Epidemiology of Schistosomiasis in the Western Region of Saudia Arabia (1) Prevalence, Intensity and Incidence in the Human Population in the Community

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The prevalence, intensity and incidence of schistosomiasis in the human population was investigated in 20 sites in the Hijaz highlands and in 10 sites in the Tihama lowlands. The prevalence rate of S. mansoni in a total of 3092 persons examined in the Hijaz highlands ranged between 0.5 and 22.6% with a mean of 5.98%: males having a greater prevalence than females. In the Hijaz highlands S. haematobium was not recorded. In the Tihama lowlands S. mansoni was recorded at one site with a prevalence of 0.53% and S. haematobium at two sites with a prevalence of 0.55% and 1.13%. A total of 1771 persons were examined in the Tihama. The prevalence of S. mansoni in males was maximal in the age group 11-15 years with a decline afterwards and another slight increase at 31 + years old. In females S. mansoni was low in prevalence at early life (1-20 years) and increased from 21 + years onwards. As to intensity of infection (eggs/g stool) 54.05%, 34.05% and 11.9% of the infected persons had light, moderate and heavy intensities. The mean incidence rate of S. mansoni in four sites was 2.94%. The implications of these epidemiological findings in relation to control are discussed.

Schistosomiasis is one of the most important endemic diseases in Saudi Arabia. Infections with urinary and intestinal schistosomiasis have been recorded in the human population in most parts of the country with patchy distribution and varying prevalence rates.1-7 Schistosoma mansoni infection occurs among inhabitants of the north and south-central regions and both S. mansoni and S. haematobium occur in the northwest, midwest, southwest and north central regions.7 Few studies have been conducted on the prevalence of schistosomiasis in humans in the western region of Saudi Arabia with no stress on intensity of...
infection, prevalence in relation to sex and age groups or incidence.\textsuperscript{8}

Saudi Arabia has active schistosomiasis control programmes (sponsored by the Ministry of Health) based on chemotherapy, snail control, sanitation and environmental control. The present study on the distribution of schistosomiasis in the human population in the western region of Saudi Arabia, its prevalence (in relation to sex and age groups), intensity and incidence could help to define areas requiring priority action for control. This study could also stress the relationship between intensity of infection and morbidity and evaluate the success of schistosomiasis control.

**Material and Methods**

The western region of Saudi Arabia is an extensive area extending from the Red Sea and including the Tihamah plateau lowlands and the Hijaz highlands: 20 sites in the Hijaz highlands and 10 sites in the Tihamah lowlands were studied.

**Sampling techniques**

To ensure the samples were representative of the population various points were followed. The prevalence of infection with schistosomiasis was estimated in different age groups (for both male and female): 1–5 years, 6–10, 11–15, 16–20, 21–30, 31–40 and 41+ years. Demographic data from the area of study were previously gathered by primary health care units and the age and sex structure of the population was known. Almost 60.0% were of the age 1–20 years, 17.0% of the age 21–30 years, 12.0% of the age 31–40 and 11.0% of the age 41+ years. The male : female ratio was 53 : 47. The sample population was almost similar to that of the population as a whole. The methodology of two-stage cluster sampling as described by Ansari\textsuperscript{3} was followed. In the Hijaz highlands and the Tihamah lowlands a total of 3092 (1590 males and 1502 females) and 1771 individuals (984 males and 787 females) respectively were examined. The endemic areas were demographically subdivided into different divisions so that age, sex, occupation and different transmission areas were fairly represented. A random sample (using random number lists) was then drawn of the villages in each area. Within each village thus selected (30 in all, 20 in the Hijaz highlands and 10 in the Tihamah lowlands) all households were assigned numbers and a sample of these households were taken again at random. In each randomly selected household all members of the age 1–5 years, and 21–41+ years were examined. Members of households attending schools (6–20 years) were examined in their schools since they were there during the time of the household examination.

This study was originally designed to compare the prevalence of schistosomiasis by standard parasitological egg detection techniques and by immunological techniques, which necessitated obtaining blood from the subjects in study. Young age groups (1–5 years) and females were sometimes reluctant to give blood in their households and were asked to attend clinics in the area where physicians and nurses helped to explain the need for this procedure and eventually managed to collect blood. The results of the immunological estimation of prevalence of schistosomiasis are to be presented by the authors in a separate publication.

**Statistical analysis**

The reliability of the samples was estimated by comparison of proportions using the $\chi^2$ test and of the means using Student's $t$-test.

**Specimen collection and examination**

Stool samples were collected in wide-labelled screw top bottles in the morning from the subjects studied. These were transported to the laboratory and examined the same day. Each stool sample was divided into two portions. A portion was examined by the saline sedimentation technique for protozoan and intestinal parasites.\textsuperscript{9} The second weighed portion (300 mg collected on a pre-weighed spoon) was examined by the digestion technique to determine the intensity of infection i.e. number of eggs/g stool.\textsuperscript{10} Duplicate aliquots from the same stool samples were examined and the mean was estimated. Multiple stool examination was conducted on 5% of the test population to confirm the reliability of the technique. Urine was collected between 0900 and 1400 hours corresponding to the peak time of egg passage in urine. The syringe filtration technique\textsuperscript{11} was used for quantitative and qualitative estimation of infection due to *S. haematobium*.

**Incidence studies**

Groups of school children of 6–10 years of age in the Hijaz highlands (204 in different sites), who were examined one year previously for schistosomiasis, as described above, and found negative were re-examined a year later. Children who were found to have become positive in the second survey were said to have become 'converted'. The annual number of children converting, expressed as a percentage of the total number of uninfected children who were at risk of infection represents the level of incidence.

**Results**

**Prevalence and distribution of schistosomiasis**

Figure 1 shows the overall prevalence and distribution of *S. mansoni* and *S. haematobium* in people examined in 20 sites in the Hijaz highlands and in 10 sites in the Tihamah lowlands from September 1987 to September 1988. The prevalence rate of *S. mansoni* (people of age group 1–41+ years, males and females) in the Hijaz highlands varied between 0.5% and 22.6% with a mean of 5.98% (in both sexes) for a total of 3092 people examined. Males had a higher prevalence (mean of 8.05%) than females (mean of 3.79%) and the difference was significant ($p<0.001$). *S. haematobium* was not recorded in any of the 20 sites in the Hijaz highlands. In the 10 sites examined in the Tihamah lowlands *S. mansoni* was recorded in only one site i.e. Bitat Al Zinad at a prevalence rate of 0.53%. *S. haematobium* was recorded in two sites in the Tihamah lowlands: Bitat Al Zinad (0.5%) and Ghumayagh (1.13%). In Al-Farash, Roumi and Beda, the prevalence of *S. mansoni* in females was 22.6%, 2.1% and 4.8% respectively and corresponding values for males (8.2%, 0.0% and 0.0%). The $\chi^2$ test revealed a significant difference.
The prevalence of *S. mansoni* infection in different age groups is shown in Table 1. The difference between the prevalence in different age groups was computed by the $\chi^2$ test for four degrees of freedom and was 9.85 ($p<0.05$).

### Intensity of infection

In the *S. mansoni* infected individuals 54.05% had a light infection (1–100 eggs/g stool), 34.05% had moderate infection (101–400 eggs/g stool) and 11.9% had a heavy infection (401+ eggs/g stool). The overall intensity of infection was higher in males than in females showing a significant difference ($p<0.001$): light infection occurred in 37.29% of males and in 16.75% of females with corresponding values of 24.86% and 9.19% for moderate infection and 7.03% and 4.88% for heavy infection. The mean egg count for all infected male individuals was more than that in infected females and differed significantly ($p<0.001$). The intensity of *S. haematobium* infection was light (75 eggs/10 ml of urine).

### Incidence of infection

Table 2 shows the results of incidence studies for *S. mansoni* in four sites in the Hijaz highlands. The conversion rates in Wadi Al Sadr, Al Mashneya and Garanta respectively were 5.7%, 2.5% and 1.51%. However, none of the negative individuals re-examined in Al Beydani converted. The overall incidence rate for 204 children was 2.9%.

### Discussion

The present study shows a marked contrast in prevalence of schistosomiasis in the Hijaz highlands and the Tihamah lowlands in the western region of Saudi Arabia: with a predominance of *S. mansoni* in the Hijaz highlands and a very low prevalence of *S. haematobium* in the Tihamah lowlands. Similar conditions have been recorded in many other schistosomiasis endemic areas: Ethiopia, Somalia, Zimbabwe and Yemen. However,
### Table 1

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>No. infected/ No. examined (%)</td>
<td>Mean egg counts/g stool of infected individuals arithmetic ± SE geometric</td>
<td>No. infected/ No. examined (%)</td>
<td>Mean egg counts/g stool of infected individuals arithmetic ± SE geometric</td>
<td>No. infected/ No. examined (%)</td>
<td>Mean egg counts/g stool of infected individuals arithmetic ± SE geometric</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1-5</td>
<td>4/311 (1.89)</td>
<td>120 ± 20 (90)</td>
<td>3/197 (1.52)</td>
<td>100 ± 20 (80)</td>
<td>7/408 (1.71)</td>
<td>110 ± 20 (85)</td>
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<tr>
<td>6-10</td>
<td>27/323 (8.35)</td>
<td>140 ± 90 (110)</td>
<td>6/307 (1.95)</td>
<td>138 ± 70 (110)</td>
<td>33/630 (5.23)</td>
<td>156 ± 85 (110)</td>
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<tr>
<td>11-15</td>
<td>43/300 (14.33)</td>
<td>170 ± 100 (110)</td>
<td>6/244 (2.46)</td>
<td>121 ± 60 (90)</td>
<td>49/544 (9.00)</td>
<td>145 ± 80 (100)</td>
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<tr>
<td>16-20</td>
<td>18/214 (8.41)</td>
<td>116 ± 80 (90)</td>
<td>4/200 (2.0)</td>
<td>200 ± 80 (120)</td>
<td>22/414 (5.31)</td>
<td>158 ± 55 (105)</td>
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<td>21-30</td>
<td>10/220 (4.54)</td>
<td>115 ± 50 (85)</td>
<td>13/218 (5.96)</td>
<td>107 ± 60 (95)</td>
<td>23/438 (5.25)</td>
<td>111 ± 55 (90)</td>
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<tr>
<td>31-40</td>
<td>10/164 (6.09)</td>
<td>145 ± 50 (120)</td>
<td>13/162 (8.02)</td>
<td>120 ± 50 (100)</td>
<td>23/326 (7.05)</td>
<td>135 ± 55 (105)</td>
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<tr>
<td>41+</td>
<td>16/158 (10.12)</td>
<td>218 ± 150 (160)</td>
<td>12/174 (6.89)</td>
<td>128 ± 50 (90)</td>
<td>28/332 (8.43)</td>
<td>173 ± 100 (120)</td>
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<tr>
<td>Total</td>
<td>128/1590 (8.05)</td>
<td>156 ± 60 (120)</td>
<td>57/1502 (3.79)</td>
<td>135 ± 50 (110)</td>
<td>185/3092 (5.98)</td>
<td>141 ± 55 (110)</td>
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The overall prevalence rate of *S. mansoni* in the Hijaz highlands in the present study (5.98%) is much less than that recorded in neighboring countries, Ethiopia\(^{11}\) (25–75%), Zimbabwe\(^{13}\) (15.2%), Yemen\(^{15}\) (64–68%), Sudan (60–85%) or Egypt\(^{16}\) (55–74%).

Schistosomiasis is a disease of focal transmission (some areas have higher or lower prevalence than normal) and this is already evident in the present study. Al-Farsah, Ganab Shukr and Ganaben in the Hijaz highlands have high prevalence rates of *S. mansoni*: 20.1%, 16.4% and 13.2% respectively. This is due probably to the fact these communities live close to many dams and perennial water courses and that they are nomadic and sheep herders (Ganaben and Ganab Shukr) and are thus more at risk of contact with cercariae-infested water.

### Table 2

<table>
<thead>
<tr>
<th>Site</th>
<th>No. negative in 1987</th>
<th>No. positive in 1987</th>
<th>% incidence</th>
</tr>
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<tbody>
<tr>
<td>Wadi Al Sadr</td>
<td>70</td>
<td>4</td>
<td>5.71</td>
</tr>
<tr>
<td>Al Mashnaya</td>
<td>40</td>
<td>1</td>
<td>2.50</td>
</tr>
<tr>
<td>Al Beydani</td>
<td>28</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Al Garanta</td>
<td>66</td>
<td>1</td>
<td>1.51</td>
</tr>
<tr>
<td>Total</td>
<td>204</td>
<td>6</td>
<td>2.94</td>
</tr>
</tbody>
</table>

The occurrence of the peak prevalence and the highest intensity of *S. mansoni* infection in males of the age group 10–19 years has been noted in many endemic areas in different countries. However, the prevalence in females in the present study reached a peak in adult age groups (21+ years) and may be due to more contact of these age groups with water since they are responsible for both household activities and sheep herding.\(^{17,18,19}\)

The mean incidence level of 2.94% in the four sites of the Hijaz highlands indicates that transmission of schistosomiasis is still occurring. Jordan\(^{20}\) concluded that although it was easy to produce a rapid and significant reduction of a high prevalence rate of schistosomiasis yet it was difficult to reduce an already low rate. Quma *et al.*\(^{21}\) reported that treatment of persons with high egg output led to a reduction of the intensity of infection in the whole population but that after a first considerable drop in the prevalence rate, further decreases were smaller.

### Acknowledgements
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References


