Am. J. Trop. Med. Hyg., 62(2)S, 2000, pp. 73–79

THE EPIDEMIOLOGY OF SCHISTOSOMIASIS IN EGYPT: ASSIUT GOVERNORATE

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Abstract. In the Assiut, Egypt Epidemiology 1, 2, 3 investigation, a sample of 14,204 persons in 10 villages, 31 ezbas (satellite communities), and 2,286 households was drawn from a rural population of 1,598,607. Parasitologic examination of urine and stool were made for *Schistosoma haematobium* and *S. mansoni*, and physical and ultrasound examinations were made on a 20% subsample. The overall estimated prevalence of *S. haematobium* was 5.2 ± 0.5 (± SE). This varied considerably by village and ezba, ranging from 1.5% to 20.9%, with ezbas having a slightly higher overall prevalence than villages. The overall estimated geometric mean egg count was 6.6 ± 0.5 eggs per 10 ml of urine and was consistently low throughout the communities. Infection with *S. haematobium* was associated with age (peak prevalence of 10.6 ± 1.5% in 15–19-year-old age group) males, children playing in the canals, a history of blood in the urine, and reagent strip positivity for hematuria and proteinuria. The prevalence of either hepatomegaly or splenomegaly detected by physical examination was low (4.0% and 1.5%, respectively). The prevalence of hepatomegaly determined by ultrasonography was substantially higher, 24.1%. The prevalence of periportal fibrosis (PPF) was 12.0%, but grade II or III PPF was present in less than 1%. Ultrasonography-determined hepatomegaly, in both the midclavicular line and the midsternal line, increased by age to more than 30%. Periportal fibrosis was more common in the age groups in which infection rates were the highest. At the village and ezba level of analysis, the prevalence of hepatomegaly, splenomegaly, and PPF tended to be higher in communities having the highest prevalence of infection with *S. haematobium*.

Assiut, the southernmost governorate of Middle Egypt, is bordered on the north by the Minya governorate and on the south by Sohag. As determined by the 1986 census reported by the Egyptian Central Agency for Public Mobilization and Statistics, it had a total population of 2,215,679 persons, of which 1,598,607 were defined as rural. Assiut city, the governorate capital, is also the home of Assiut University where much of the directed epidemiologic research on schistosomiasis in Assiut has been carried out.[1–11] Historically, Assiut has been endemic only for *S. haematobium*.[12,13] Because of early perennial irrigation systems in this governorate, prevalence of *S. haematobium* was high. In areas perennially irrigated in 1975, prevalence was in the 30–40% range.[2] Following the implementation of the current National Schistosomiasis Control Program in Upper Egypt,[14,15] there has been a steady decrease in prevalence to approximately 10% in 1988. Infections with *S. mansoni* have only very recently been reported.[9]

The following is a report of the Epidemiology 1, 2, 3 (EPI 1, 2, 3) investigation that was conducted in the Assiut governorate and provides more recent data from a probability sample of the rural population.

SUBJECTS AND METHODS

The EPI 1, 2, 3 objectives, study design, sample design, and sample selection of villages, ezbas, households, and individuals for the Assiut governorate has been described in detail.[16] This includes methods for the detection of *Schistosoma* ova in the urine and stool[17] and methods for physical and ultrasound examinations.[18] As mentioned, the clinical and ultrasound examinations were made on a 20% subsample.[16] Prescribed methods for the collection, recording, management, and analysis of data have also been provided.[16] Additional unweighted analysis of data was made separately using SPSS/PC+ version 4.0.1 (SPSS, Inc., Chicago, IL) for calculating odds ratios (ORs), 95% confidence intervals (CIs) for ORs, and regression coefficients for trends.

RESULTS

The sample selection of villages, ezbas, households, and person data (interview, stool, urine, physical examination, and ultrasound data) and response rates are shown in Table 1. Participation in giving an individual interview was lowest. Age and sex data were nevertheless available for all selected individuals.

TABLE 1
Sample selection and response rates in the Assiut Epidemiology 1, 2, 3 study

Item	Sampling unit	Selected	Responded	Response
Village	Village	10	10	100.0%
Ezba	Ezba	31	31	100.0%
House	Households	2,286	1,888	85.8%
Person	Individuals in selected household	14,204	7,978	56.2%
Stool	Individuals in selected household	14,204	9,268	65.3%
Urine	Individuals in selected household	14,204	9,555	67.3%
Clinical and Ultrasound	Individuals selected for ultrasound	2,840	1,787	63.0%

TABLE 2

Odds ratio and confidence limits for risk factors for infection with *Schistosoma haematobium* in Assiut Governorate*

Risk factor	Total in group	Infected No. (%)	Odds ratio	Confidence limits
Demographics				
Age groups (years)				
0–10	3,142	164 (5.2%)		
11–20	2,403	287 (11.9%)	2.46	2.02–3.01
21–35	1,864	81 (4.3%)	0.82	0.63–1.08
36–55	1,430	36 (2.5%)	0.47	0.33–0.68
>55	716	20 (2.8%)	0.52	0.33–0.84
Gender				
Female	5,036	219 (4.3%)		
Male	4,519	369 (8.2%)	1.96	1.65–2.32
Domicile				
Village (≥500 houses)	3,881	180 (4.6%)		
Ezba (<500 houses)	5,674	408 (7.2%)	1.59	1.33–1.91
Exposure to canal water				
Bathing (males)				
No	2,466	164 (6.7%)		
Yes	1,144	155 (13.5%)	2.20	1.74–2.77
Washing (females)				
No	3,900	159 (4.1%)		
Yes	491	36 (7.3%)	1.86	1.28–2.71
Playing (children <15 years old)				
No	2,516	169 (6.7%)		
Yes	572	104 (18.2%)	3.09	2.37–4.02
Clinical findings				
History of schistosomiasis				
No	6,096	306 (5.0%)		
Yes	1,569	195 (12.4%)	2.69	2.22–3.24
Prior treatment of schistosomiasis				
No	5,808	277 (4.8%)		
Yes	1,606	207 (12.9%)	2.95	2.44–3.57
History of burning micturition				
No	990	48 (4.8%)		
Yes (total)	446	40 (9.0%)	1.93	1.25–2.99
<15 years	105	20 (19.0%)	4.62	2.62–8.14
≥15 years	341	20 (5.9%)	1.22	0.71–2.09
History of blood in urine				
No	1,246	51 (4.1%)		
Yes	185	37 (20.0%)	5.86	3.71–9.25
<15 years	76	24 (31.6%)	10.81	6.18–18.91
≥15 years	109	13 (11.9%)	3.17	1.67–6.04
Hepatomegaly in MCL (by PE)				
No	1,262	81 (6.4%)		
Yes	162	7 (4.3%)	0.66	0.30–1.45
<15 years	46	4 (8.7%)	1.39	0.49–3.97
≥15 years	116	3 (2.6%)	0.39	0.12–1.25
Splenomegaly (by PE)				
No	1,412	87 (6.2%)		
Yes	21	1 (4.8%)	0.76	0.10–5.74
<15 years	5	0 (0.0%)		
≥15 years	16	1 (6.3%)	1.02	0.13–7.78
Laboratory findings				
Hematuria				
No	7,846	343 (4.4%)		
Yes	1,709	245 (14.3%)	3.66	3.08–4.35
<15 years	657	137 (20.9%)	5.76	4.64–7.16
≥15 years	1,052	108 (10.3%)	2.50	2.00–3.14

TABLE 2
Continued

Risk factor	Total in group	Infected No. (%)	Odds ratio	Confidence limits
Proteinuria				
No	8,795	433 (4.9%)		
Yes	760	155 (20.4%)	4.95	4.05–6.05
<15 years	337	98 (29.1%)	7.92	6.14–10.21
≥15 years	423	57 (13.5%)	3.01	2.24–4.04
Ultrasonography				
Hepatomegaly in MCL				
No	940	56 (6.0%)		
Yes	397	25 (6.3%)	1.06	0.65–1.73
<15 years	165	18 (10.9%)	1.93	1.11–3.08
≥15 years	232	7 (3.0%)	0.49	0.22–1.09
Hepatomegaly in MSL				
No	1,060	67 (6.3%)		
Yes	278	14 (5.0%)	0.79	0.43–1.42
<15 years	48	5 (10.4%)	1.72	0.66–4.49
≥15 years	230	9 (3.9%)	0.60	0.30–1.23
Splenomegaly				
No	1,319	80 (6.1%)		
Yes	94	7 (7.4%)	1.25	0.56–2.78
<15 years	25	3 (12.0%)	2.11	0.62–7.21
≥15 years	69	4 (5.8%)	0.95	0.34–2.68
Periportal fibrosis				
No	1,250	72 (5.8%)		
Yes (≥3 mm)	170	16 (9.4%)	1.70	0.96–2.00
<15 years	54	7 (13.0%)	2.44	1.06–5.58
≥15 years	116	9 (7.8%)	1.38	0.67–2.83
Grade I (3–<5 mm)	166	16 (9.6%)	1.75	0.99–3.08
Grade II (5–<7 mm)	0			
Grade III (≥7 mm)	4	0 (0.0%)		
Bladder wall lesions				
No	1,385	74 (5.3%)		
Yes	33	13 (39.4%)	11.52	5.51–24.05
<15 years	20	10 (50.0%)	17.72	7.15–43.89
≥15 years	13	3 (23.1%)	5.31	1.43–19.72
Obstructive uropathy				
No	1,384	86 (6.2%)		
Yes	38	2 (5.3%)	0.84	0.20–3.54
<15 years	5	1 (20.0%)	3.77	0.42–34.13
≥15 years	33	1 (3.0%)	0.47	0.06–3.49

* MCL = midclavicular line; PE = physical examination; MSL = midsternal line.

The overall estimated prevalence of *S. haematobium* was 5.2 ± 0.5% (±SE). This varied considerably by village and ezba, ranging from 1.5% to 20.9%, with ezbas having a slightly higher overall prevalence than villages (Figure 1). The overall estimated geometric mean egg count (GMEC) was 6.6 ± 0.5 eggs per 10 ml of urine and was consistently low throughout the communities.

The collective estimated age- and sex-specific distribution of *S. haematobium* infection (Figure 2) shows a classical pattern of increasing prevalence with age, with males having a distinctly higher prevalence than females, and the peak prevalence in the adolescent age groups.

Infection with *S. haematobium* was associated with males, children playing in the canals, a history of blood in the urine, and reagent strip positivity for hematuria and proteinuria (Table 2). These associations were generally stronger in those less than 15 years old.

The prevalence of either hepatomegaly or splenomegaly detected by physical examination was low (4.0% and 1.5%, respectively). The prevalence of hepatomegaly determined by ultrasonography was substantially higher (24.1%). Ultrasonography-determined splenomegaly was only slightly higher (6.6%). The prevalence of periportal fibrosis (PPF) was 12.0%, but the prevalence of grade II or III PPF was less than 1%. The prevalence of all three ultrasonography-determined measures were modified by age as shown in Figure 3. Ultrasonography-determined hepatomegaly, both in the midclavicular line and the midsternal line, increased to more than 30% in adults. Ultrasonography-determined splenomegaly had a much lower prevalence and no consistent trend with age, but PPF seems to be higher in the same age groups having the highest *S. haematobium* infection rates. At the village and ezba level of analysis, the prevalence of hepatomegaly, splenomegaly, and PPF tended to be

TABLE 3

Odds ratio and confidence limits for risk factors for urinary tract morbidity (obstructive uropathy and/or bladder wall lesion) with *Schistosoma haematobium* in Assiut Governorate*

Risk factor	Total in group	Morbidity No. (%)	Odds ratio	Confidence limits
Demographics				
Age groups (years)				
0–10	604	19 (3.1%)		
11–20	436	29 (6.7%)	2.19	1.21–3.97
21–35	307	11 (3.6%)	1.14	0.54–2.44
36–55	290	19 (6.6%)	2.16	1.12–4.14
>55	149	14 (9.4%)	3.19	1.56–6.53
Gender				
Female	975	15 (1.5%)		
Male	811	77 (9.5%)	6.71	3.83–11.77
Domicile				
Village (≥500 houses)	710	30 (4.2%)		
Ezba (<500 houses)	1,076	62 (5.8%)	1.39	0.89–2.17
Exposure to canal water				
Bathing (males)				
No	435	38 (8.7%)		
Yes	212	30 (14.2%)	1.72	1.03–2.87
Washing (females)				
No	728	13 (1.8%)		
Yes	92	1 (1.1%)	0.60	0.07–4.67
Playing (children <15 years old)				
No	442	18 (4.1%)		
Yes	108	11 (10.2%)	2.67	1.22–5.84
Parasitologic findings				
S. haematobium infection				
No	1,330	52 (3.9%)		
Yes	87	14 (16.1%)	4.71	2.50–8.90
<20 ova/10 ml of urine	63	10 (15.9%)	4.64	2.23–9.63
≥20 ova/10 ml of urine	24	4 (16.7%)	4.92	1.62–14.90
Clinical findings				
History of schistosomiasis				
No	1,045	42 (4.0%)		
Yes	315	34 (10.8%)	2.89	1.80–4.63
Prior treatment of schistosomiasis				
No	1,115	44 (3.9%)		
Yes	305	35 (11.5%)	3.16	1.98–5.02
History of burning micturition				
No	1,183	38 (3.2%)		
Yes (total)	509	46 (9.0%)	2.99	1.92–4.66
<15 years	120	15 (12.5%)	4.30	2.29–8.08
≥15 years	389	31 (8.0%)	2.61	1.60–4.25
History of blood in urine				
No	1469	54 (3.7%)		
Yes	218	30 (13.8%)	4.18	2.61–6.70
<15 years	90	15 (16.7%)	5.24	2.83–9.72
≥15 years	128	15 (11.7%)	3.48	1.90–6.36
Hepatomegaly in MCL (by PE)				
No	1,498	75 (5.0%)		
Yes	181	9 (5.0%)	0.99	0.49–2.02
<15 years	54	3 (5.6%)	1.12	0.34–3.66
≥15 years	127	6 (4.7%)	0.94	0.40–2.21
Splenomegaly (by PE)				
No	1,668	82 (4.9%)		
Yes	23	2 (8.7%)	1.84	0.42–7.99
<15 years	5	0 (0.0%)		
≥15 years	18	2 (11.1%)	2.42	0.55–10.69

TABLE 3
Continued

Risk factor	Total in group	Morbidity No. (%)	Odds ratio	Confidence limits
Laboratory findings				
Hematuria				
No	1,186	43 (3.6%)		
Yes	232	23 (9.9%)	2.93	1.73–4.96
<15 years	82	8 (9.8%)	2.87	1.30–6.33
≥15 years	150	15 (10.0%)	2.95	1.60–5.46
Proteinuria				
No	1,318	51 (3.9%)		
Yes	100	15 (15.0%)	4.38	2.37–8.12
<15 years	42	6 (14.3%)	4.14	1.67–10.27
≥15 years	58	9 (15.5%)	4.56	2.13–9.80
Ultrasonography				
Hepatomegaly in MCL				
No	1,200	60 (5.0%)		
Yes	470	24 (5.0%)	1.00	0.62–1.63
<15 years	199	11 (5.5%)	1.11	0.57–2.15
≥15 years	279	13 (4.7%)	0.93	0.50–1.72
Hepatomegaly in MSL				
No	1,341	74 (5.5%)		
Yes	339	10 (2.9%)	0.52	0.27–1.02
<15 years	60	3 (5.0%)	0.90	0.28–2.95
≥15 years	279	7 (2.5%)	0.44	0.20–0.97
Splenomegaly				
No	1,662	78 (4.7%)		
Yes	114	14 (12.3%)	2.84	1.55–5.20
<15 years	30	3 (10.0%)	2.26	0.67–7.60
≥15 years	84	11 (13.1%)	3.06	1.56–6.00
Periportal fibrosis				
No	1,569	71 (4.5%)		
Yes (≥3 mm)	215	21 (9.8%)	2.28	1.37–3.00
<15 years	67	10 (14.9%)	3.70	1.81–7.55
≥15 years	148	11 (7.4%)	1.69	0.88–3.27
Grade I (3–<5 mm)	211	21 (10.0%)	2.33	1.40–3.88
Grade II (5–<7 mm)	0			
Grade III (≥7 mm)	4	0 (0.0%)		

* MCL = midclavicular line; PE = physical examination; MSL = midsternal line.

higher when infection was higher, but it was statistically significant only for hepatomegaly.

Although bladder wall lesions were infrequent, 2.4% (33 cases), bladder wall lesions had the strongest association (OR = 11.8, 95% CI = 5.3–26.2) with infection (Table 2). Other associations of exposure factors, infection, and morbidity of smaller magnitude are also summarized in Table 2.

Table 3 shows patterns of urinary tract morbidity (obstructive uropathy and or bladder wall lesions) and the same factors that were tested and shown in Table 2. The most strongly associated factors were male sex, history of blood in the urine, history of burning micturition, and current proteinuria.

The overall prevalence of *S. mansoni* infection was 0.4 ± 0.2 % (389 persons), ranging from 0.38% to 2.2% among the villages and ezbas sampled. The overall GMEC per gram of stool was 48.9 ± 7.5.

DISCUSSION

The overall estimated prevalence and intensity of of *S. haematobium* infection in Assiut was low. However, there was significant variation in prevalence of *S. haematobium* between the villages and ezbas, ranging from 1.5% to 20.9%. The prevalences in some ezbas were strikingly higher than their ''mother'' village. There were no specific factors identified that could explain why some of they ezbas had such higher prevalences. This remains to be further investigated with the data available.

Kessler and others[14] and Webbe and El Hak[15] have documented trends in Assiut of *S. haematobium* infection, using Ministry of Health surveillance data, as an evaluation of the Upper Egypt National Schistosomiasis Control Program. In both reports, Assiut is divided into Assiut North and Assiut South. In the 10% household survey reports (the most appropriate data for comparison), by 1988 in Assiut South, the prevalence of *S. haematobium* was 9.6%. The GMEC of *S. haematobium* ova in 10-ml urine specimens was 30.9 in positive school children from Assiut North and in 29.1 in those from Assiut South. Our EPI 1, 2, 3 results based on sampling estimates that include villages and ezbas suggest that *S. haematobium* prevalence and intensity of infection has continued to decrease since the 1988 reference period.

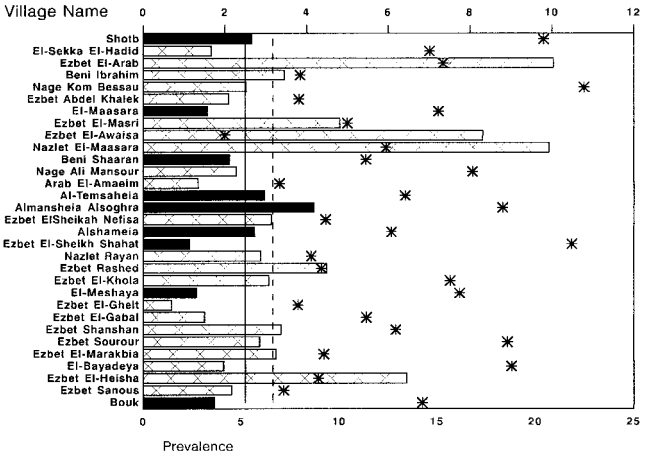

FIGURE 1. Prevalence (%) (**bars**) and intensity (**asterisks**) of *Schistosoma mansoni* infection in Assiut Governorate. Solid horizontal bars show prevalences in villages, hatched horizontal bars show prevalences in ezbas, the solid vertical line is the mean prevalence for all communities, the broken vertical line is the mean intensity of infection, and the asterisks are the geometric mean egg counts/10 ml of urine for each community.

Measurement of morbidity detected by ultrasonography also shows a low level, regardless of the specific measurement. Bladder lesions and liver PPF, which can be determined only by ultrasonography, were very infrequent. Grade III PPF was not found. Obstructive uropathy was also rare.

Medhat and others[9] in 1993 were the first to identify a focus of *S. mansoni* infection in a village in Assiut. Our report confirms that *S. mansoni* is now likely to be established in more than 1 village or ezba in the Assiut governorate, but the occurrence appears to be very sporadic and no communities had a high prevalence. This pattern is different from the Minya EPI 1, 2, 3 study[19] or the Qena EPI 1, 2, 3 investigation,[20] in which at least 1 community in each governorate had a much higher prevalence of *S. mansoni* infection than the other sampled communities. Applying the prevalence of *S. mansoni* infection estimated by this study to the Assiut rural population in the 1986 census would estimate that there are 6,714 persons infected with *S. mansoni* in Assiut. Because the rural population has grown since 1986, and due to the sensitivity limitations of the Kato technique, especially for detecting light infections, the actual number of persons infected with *S. mansoni* in Assiut is most likely higher. This suggests there is a significant human reservoir of *S. mansoni* ova in Assiut that could lead to an increase in transmission of *S. mansoni* and a more established endemicity of this species.

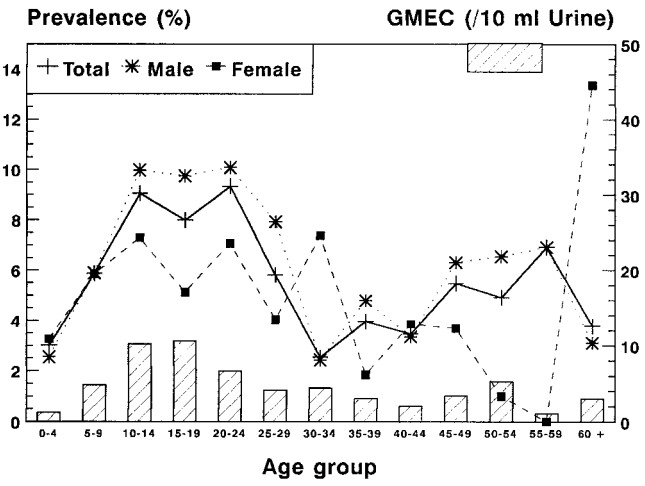

FIGURE 2. Age- and sex-adjusted prevalence (**lines**) and intensity of infection (**bars**) of *Schistosoma haematobium* in Assiut Governorate. GMEC = geometric mean egg count.

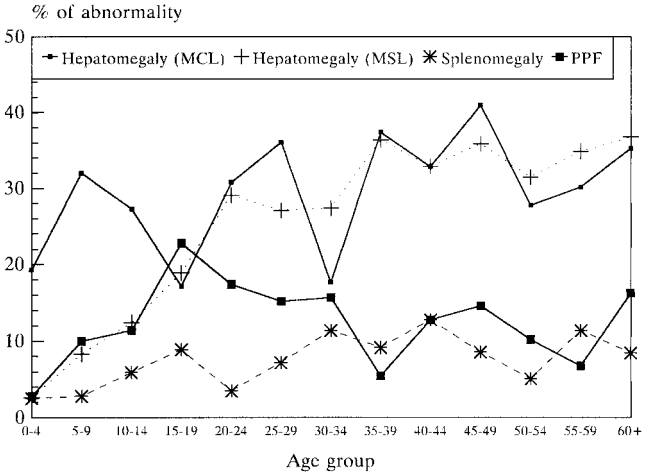

FIGURE 3. Hepatomegaly, splenomegaly, and periportal fibrosis (PPF) detected by ultrasonography in relation to age in Assiut Governorate. MCL = midclavicular line; MSL = midsternal line.

The Assiut EPI 1, 2, 3 results further document and establish important benchmarks for the continued evaluation of control activities and other natural changes of schistosomiasis patterns in this governorate. The identification of *S. mansoni* infections warrant rapid intervention and justify investigation of factors that may give insight into why *S. mansoni* is being established and what other communities may be affected. More importantly, the results infer that there is a large population of *S. mansoni* infection in Assiut.

Acknowledgments: We thank the members of the Assuit EPI 1, 2, 3 field teams who worked so diligently to collect the data upon which this report is based.

Financial support: This research was supported by the Egyptian Ministry of Health/United States Agency for International Development-funded Schistosomiasis Research Project, 263-0140.2, grants no. 02-04-18 and 10-04-83.

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