many foci for schistosomiasis in Cameroon have shown a trend toward reduction of endemicity compared with earlier reports. For example in

<table>
<thead>
<tr>
<th>Snail species*</th>
<th>Survey 1 (dry season)</th>
<th>Survey 2 (rainy season)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site 1</td>
<td>Site 2</td>
</tr>
<tr>
<td>B. pfeifferi</td>
<td>10 (1)</td>
<td>0</td>
</tr>
<tr>
<td>B. forskalii</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>L. natalensis</td>
<td>138</td>
<td>13</td>
</tr>
<tr>
<td>Potadoma sp.</td>
<td>&gt;200</td>
<td>&gt;200</td>
</tr>
<tr>
<td>M. mytilus</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* B = Biomphalaria (pfeifferi); B = Bulinus (forskalii); L. = Lymnea; M. = Mytilus.
Makenene village, which is located 50 km north of Yoro village, the prevalence of *S. mansoni* was 82% in 1987, 36% in 1995, and 18% in 2001. The report of the interruption of transmission of schistosomiasis in an endemic area of Cameroon following the construction of a water pump in this zone, which reduced the human-water contact, should not be considered universally true because although there are two modern fountains in Yoro village, the transmission of schistosomiasis there is still high. At Yoro center, the water pump is located only 50 meters from the snail collection site where infected specimens were found.

*Bulinus forskalii* was collected at the study site, but none of the specimens were positive for cercaria. This observation corroborates the absence of *S. intercalatum* eggs during the parasitologic examination of stools. It was shown that when *S. mansoni* and *S. intercalatum* or *S. haematobium* and *S. intercalatum* coexist, *S. intercalatum* gradually disappears with time due to competitive exclusion through introgressive hybridization. This might have happened in Yoro village and one can imagine that many years ago, *S. mansoni* and *S. intercalatum* were present in the village and that *S. intercalatum* subsequently disappeared. Consequently, *B. forskalii* and *B. pfeifferi* are present, but only the latter has been incriminated in the transmission of disease. Finally in Cameroon, it appears that unlike the distribution of *S. mansoni*, which is usually similar to that of *B. pfeifferi*, *B. forskalii* are commonly found where *S. intercalatum* does not exist.

Three foci of *S. mansoni* were previously reported in the Mbam and Inoubou Division of Cameroon. Thus, with the present focus in Yoro, this division appears to be the most important endemic zone for *S. mansoni* in southern Cameroon.

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Authors’ addresses: Roger Moyou-Somo, Institute of Medical Research and Study of Medicinal Plants/Medical Research Center, Yaounde, Cameroon and Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon. Lysette Elisabeth Kouemeni and Blaise Ndjam, Institute of Medical Research and Study of Medicinal Plants/Medical Research Center, Yaounde, Cameroon. Jeanne Ngogang, Roger Dongla, Virginie Longang, and Mohamadou Hassimi, Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

Reprint requests: Roger Moyou-Somo, Institute of Medical Research and Study of Medicinal Plants/Medical Research Center, Yaounde Cameroon, Telephone: 237-997-8625 and 237-223-4037, Fax: 237-222-4529, E-mail: roger_moyou@yahoo.fr and roger.moyou@camnet.cm.

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