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The Epidemiology of *Schistosoma haematobium* and *S. mansoni* Infections in the Egypt-49 Project Area

3. Prevalence of Bilharziasis in Relation to Certain Environmental Factors

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The influence of the size and location of communities in relation to the different types of watercourse, the availability of a protected water supply, types of housing and the presence of other sanitary facilities on the prevalence of bilharziasis in the Egypt-49 project area has been studied. There is no direct relationship between the size of village and the prevalence of bilharziasis. Main drains and distributaries are potent sources of infection and, in terms of the total population exposed, distributaries play the most significant role in the transmission of infection. Of the other factors, the availability of a protected water supply seems to have the greatest effect on the prevalence. Although the presence of a latrine in the dwelling does not of itself influence the extent of schistosome infection, which is caught from polluted water, the installation of latrines assists in the cultivation of healthy habits, thereby lessening the prevalence not only of bilharziasis but also of certain other infections.

Certain insanitary personal habits and faulty environmental conditions are responsible for the maintenance of bilharziasis. The relationship of the prevalence of infection to specific personal attributes of the population in the project area was discussed in Part 2 of this series,[4] and in the present paper the prevalence of *Schistosoma haematobium* and *S. mansoni* infections in relation to certain environmental factors is discussed.

During the prevalence survey in 1962-63, information was recorded on an Individual Record Form about the following environmental conditions for a representative sample of 11 944 individuals in the project area[5]—

Size of community or village
Location of village in relation to type of watercourse
Source of water supply
Type of housing
Presence or absence of stables (cowsheds)
Presence and use of latrines.

Reference was made in Part 2[4] to the better housing and sanitary facilities in the Urban and Reclamation Divisions. Living conditions in the Rural and Control Divisions do not differ markedly from those observed in other parts of rural Egypt both recently (Nagaty & Rifaat, 1959; Zaghloul, 1963; Sherif[6]) and about a generation ago (Headlee, 1933). Headlee, under the auspices of the Egyptian Government and the International Health Division of the Rockefeller Foundation, made an intensive epidemiological survey, including detailed observations on living conditions, defaecation habits and soil pollution, in a village near Cairo. Later observations (Scott, 1939; Chandler, 1954) indicated that similar conditions exist in other villages in the southern part of the Delta. We have observed that they also exist in the rural parts of the Egypt-49 project area in the northern part of the Delta,

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[5] See the paper on page 281 of this issue.

[6] Sherif, A. F. (1964) *Second annual report on the Iflaka bilharziasis project*, mimeographed document issued by the Department of Parasitology, High Institute of Public Health, University of Alexandria, Egypt, United Arab Republic.

confirming the homogeneity of living standards and habits of the rural population throughout the Nile Delta. In spite of the progress made in recent years in the provision of a rural water supply and the expansion of educational and medical facilities, age-long habits dictated by religious and cultural prejudices appear to die hard. Coupled with low living standards and ignorance, these habits will considerably delay the impact of education on the prevailing standards of personal hygiene and environmental sanitation.

SIZE OF COMMUNITY OR VILLAGE

The prevalence rates of *S. haematobium* and *S. mansoni* infections, mixed infections and " bilharziasis " (either infection) in villages of different sizes in the Rural, Urban and Control Divisions are summarized in Table 1. The Reclamation Division has been excluded from this study because of the special pattern of housing in this division.

In the Rural Division the over-all prevalence rate of bilharziasis was 35.9%; the rate was somewhat

TABLE 1

PREVALENCE OF BILHARZIASIS BY SIZE OF VILLAGE IN THREE PROJECT DIVISIONS

Infection	Number of inhabitants in village							Total examined and average prevalence
	1-99	100-199	200-499	500-999	1 000-1 999	2 000-3 999	4 000 or more	
				Rural Division				
No. of villages	4	10	8	10	5	2		39
No. of persons examined	75	307	579	1 27	1 198	786		4 222
Percentage with								
S. haematobium infection	28.0	27.4	30.2	29.1	21.0	33.1		27.6
S. mansoni infection	28.0	31.6	30.9	28.7	13.0	12.2		21.7
Mixed infection	21.3	19.5	16.4	17.1	8.0	9.8		13.3
" Bilharziasis "	34.7	39.4	44.7	40.7	26.0	35.5		35.9
				Urban Division				
No. of villages				1	1	3	3	8
No. of persons examined				157	254	1 055	2 128	3 594
Percentage with								
S. haematobium infection				19.1	34.3	8.9	11.6	12.7
S. mansoni infection				15.3	56.3	7.7	11.8	13.9
Mixed infection				7.0	24.8	2.8	4.7	5.7
" Bilharziasis "				27.4	65.7	13.7	18.7	21.0
				Control Division				
No. of villages			6	5	2	2		15
No. of persons examined			365	789	540	603		2 297
Percentage with								
S. haematobium infection			43.8	43.5	37.0	34.5		39.7
S. mansoni infection			48.2	49.3	32.4	50.9		45.6
Mixed infection			27.9	29.8	19.1	25.2		25.8
" Bilharziasis "			64.1	63.0	50.4	60.2		59.5

lower in the smallest and in the two largest size-groups and higher in the intermediate groups. In respect of infection with *S. haematobium* and *S. mansoni* separately, the pattern is irregular and no relationship between size of village and prevalence rates can be established.

In the Urban Division also, no clear relationship is apparent between size of village and infection rates. The two villages in the lower size-groups contain a predominantly agricultural population, whereas the six units with larger populations are parts of Kafr el Dawar town, a semi-urban area. This fact alone would account for the significantly lower rates recorded.

In the Control Division the over-all prevalence rate was highest (64.1%) in the smallest villages, lowest (50.4%) in villages of intermediate size (1000-1999 inhabitants) and a little above the over-all average (60.2%) in the largest villages. The differences between the relatively low prevalence in the villages of intermediate size and the rates in the other three size-groups are statistically significant, the differences bearing no apparent relation to the size of the village. While *S. mansoni* infections generally conform to this pattern, *S. haematobium* infections exhibit a different one.

It is thus clear that there is no definite relation between the prevalence rate of bilharziasis and the size of village *per se*. The variations noted in the different divisions should therefore be regarded as governed by other variables.

LOCATION OF VILLAGES IN RELATION TO TYPE OF WATERCOURSE

The 100 villages surveyed in the four project divisions were classified according to their location in relation to a type of watercourse in the following nine categories—

- principal canal (Mahmoudia)
- main canal
- branch canal
- distributary and/or field channel
- main drain
- collector, lateral and/or sublateral drain
- more than one type of canal, but no drain
- both canal of any type and drain of any type
- not classifiable as above.

Data on prevalence rates show that communities on main drains were more exposed to the risk of acquiring *S. haematobium* infection than were other communities; distributaries and field channels came next in importance, although it was unusual for a village to be located on a field channel alone. In respect of *S. mansoni* infections, distributaries were shown to play a more significant role than main drains. In terms of population exposed, distributaries constituted the most potent transmission sites. The principal canal (Mahmoudia canal), although playing a significant role in the transmission of *S. haematobium*, is relatively unimportant in respect of *S. mansoni* infection (Farooq, 1966).

SOURCE OF WATER SUPPLY

Villages in the Rural and Control Divisions have been increasingly served since 1959 with a protected water supply, as a result of the installation of public water standpipes at one or two strategic points on the outskirts. Four taps fixed to a vertical concrete slab provide a continuous supply of filtered and chlorinated water, approximately 16 litres per head, as determined by observation in villages in the project area.[1] This serves only to meet basic domestic needs and makes the use of unprotected irrigation waters inevitable for other purposes, particularly washing, bathing, swimming and ritual ablution.

The data in Table 2 show that 87.6% of the population have access to the piped water supply, although this does not exclude the possibility of their also utilizing irrigation waters. However, those indicated as using canal water (10.5%) are individuals who exclusively use water from that source, not having access to piped water. The proportion of such individuals is lower in the Urban (0.7%) and Reclamation (11.3%) Divisions than in the Rural (16.7%) and Control (13.5%) Divisions.

Table 3 shows the prevalence of bilharziasis in each of the four divisions in relation to the two principal sources of water. It is evident that even the partial use of protected water markedly lowers the rates of infection; this trend is discernible in all four divisions of the project area. The data further indicate that the impact of a protected water supply is generally greater on *S. mansoni* infection than on *S. haematobium* infection.

TYPE OF HOUSING

The survey form contained an entry in respect of the type of house-building material used, namely—

[1] Average consumption of three earthen jars of 6 UK gal (27.3 litres) capacity for a family of five.

TABLE 2

DISTRIBUTION OF EXAMINED POPULATION BY SOURCE OF WATER SUPPLY

Water supply	Number of people					Percentage distribution				
	Project area	Division				Project area	Division			
		Rural	Urban	Recla-mation	Control		Rural	Urban	Recla-mation	Control
Canal	1 248	705	26	206	311	10.5	16.7	0.7	11.3	13.5
Piped water	10 466	3 375	3 554	1 599	1 938	87.6	79.9	98.9	87.3	84.4
Other	70	65	5	0	0	0.6	1.5	0.1	0	0
Not stated	160	77	9	26	48	1.3	1.8	0.3	1.4	2.1
Total	11 944	4 222	3 594	1 831	2 297	100.0	100.0	100.0	100.0	100.0

TABLE 3

DEPENDENCE OF PREVALENCE RATES OF BILHARZIASIS ON SOURCE OF WATER SUPPLY

Source of water supply	No. examined	Percentage with			
		S. haematobium infection	*S. mansoni* infection	Mixed infection	" Bilharziasis "
Project area					
Canal	1 248	34.4	40.7	22.0	53.0
Piped water	10 466	24.9	20.7	11.6	34.0
Total [a]	11 944	25.7	22.8	12.6	35.9
Rural Division					
Canal	705	31.8	36.0	21.0	46.8
Piped water	3 375	27.4	18.8	12.0	34.2
Total [a]	4 222	27.6	21.7	13.3	35.9
Urban Division					
Canal	26	19.2	15.4	11.5	23.1
Piped water	3 554	12.7	13.8	5.6	20.8
Total [a]	3 594	12.7	13.9	5.7	21.0
Reclamation Division					
Canal	206	30.1	33.5	17.0	46.6
Piped water	1 599	29.7	11.9	7.1	34.5
Total [a]	1 831	29.7	14.3	8.1	35.9
Control Division					
Canal	311	44.4	58.2	28.6	73.9
Piped water	1 938	39.1	43.7	25.4	57.4
Total [a]	2 297	39.7	45.6	25.8	59.5

[a] Persons with " other " or " not stated " sources are included in the totals.

TABLE 4
DISTRIBUTION OF EXAMINED POPULATION BY TYPE OF HOUSING

Type of housing	Number of people					Percentage distribution				
	Project area	Division				Project area	Division			
		Rural	Urban	Recla-mation	Control		Rural	Urban	Recla-mation	Control
Stone or redbrick	6 988	1 185	3 430	1 529	844	58.5	28.1	95.4	83.5	36.7
Mudbrick or mud	4 811	2 975	155	271	1 410	40.3	70.5	4.3	14.8	61.4
Other	7	0	2	5	0	0.1	0	0.1	0.3	0
Not stated	138	62	7	26	43	1.2	1.5	0.2	1.4	1.9
Total	11 944	4 222	3 594	1 831	2 297	100.0	100.0	100.0	100.0	100.0

stone, redbrick (baked by fire), mudbrick (sun-baked) or mud. Although the type of housing has no direct bearing on the prevalence of bilharziasis, it serves to indicate the socio-economic status of the occupants.

The distribution of the individuals examined according to the kind of house is given in Table 4. Mudbrick or mud houses predominate in the Rural and Control Divisions (70.5% and 61.4%, respectively), whereas stone and redbrick houses are most common in the Urban and Reclamation Divisions (95.4% and 83.5%, respectively).

Table 5 gives the prevalence rates of infection by type of housing. Because of the small numbers, rates have not been computed for persons living in houses classed under " other " or " not stated ". It is seen that the prevalence rates are considerably higher for persons living in houses constructed of mudbrick or mud. This is true for both *S. haematobium* and *S. mansoni* infections and for all the four divisions of the project area.

An analysis has been made of the interaction of occupation and type of housing on the prevalence rates, by splitting up the examined population into two occupational groups—agricultural and other; these rates are given in Table 6. Persons living in mudbrick or mud houses have higher over-all infection rates than those living in stone or redbrick houses for both these occupational groups. This relationship between housing and prevalence rate is evident for both species of schistosome. Analysis of these rates by division shows that for non-agricultural workers there are significantly higher infection rates among persons living in houses of mudbrick or mud, in each division and for both forms of infection. For farmers and farm labourers this relationship holds only in the Control and Reclamation Divisions.

We believe that the type of house is an easily determined index of the social and economic standard of the population. The fact that it has a significant influence on the levels of endemicity confirms that bilharziasis is " a public health problem with marked social and economic overtones " (Farooq, 1964).

PRESENCE OR ABSENCE OF COWSHED

Another entry under " environmental conditions " on the survey form called for information on the presence or absence of an adjoining or separate stable (cowshed) for cattle. Households with cowsheds belong predominantly to those whose occupation is farming; the better-off farmers naturally are more likely to have a separate cowshed. Thus the present analysis should be viewed from the occupational and socio-economic angle rather than as a determinant of bilharziasis *per se*.

Table 7 shows the distribution of households with and without cowsheds, for the project area as a whole and by division.

The relevant prevalence rates of bilharziasis are similarly tabulated in Table 8, which shows clearly that prevalence rates are higher if a cowshed is present and highest where it is not separated from the living quarters. The influence of occupation and economic status in determining this pattern is evident.

TABLE 5
DEPENDENCE OF PREVALENCE RATES OF BILHARZIASIS ON TYPE OF HOUSING

Type of housing	No. examined	Percentage with			
		S. haematobium infection	*S. mansoni* infection	Mixed infection	" Bilharziasis "
Project area					
Stone or redbrick	6 988	21.1	16.5	8.8	28.8
Mudbrick or mud	4 811	32.7	31.9	18.2	46.4
Total [a]	11 944	25.8	22.8	12.6	35.9
Rural Division					
Stone or redbrick	1 185	26.0	16.5	12.0	30.5
Mudbrick or mud	2 975	28.5	23.9	14.0	38.5
Total [a]	4 222	27.6	21.7	13.3	35.9
Urban Division					
Stone or redbrick	3 430	11.9	12.5	5.0	19.4
Mudbrick or mud	155	31.6	40.6	20.0	52.3
Total [a]	3 594	12.7	13.9	5.7	21.0
Reclamation Division					
Stone or redbrick	1 529	28.9	11.8	7.3	33.4
Mudbrick or mud	271	34.7	29.2	13.7	50.2
Total [a]	1 831	29.7	14.3	8.1	35.9
Control Division					
Stone or redbrick	844	37.1	41.4	22.6	55.8
Mudbrick or mud	1 410	41.3	48.2	27.7	61.8
Total [a]	2 297	39.7	45.6	25.8	59.5

[a] Persons with " other " or " not stated " type of housing are included in the totals.

PRESENCE AND USE OF LATRINES

Latrines are invariably of the pit type in the Rural and Control Divisions and predominantly of the water-flush type in the Urban Division and in the newly built villages in the Reclamation Division. The distribution of the examined population in relation to the presence and use of these latrines is shown in Table 9. In the project area, 62.3% of the total population examined lived in houses with a latrine; the proportion was as high as 97.6% in the Urban Division and 83.2% in the Reclamation Division, whereas in the Rural and Control Divisions it was only 36%. Even when the latrines are present, some members of the household, especially younger children, do not use them.

Rates of bilharziasis in relation to the presence and use of latrines, presented in Table 10, indicate that the infection rates are higher for persons without access to a latrine. Surprisingly, persons living in households with a latrine but not using it have very low infection rates; this apparent anomaly is at least partly explicable on the grounds that non-users are primarily very young children, in whom the rates of bilharziasis are low anyway. Moreover, other social factors have an influence. To elucidate the picture, the data have been analysed by the type of house, as a measure of socio-economic status, and

TABLE 6

DEPENDENCE OF PREVALENCE OF BILHARZIASIS ON TYPE OF HOUSING AND OCCUPATION

Occupation, infection, and type of housing	Rate of infection (%) in				
	Project area	Rural Division	Urban Division	Reclamation Division	Control Division
Farmer and farm labourer					
S. haematobium					
Stone or redbrick	33.8	37.4	32.2	29.9	41.5
Mudbrick or mud	36.1	31.6	36.5	36.6	44.7
Total	35.0	32.4	33.8	30.8	43.7
S. mansoni					
Stone or redbrick	24.3	26.3	56.2	12.1	47.4
Mudbrick or mud	36.0	28.2	50.0	27.2	52.1
Total	31.0	27.8	53.8	14.1	50.5
Mixed infection					
Stone or redbrick	14.2	18.9	23.1	7.2	26.9
Mudbrick or mud	21.0	16.6	25.7	14.7	30.6
Total	18.1	16.9	24.1	8.2	29.4
" Bilharziasis "					
Stone or redbrick	43.9	44.7	65.3	34.8	62.1
Mudbrick or mud	51.1	43.2	60.8	49.1	66.1
Total	47.9	43.3	63.6	36.8	64.8
Other occupations					
S. haematobium					
Stone or redbrick	14.6	20.3	11.2	21.8	30.5
Mudbrick or mud	25.2	22.4	27.2	25.5	32.2
Total	17.2	21.2	11.5	22.5	31.4
S. mansoni					
Stone or redbrick	12.6	11.7	10.9	9.8	32.2
Mudbrick or mud	22.6	15.2	32.1	38.3	37.7
Total	15.2	13.6	11.6	15.4	35.5
Mixed infection					
Stone or redbrick	6.1	8.5	4.4	7.8	16.3
Mudbrick or mud	11.9	8.7	14.8	8.5	19.8
Total	7.6	8.6	4.6	7.9	18.4
" Bilharziasis "					
Stone or redbrick	21.1	23.4	17.7	23.8	46.4
Mudbrick or mud	36.0	28.8	44.4	55.3	50.1
Total	24.8	26.1	18.5	30.0	48.6

TABLE 7. DISTRIBUTION OF EXAMINED POPULATION IN RELATION TO PRESENCE OF COWSHED IN OR BY DWELLING

Availability of cowshed	Number of people					Percentage distribution				
	Project area	Division				Project area	Division			
		Rural	Urban	Recla-mation	Control		Rural	Urban	Recla-mation	Control
Present, separate	1 714	225	6	1 323	160	14.4	5.3	0.2	72.3	7.0
Present, not separate	3 935	2 276	139	284	1 236	32.9	53.9	3.9	15.5	53.8
Not present	6 134	1 648	3 435	198	853	51.4	39.0	95.6	10.8	37.1
Not stated	161	73	14	26	48	1.3	1.7	0.4	1.4	2.1
Total	11 944	4 222	3 594	1 831	2 297	100.0	100.0	100.0	100.0	100.0

TABLE 8. DEPENDENCE OF PREVALENCE RATES OF BILHARZIASIS ON PRESENCE OF COWSHED

Availability of cowshed	No. examined	Percentage with			
		S. haematobium infection	*S. mansoni* infection	Mixed infection	" Bilhar-ziasis "
Project area					
Present, separate	1 714	31.2	16.9	9.7	38.4
Present, not separate	3 935	36.1	35.4	21.1	50.4
Not present	6 134	17.7	16.4	8.0	26.0
Total [a]	11 944	25.8	22.8	12.6	35.9
Rural Division					
Present, separate	225	28.4	15.6	10.2	33.8
Present, not separate	2 276	31.9	27.8	17.0	42.7
Not present	1 648	22.0	14.4	8.9	27.5
Total [a]	4 222	27.6	21.7	13.3	35.9
Urban Division					
Present, separate	6	50.0	66.7	50.0	66.7
Present, not separate	139	38.8	56.1	28.1	66.9
Not present	3 435	11.7	12.0	4.7	19.0
Total [a]	3 594	12.7	13.9	5.7	21.0
Reclamation Division					
Present, separate	1 323	30.7	11.6	7.3	35.0
Present, not separate	284	31.0	24.6	12.7	43.0
Not present	198	21.7	17.7	7.6	31.8
Total [a]	1 831	29.7	14.3	8.1	35.9
Control Division					
Present, separate	160	38.8	60.6	27.5	71.9
Present, not separate	1 236	44.8	49.6	29.9	64.6
Not present	853	32.8	37.3	19.8	50.3
Total [a]	2 297	39.7	45.6	25.8	59.5

[a] Persons who did not reply to this question are included in the totals.

TABLE 9. DISTRIBUTION OF EXAMINED PERSONS BY AVAILABILITY OF LATRINE IN DWELLING

Availability of latrine	Number of people					Percentage distribution				
	Project area	Division				Project area	Division			
		Rural	Urban	Recla-mation	Control		Rural	Urban	Recla-mation	Control
Present and used	6 220	1 297	2 965	1 261	697	52.1	30.7	82.5	68.9	30.3
Present, not used	1 215	283	542	262	128	10.2	6.7	15.1	14.3	5.6
Not present	4 351	2 570	75	282	1 424	36.4	60.9	2.1	15.4	62.0
Not stated	158	72	12	26	48	1.3	1.7	0.3	1.4	2.1
Total	11 944	4 222	3 594	1 831	2 297	100.0	100.0	100.0	100.0	100.0

TABLE 10. DEPENDENCE OF PREVALENCE RATES OF BILHARZIASIS ON AVAILABILITY AND USE OF LATRINE IN DWELLING

Availability and use of latrine	No. examined	Percentage with			
		S. haematobium infection	*S. mansoni* infection	Mixed infection	" Bilharziasis "
Project area					
Present and used	6 220	23.6	18.4	9.5	32.5
Present, not used	1 215	8.1	5.5	2.9	10.8
Not present	4 351	34.0	33.9	19.9	47.9
Total [a]	11 944	25.8	22.8	12.6	35.9
Rural Division					
Present and used	1 297	27.9	16.3	10.5	33.7
Present, not used	283	8.5	4.2	2.8	9.9
Not present	2 570	29.8	26.5	16.1	40.3
Total [a]	4 222	27.6	21.7	13.3	35.9
Urban Division					
Present and used	2 965	13.6	15.1	6.1	22.6
Present, not used	542	5.2	2.4	0.9	6.6
Not present	75	33.3	45.3	24.0	54.7
Total [a]	3 594	12.7	13.9	5.7	21.0
Reclamation Division					
Present and used	1 261	33.8	13.2	8.2	38.9
Present, not used	262	7.6	4.2	3.1	8.8
Not present	282	32.3	28.7	13.1	47.9
Total [a]	1 831	29.7	14.3	8.1	35.9
Control Division					
Present and used	697	39.2	45.8	24.2	60.7
Present, not used	128	21.1	24.2	10.9	34.4
Not present	1 424	41.9	47.6	28.0	61.4
Total [a]	2 297	39.7	45.6	25.8	59.5

[a] Persons not providing information on latrines are included in the totals.

TABLE 11

PREVALENCE RATES OF *S. HAEMATOBIUM* AND *S. MANSONI* INFECTIONS BY AVAILABILITY OF LATRINE, TYPE OF HOUSING AND AGE

Availability and use of latrine	Prevalence of infection (%)								
	All ages			0-14 years old			15 years old and above		
	Stone or redbrick	Mudbrick or mud	Over-all	Stone or redbrick	Mudbrick or mud	Over-all	Stone or redbrick	Mudbrick or mud	Over-all
	S. haematobium								
Present and used	21.7	34.3	23.6	27.8	43.6	29.8	17.2	29.4	19.2
Present, not used	6.2	18.4	8.1	6.1	18.3	8.0	18.2	25.0	20.0
Not present	39.2	33.1	34.0	45.1	37.5	38.6	34.5	29.5	30.2
Total	21.1	32.7	25.8	23.0	36.8	28.2	19.0	29.4	23.5
	S. mansoni								
Present and used	16.4	29.9	18.4	16.1	32.0	18.1	16.6	28.9	18.6
Present, not used	4.7	10.0	5.5	4.4	10.2	5.3	27.3	0.0	20.0
Not present	36.4	33.5	33.9	34.5	31.3	31.7	37.8	35.2	35.6
Total	16.5	31.5	22.8	14.3	29.6	20.0	18.9	33.8	25.4

in two age-groups, children and adults, separately for *S. haematobium* and *S. mansoni* infections (Table 11).

As would be expected, latrines are more common in stone or redbrick houses than in mud or mudbrick houses. The distribution of persons living in these two types of house, by presence or absence of latrine, for the whole project area is shown in Table 12. Latrines are present in more than 90% of stone dwellings but in less than 24% of mud ones.

TABLE 12

DISTRIBUTION OF POPULATION ACCORDING TO TYPE OF HOUSE AND AVAILABILITY OF LATRINE

Availability of latrine	Percentage of population in stone or redbrick houses	Percentage of population in mudbrick or mud houses
Present and used	75.9	19.0
Present, not used	14.7	3.9
Not present	9.2	76.9
Not stated	0.2	0.2
No. of people examined	6 988	4 811

Although the data in Table 10 show that *S. haematobium* infection is considerably higher in persons without a latrine than in those with one, Table 11 shows that this is true only for persons living in stone or redbrick houses and that otherwise the presence or absence of a latrine has no significant effect on rates of infection, either in children or in adults. This applies also to *S. mansoni* infections.

This conclusion is difficult to explain. People living in better houses generally also have other advantages; they are better off financially, are engaged in occupations that do not expose them to constant risk of infection, and are better educated, characteristics that have previously been shown to influence infection rates.[1] As a result, better personal habits prevail among them and the noted differences in infection rates cannot therefore be attributed entirely to their use or non-use of latrines. On the other hand, the observed lack of differences among those from the inferior types of houses could be due to their more homogeneous standards and habits of life, irrespective of the availability of a latrine.

It is not reasonable to expect that the presence or absence of latrines could influence *S. haematobium* infection. Primarily this infection results from mic-

[1] See the paper on page 293 of this issue.

turition in waters by children, mostly while swimming. Adults rarely micturate directly in water and any infection that may come from this source would arise from their washing penile meatus (religious ablution), following urination on the bank of a watercourse.[1]

Faecal contamination of watercourses due to the lack of habitual use of latrines is understandable, especially when defaecation takes place along banks of canals, distributaries, field channels and drains and is followed by ablution in these waters, during all seasons of the year. During summer months (July-September) the banks of canals become sufficiently dry during low rotation to be used as defaecation sites and the faeces deposited are washed in during subsequent high rotation and are frequently trampled by animals or human beings, contaminating the water. During the months of October to February, sufficient rain falls in the project area (annual average, 1961-64, 193.9 mm) to flush faecal material on the banks of watercourses into the water.

A cross-analysis of several other variables is required before firm conclusions can be drawn, but it is evident that the irregular use of latrines by a few individuals living in highly endemic farming communities cannot diminish for them, or for others, the risk of infection with *S. haematobium* or *S. mansoni*. These infections are not necessarily acquired in the immediate vicinity of the villages. Snails have been shown to drift up to 5 km within a week in canals with an average water velocity of less than 50 cm per second[2] and cercariae can be carried another 1.5 km downstream without losing their ability to infect vertebrate hosts (Radke, Ritchie & Rowan, 1961).

These conclusions gain support from *ad hoc* studies on the pattern of the Rockefeller hookworm campaigns of the 1910-30 period in the southern USA, repeated to cover other helminthic infections, including *S. haematobium* and *S. mansoni*, in Egypt. Two such controlled experiments were conducted as joint projects of the Government of Egypt and the Foundation (Scott & Barlow, 1938; Weir and collaborators, 1952, evaluated by Chandler, 1954). The inescapable conclusion from the first experiment was that the construction of latrines produced no measurable effects on the extent of infections with *S. haematobium* and *S. mansoni*, and Chandler conceded that the evaluation of the effect on bilharziasis over the short period of two years in the latter experiment is not realistic, but expressed the view that

> " at first sight the installation of latrines might be expected to reduce these infections in the course of time. However, children, who in Egypt have a very high infection incidence, and shed more eggs than do adults, continue to bathe and swim in the canals in and near the villages and to pollute them while doing so. It is doubtful, therefore, whether the latrines would have much effect on schistosomiasis even after a long time."

It is our considered view that these observations should not detract from the value of suitable latrine-construction programmes in villages to inculcate the habit of safe defaecation, in the hope that this will become a regular habit; such programmes should therefore form part of the community environmental sanitation and educational programme, but not be specially directed against, nor debited to, bilharziasis control.

CONCLUSION

The ultimate goal in the control of filth-borne infections is to break the chain of transmission by bringing about a change in the environment and faulty habits of the people involved. Many such changes are needed in areas where these infections are endemic and resources are limited. Under the circumstances, available funds and energies should be channelled in activities yielding maximum benefits.

A survey of the nature reported here should therefore indicate priorities on the basis of which sound administrative policies and methodology for dealing with problems effectively and economically could be evolved as an integral part of over-all community development programmes. Among the environmental aspects of such developments, our data indicate that, apart from the over-all improved living standards, a generous supply of protected water, adequate for all domestic purposes, should receive a high order of priority. A more abundant piped water-supply distributed throughout the endemic areas will undoubtedly result in diminishing the incidence of bilharziasis and certain other infections.

[1] See the paper on page 377 of this issue.

[2] Dazo, B. C., Farooq, M. & Mallah, M. B., unpublished results.

RÉSUMÉ

Ce troisième article consacré à l'épidémiologie des infections à *Schistosoma haematobium* et à *S. mansoni* dans la région du projet de lutte contre la bilharziose en Egypte étudie l'effet de certains facteurs de milieu sur la prévalence de l'infection.

Si l'importance des collectivités semble sans influence, leur situation par rapport aux cours d'eau et le type de ces derniers modifient les taux d'infection. Les canaux principaux et surtout les canaux de distribution jouent un rôle important dans la transmission. Des installations de points d'eau suffisamment protégés doivent être faites en priorité dans les zones d'endémie.

Les taux d'infection sont considérablement plus élevés chez les personnes vivant dans des maisons en pisé ou en briques cuites au soleil que chez celles qui habitent dans des maisons en pierre ou en briques cuites au four. C'est parce qu'il est le reflet de la condition économique des individus que le type de maison intervient dans la prévalence de l'infection. Les taux de prévalence sont plus élevés lorsqu'il existe une étable et atteignent une valeur maximale lorsque cette étable n'est pas séparée des pièces d'habitation.

Il apparaît que le taux d'infection (*S. mansoni* et *S. haematobium*) est plus élevé chez les personnes vivant dans des habitations dépourvues de latrines mais, en réalité, d'autres facteurs sociaux interviennent et les différences s'atténuent dans le cas de maisons très sommaires. L'installation de latrines conserve néanmoins son importance et devrait faire partie de tout programme de promotion rurale. La fourniture abondante d'eau convenant aux besoins domestiques doit être considérée comme un objectif prioritaire.

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