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Assessment of Schistosomiasis in the Dominican Republic

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Synopsis

Active transmission of intestinal schistosomiasis is currently limited to the southeastern part of the Dominican Republic. A population-based stool survey in 1980 detected 4 asymptomatic individuals among 114 selected at random in 2 towns and a rural community in El Seibo Province.

The distribution of the transmitting snail, Biomphalaria glabrata, considerably exceeds that of Schistosoma mansoni, extending to the National District and capital city of Santo Domingo and well into certain central valley provinces. There is evidence that transmission sites have shifted during the past three decades because of urban development, molluscicidal activities and, perhaps, introduction of competing mollusks.

In spite of intermittent control activities, the combination of domestic and recreational use of streams with consequent fecal contamination, and the extended distribution of B. glabrata indicates

that the potential for new transmission foci is as great today as it was 10 years ago. This potential transmission of S. mansoni is a continuing threat to public health in the Dominican Republic.

THE GEOGRAPHIC DISTRIBUTION of human schistosomiasis in the Caribbean region is notoriously irregular and follows the inconstant distribution of the intermediate snail host, *Biomphalaria glabrata*. The island of Hispaniola contains a focus of schistosomiasis in the southeastern part of the Dominican Republic. Prevalence of infection appears to be low; indeed, the endemicity of the infection was denied for many decades, and the origin of the handful of cases in the older literature was disputed (1).

Undisputed autochthonous infections with *Schistosoma mansoni* were first reported in the Dominican Republic in 1947 (2). Subsequent reports of cases, although sparse, have been persistent. The principal focus has always been the town of Hato Mayor, El Seibo Province (3-5); see map for this and other locations mentioned in the text. For several decades, Hato Mayor was thought to constitute the sole focus of these infections in the country, but after 1972 they were documented in the provincial capitals of El Seibo and Higüey (6). Reports of cases in the nearby localities of Miches and Nisibón exist but remain unverified.

Schistosomiasis was officially perceived as a public health problem in El Seibo and La Altagracia Provinces with the inception of the Center for Eradication of Bilharzia in 1970. After this date, central records were maintained of the cases detected by the routine coprologic examination method of Hoffman and coworkers (7). Regretfully, the denominators for all subsequent data were based on attendance at the clinic rather than on the population as a whole (table 1). However, a trend seemed to be indicated, that is, an apparent decline in incidence in the clinical group (most of whom, it seems, had come to the clinic with symptoms only casually related to those of schistosomiasis). Health officials could only speculate whether this trend might parallel a similar decline in incidence in the overall population and, if so, the reason for it.

The U.S. Agency for International Development (USAID) was asked in 1980 to make an up-to-date assessment of the schistosomiasis situation in the Dominican Republic and to recommend possible interventions. A small field team was recruited to

review available data and to conduct a limited field survey for human cases and for snail hosts. The work commenced on July 8 and ended on August 14, 1980. Although of limited scope, the fieldwork generated data that will be of interest to public health authorities in Santo Domingo and to parasitologists interested in the epidemiology of schistosomiasis. The new data are presented in this paper.

Materials and Method

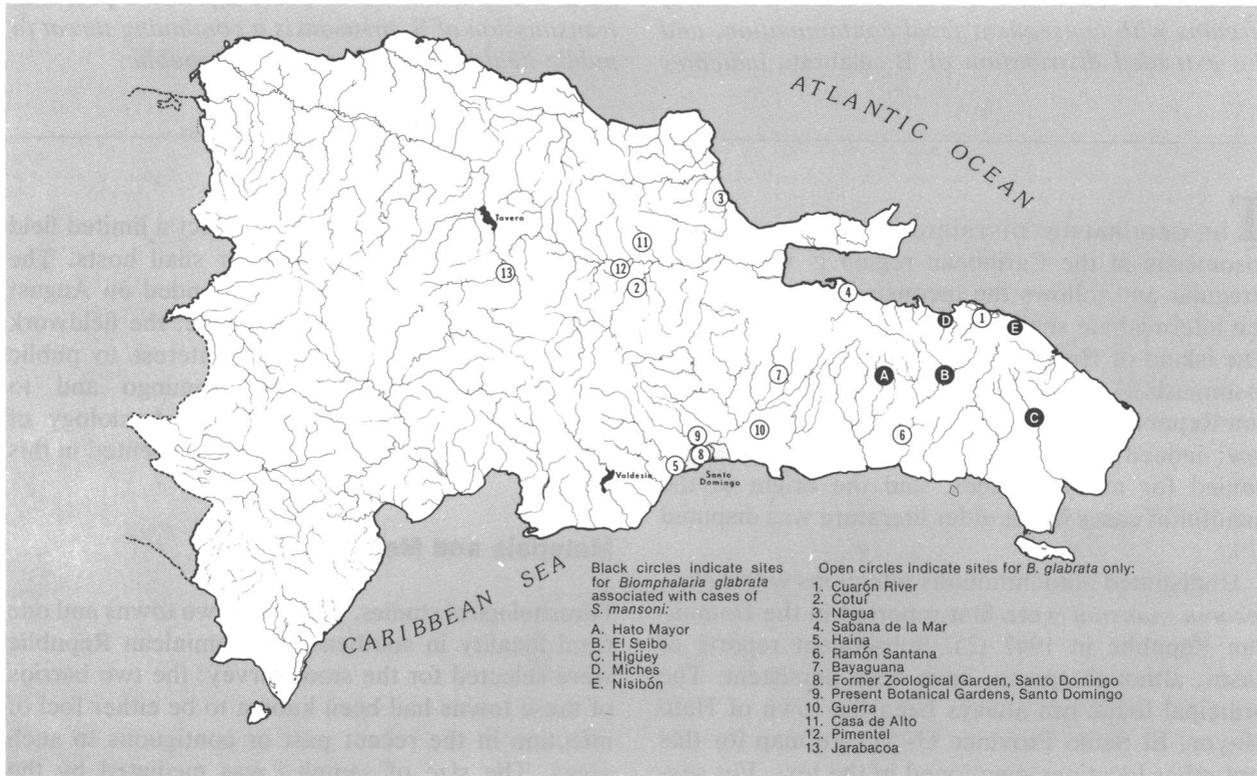
Parasitological studies. Barrios in two towns and one rural locality in southeastern Dominican Republic were selected for the stool survey; the two barrios of these towns had been known to be either foci of infection in the recent past or contiguous to such areas. The size of samples was mediated by the relatively short time available to conduct the survey.

Barrio Gauley in Hato Mayor, the town known to be the prime focus of transmission in the country, is close to the Magua River, much used by the barrio residents for washing, bathing, and defecation. A tributary of the Magua, the cañada Gauley, passes directly through the barrio.

Barrio Ginandiana is in the northernmost sector of the provincial capital of El Seibo, adjacent to the El Seibo River. On the first day of the survey about 50 people were seen bathing and washing clothes in the river, the edges of which showed evidence of indiscriminate defecation. A tributary, the cañada Ginandiana, in which infected *B. glabrata* snails had been found earlier in the year, ran through the barrio. The discovery of these infected snails was made by Mercedes Vargas de Gómez.

Batey Guaiquía, the rural site, is a permanent cowboy camp 12 kilometers east of Hato Mayor on the road to El Seibo, adjacent to the Guaiquía River. Although the residents, employees of the Gulf and Western Corporation, and their families had piped water and pit latrines, they bathed daily in the Guaiquía, and evidence of human fecal contamination at the main bathing site was found. *B. glabrata* snails were not seen here, although the habitat was judged suitable for them.

Survey for *Schistosomiasis mansoni* in water sheds in the Dominican Republic



In the Hato Mayor and El Seibo study areas, households were chosen at random by selecting the residents of every fifth house until a sample of 50 persons had been included in the survey. Thus, in Hato Mayor, 10 houses were visited; in El Seibo, 11. Every person more than 6 months old who was living in the house was given a plastic specimen cup labeled on the lid and side with an identifying number and the person's name. In Batey Guaiquía, all nine occupied houses of the batey were included in the survey, and specimen cups distributed in the same way. During the following 2 days the cups were collected and the numbers checked against our records. Specimens from the three sites were taken each day to the clinical laboratory of the Hato Mayor health subcenter for processing. One gram of each fecal specimen was measured by displacement of 1 milliliter in a graduated 15-milliliter screw-top plastic centrifuge tube containing 7 milliliters of 10 percent formol-saline solution. Fecal samples were thoroughly comminuted in the numbered tubes, and the tops screwed down tightly and sealed with Parafilm-M. The tubes were shaken thoroughly to ensure adequate mixing with the formol-saline and packaged for transport to the Centers for Disease

Control laboratory in San Juan, Puerto Rico, where parasitological analysis, using the modified Ritchie formol-ether concentration method, was performed (8). Egg counts were reported as eggs per gram of feces (epg).

Malacologic studies. Snail surveys were carried out mainly in El Seibo Province. Collections were also made in the Provinces of La Altagracia, Azua, Duarte, Sánchez Ramírez, and the National District. Localities that had been reported in the literature as harboring *B. glabrata* were searched when time permitted, as were certain other sites.

Results

Parasitological studies. A total of 151 specimen cups were distributed: 59 in Hato Mayor, 36 in Batey Guaiquía, and 56 in El Seibo. The overall positive response was 76 percent, but this varied by locality: 83 percent responded with specimens in Hato Mayor and 89 percent in Batey Guaiquía, but only 60 percent provided a specimen in El Seibo. The low response in El Seibo was due to almost total refusal by members of three households (12

Table 1. Number of persons examined and percentage infected with *Schistosoma mansoni* in the Dominican Republic between 1970 and 1978¹

Year	Hato Mayor			El Seibo			Higüey		
	Number examined	Positive	Percent positive	Number examined	Positive	Percent positive	Number examined	Positive	Percent positive
1970	3,028	328	10.8	...	...	...	...	...	...
1971	4,173	137	3.3	...	...	...	...	...	...
1972	4,674	88	1.9	1,228	60	4.9	4,596	560	12.2
1973	7,668	97	1.3	3,957	58	1.5	8,534	216	2.5
1974	6,261	53	0.9	217	22	10.1	6,373	60	0.9
1975	6,455	23	0.4	9,284	3	0.03	14,517	50	0.3
1976	5,361	12	0.2	644	0	0.0	4,974	56	1.1
1977	5,570	14	0.3	5,427	29	0.5	3,820	29	0.8
1978	3,989	16	0.4	...	...	...	3,285	14	0.4

¹ Data adapted from Sánchez and Grullón, 1980 (6).

people). The only important age group with a response rate substantially below 80 percent was the 16- to 20-year group, which returned only 40 percent. The age, sex, and place of residence of the 114 persons who contributed fecal samples are given in table 2.

Of 114 stools from different persons, 4 (or 3.5 percent) contained eggs of *S. mansoni*. This included 1 of 49 (2 percent) from Barrio Gualey, Hato Mayor; 1 of 32 (3.2 percent) from Batey Guaiquía; and 2 of 33 (6.1 percent) from Barrio Ginandiana, El Seibo (table 2). All four infections detected in our survey occurred among males (table 3). The case from Hato Mayor with the relatively high egg count (152 epg) had been seen clinically and previously treated. The others represented new findings; their egg counts were all less than 3 epg.

Malacologic studies. Localities where *B. glabrata* not infected with *S. mansoni* was encountered are indicated in the figure by numbers in open circles. Descriptions of the localities follow.

- *El Seibo Province*—A well at Las Palmillas, 3 kilometers northeast of Hato Mayor; swamp in Hato Mayor near Paña Paña stream; cattle-watering pond at Paso Cibao (between points A and B in map); cattle-watering pond 9 kilometers south of Hato Mayor; cattle-watering pond 10 kilometers east of Hato Mayor, shells only; swamp near El Valle, about 20 kilometers south of Sabana de la Mar, shells only; and irrigation canals and a large rice plantation, 10 kilometers west of Miches, shells only.

- *La Altagracia Province*—Laguna, Barrio Sabeka, Higüey, in drying lake, many shells; Arroyo Cahero, Barrio San Martín, Higüey, shells only.

- *National District*—Freshwater ponds, Botanical Gardens, Santo Domingo; large pond and swamp north of main highway east of Haina, many shells.
- *Sánchez Ramírez Province*—Drainage canal, rice plantation about 5 kilometers west of Cotuí.

Some foci for *B. glabrata* reported in the literature were searched that, at the time of this survey, did not harbor this planorbid species. These included a swamp in Sabana de la Mar, about 20 meters from the Atlantic Coast, cañadas in Miches, the Magua River and Paña Paña stream in Hato Mayor, cañada Ginandiana in El Seibo, and Juda River at Pimentel.

Other habitats examined that did not harbor *B. glabrata* were the El Seibo River at Ginandiana, Guaiquía River about 12 kilometers east of Hato Mayor, Arroyo Santa Lucía about 10 kilometers southeast of El Seibo, Río Vía in the hills just north of Azua (approximately 50 kilometers west of the Valdesia dam), and a large number of streams, irrigation canals, and drainage canals between Cotuí and Fantino and Cotuí and Pimentel (between points 2 and 12, 2 and 11).

In the present limited survey, all live *B. glabrata* collected were examined for the presence of natural infections with *S. mansoni*, but none was encountered.

During the search for *B. glabrata*, other snail species of epidemiologic interest were seen in locations indicated on the map. *Biomphalaria havanensis*, a potential host for *S. mansoni*, was found in Arroyo Santa Lucía (about 10 kilometers southeast of El Seibo) as well as in the large pond near Haina. *Marisa cornuarietis* was found in the El Seibo River at Ginandiana (see map, point B) as well as in irrigation and drainage canals west and south of

Table 2. Age, sex, and residence of 114 persons from 3 localities of El Seibo Province, Dominican Republic, who contributed fecal specimens in the July 1980 survey

Age in years	Barrio Gualey (Hato Mayor)			Batey Guaiquía			Barrio Gianandiana (El Seibo)			All localities		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
.5-5	5	6	11	2	2	4	4	3	7	11	11	22
6-10	4	6	10	4	3	7	1	3	4	9	12	21
11-20	3	3	6	2	5	7	4	7	11	9	15	24
21-30	5	3	8	1	3	4	1	3	4	7	9	16
31-40	2	4	6	2	1	3	0	2	2	4	7	11
41-70	1	5	6	5	2	7	3	2	5	9	9	18
70 and over	2	0	2	0	0	0	0	0	0	2	0	2
All ages	22	27	49	16	16	32	13	20	33	51	63	114
Percentage positive	...	...	2.0	...	...	3.1	...	...	6.1	...	...	3.5

¹ Includes 1 positive.

Cotuí. It is of interest that *M. cornuarietis* was cultivated for many years in large, concrete tanks on the grounds of the Center for Eradication of Bilharzia in Hato Mayor and was actively distributed by control personnel about the waterways of El Seibo Province in an effort to control *B. glabrata*. It is believed that this activity ceased in 1978.

Asian snails that had been introduced to the Dominican Republic, *Thiara granifera* and *Thiara tuberculata*, were found in extraordinary numbers. They were found in the Magua River at Barrio Gualey, Hato Mayor; Guaiquía River about 12 kilometers east of Hato Mayor; El Seibo River at Ginandiana; a cañada near the western entrance to Higüey; and a large number of streams, irrigation canals, and drains in rice plantations throughout the area between Cotuí-Fantino and Cotuí-Pimentel between points 2 and 12, 2 and 11 on the map. *Lymnaea cubensis*, intermediate host of the cattle fluke *Fasciola hepatica*, was encountered on aquatic vegetation and moist mud on the edge of the pool near Haina.

Discussion

Prevalence figures derived from persons seen clinically have fallen steadily since 1970 and precipitously since 1975. It is not known if this decline represents a true reduction in incidence because of the selective bias in data from persons seen only in a clinical setting. There were 4 infections among 114 persons examined randomly, giving a point prevalence of 3.5 percent. Because extrapolation from small samples is unwise, obtaining improved population-based data is a clear priority in future planning.

Even if transmission was indeed reduced by the activities of the Center for Eradication of Bilharzia during the decade of the 1970s, it was not eliminated. Our survey uncovered a positive case in a 6-year-old.

Discovery of the positive case at Batey Guaiquía does not establish the existence of transmission there, because the subject had moved there 3 years earlier from either Hato Mayor or El Seibo, both known transmission sites. We did not find *B. glabrata* in the section of the Guaiquía River used by the residents for bathing.

Transmission sites have undoubtedly changed with time. The town of Hato Mayor has grown westward during the last 20 years. Barrio Gualey, which did not exist when Olivier and coauthors worked in the area (3,4), is now adjacent to the Magua River, and the distinction between rural and urban transmission has become blurred.

B. glabrata infected with *S. mansoni* were first reported in the Dominican Republic by Ponce Pinedo (2). Olivier and his colleagues (3,4) concluded that the transmitting snail was limited to the Las Guamas-Paña Paña drainage adjacent to Hato Mayor and to a segment of the Magua River near its confluence with the Paña Paña. But later, on the basis of six surveys done during 1963-68, Etges and Maldonado (9) found a far more extensive distribution and noted that the snail was established over a range that represented approximately one-sixth of the total area of the Dominican Republic.

Surveys in the eastern and central regions were conducted by Vargas Castro (10) and Vargas Castro and Gómez (11). *B. glabrata* was found in the Ginandiana and Los Guincoles sectors of El Seibo,

Table 3. Characteristics of 4 persons infected with *Schistosoma mansoni*, July 1980, El Seibo Province, Dominican Republic

Locality	Sex	Age	Occupation	Intensity of infection (EPG) ¹	Previous treatment	Notes
Barrio Gauley (Hato Mayor)	Male	21	Student	152	Hycanthone	Record missing on results of treatment
Batey Guaiquía	Male	32	Cowboy	3	None	Lived at batey 3 years, previous residence unrecorded
Barrio Ginandiana (El Seibo)	Male	6	Preschool	2	None	...
Barrio Ginandiana (El Seibo)	Male	49	Laborer	1	None	Lived in barrio 8 years

¹ EPG = Eggs per gram of feces.

Sabana de la Mar, Higüey (La Altagracia Province) (map, point 6); Ramón Santana (San Pedro de Macorís Province), Bayaguana (San Cristóbal Province), National District (map, point 10), the old Zoological Park in the center of Santo Domingo, Casa de Alto (San Francisco de Macorís Province), Pimentel (Duarte Province), and Pinar Quemado near Jarabacoa (La Vega Province).

Without doubt other snail foci and transmission foci will be found when and if support for further field searches becomes available. For example, there is an unconfirmed report of *B. glabrata* in the southwest region of Barahona and another in Jimaní, adjacent to the frontier with Haiti (12). At present, we are limited to the statement that the geographic range of *B. glabrata* is more extensive than that of the *S. mansoni*, and extends into the National District and the Provinces of San Cristóbal, Sánchez Ramírez, María Trinidad Sánchez, La Vega, San Pedro de Macorís, and San Francisco de Macorís.

Transmission of schistosomiasis in the eastern regions, which was once so extensive in the Paña Paña and the Magua River, is by no means gone from the general area. It extends from Hato Mayor to Sabana de la Mar and into the rice fields of Miches. It is present in Higüey (dead snails in one arroyo in Higüey apparently died because of local fouling; snails are undoubtedly present in other sections of that arroyo). In the rice fields at La Cruz, south of Sabana de la Mar, *B. glabrata* was present not only in irrigation and drainage canals but also in cultivated plots. It will probably breed extensively in similar sites west of Miches when these fill with rain water.

However, some bodies of water reported to be good habitats for *B. glabrata* proved not to harbor the snail. If this can be attributed to the use of molluscicide, the Center for Eradication of Bilharzia may take the credit. Examples are the Paña Paña

stream, a ditch and swamp at Sabana de la Mar, and the cañada Ginandiana in El Seibo. Since the molluscicide employed by the Center was the non-ovicidal Frescon (n-trityl-morpholine), resurgence of some snail populations must be expected in the absence of continuous application.

The absence of snails in some other localities cannot be traced to the Center. For example, the filling-in of the swamp in the center of Miches caused the disappearance of the snails. Draining ponds in Higüey caused temporary reductions of snail numbers.

The true geographic extent of schistosomiasis in the Dominican Republic is uncertain because of the small number of cases found. Many studies have been based on indirect evidence such as the intradermal or the circumoval precipitin (COP) tests. Some guesswork has also been based on population movements within the country. For example, Maldonado (13) focused attention on the possibility of introducing schistosomiasis transmission into the capital city. In his group of 172 urban orphans, 44 (25.6 percent) gave positive intradermal test reactions to whole worm antigen. In the same study, the COP test was positive in 116 of the orphans (67.5 percent). However, the place of origin of the orphans was not recorded, and it is now recognized that results of COP or intradermal tests are not proof of parasite infection. It is known that the intradermal test may overstate true prevalence in areas where it is low (14). The intradermal test has low specificity because of interaction between test antigens and antibodies due to host encounters with avian or mammalian schistosomes (15).

A study of 1,176 persons residing near the Valdesia and Tavera dams (see map) elicited positive intradermal reactions in 171 (14.5 percent). Since these rates did not vary with age, we believe the reactions were nonspecific. *B. glabrata* was not found in the impounded waters, but snails were

encountered in Jarabacoa in a tributary of Lake Tavera (16).

There may be control of snails by competing mollusks now in the Dominican Republic. The Asian snails *T. granifera* and *T. tuberculata* were initially introduced near Nisibón (9) but now occur throughout many provinces. According to Ferguson (17), *T. granifera* competes successfully with *B. glabrata* in Puerto Rico. In St. Lucia, four field trials demonstrated that *B. glabrata* was eliminated from marshes and streams 6–22 months after introduction of *T. granifera* (18).

Another competitor of *B. glabrata* is the ampullariid *M. cornuarietis*, which was introduced in the Dominican Republic in the early days of the Center for Eradication of Bilharzia. Rice fields in the Cotuí area, which had been ideal habitats for *B. glabrata* (11), were bare of them; only 1 site of 30 examined contained *B. glabrata* (four snails). The predominant snails were the two species of *Thiara* followed by *M. cornuarietis*. Similarly, *B. glabrata* no longer is found in the Juda River near Pimentel; the predominant snail is now *T. granifera*. Because no molluscicides have been applied in the Cotuí-Fantino-Pimentel area (in contrast with the eastern provinces), the attenuation of *B. glabrata* there may be due to the competitor snails.

We believe that a potential for spread of schistosomiasis exists in the Dominican Republic. We frequently observed streams being used for domestic purposes and for recreation. The contamination of water contact sites with human excreta was often intense. At present there is a steady influx of population from the eastern endemic areas into the National District and the city of Santo Domingo, where foci of *B. glabrata* have been demonstrated. There is also considerable migration of farm workers around the entire island and many rural areas. At present, transmission of *S. mansoni* does not occur in these areas, but they appear to be ecologically suitable as new foci of transmission.

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