Water contact activities and schistosomiasis infection in Menoufia, Nile Delta, Egypt

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Resumen: El contacto con el agua, que lleva a la infección por la schistosomiasis, fue estudiado en dos grandes aldeas de Menoufia. En 1994, se realizó una investigación epidemiológica en una muestra calcada de hogares que mostró que ciertas actividades de contacto con el agua (lavado de granos, irrigación y abluciones) llevaban a una tasa superior de infección por la schistosomia por comparación con otras actividades. El contacto con el agua parece estar significativamente asociado con el sistema de irrigación utilizado. La educación sanitaria y la participación comunitaria son recomendadas para el control de la schistosomiasis.

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Introduction

In Egypt, epidemiological water contact studies have identified a wide range of human behavioural activities associated with exposure to schistosomiasis infection [2–3]. In past studies, different canal water contact activities have been found to vary in weight as risk factors. Exposed body parts in each activity appear to play a role in determining the risk of schistosomiasis infection. Yet to change behaviour is a long and involved process, particularly when such behaviour has a sociocultural or occupational nature and there are logical reasons for it.

An in-depth study of water contact activities in various parts of Egypt found many factors behind the persistent use of canals for domestic purposes, even when a safe water supply is available. Furthermore, the lack of control programmes with regard to re-exposure and reinfestation has allowed the schistosomiasis problem to continue [4].

On the other hand, simple modifications in water contact patterns could minimize infection risk and primary health care could play an effective part in this respect. Ecological conditions which are optimal for the existence of the snail vector and the release of cercaria could be avoided in the choice of water contact sites. Moreover, health education programmes could be more intensively directed towards high infection risk activities as found by water contact and schistosomiasis epidemiological studies.

This study, therefore, aimed at studying schistosomiasis infection in two different village settings in Menoufia governorate in relation to water contact activities and sites in order to enhance the effectiveness of primary health care in schistosomiasis control.

Methods

Study sample and setting

A purposive sample of two large villages was chosen in Menoufia governorate, representing its various environmental situations. El-Garda village, with a population of 7679, has a sewage disposal system which covers about half the village households. Salamoniya, with a population of 8181 (1991 census, which was a recensus performed by the project), has no sewage disposal system. In both villages, most households have a piped water supply, but wastewater disposal is not provided in Salamoniya and in parts of El-Garda. Therefore, many households, particularly those in the vicinity of water courses, have installed disposal pipes which empty into the canals that pass through the villages. Moreover, much of the sewage collected by the disposal plant is often ultimately dumped into the canals.

The two villages are densely settled and, in spite of the availability of piped water, canal water is still used for many domestic purposes, and water contact for irrigation purposes occurs for many hours during the day.

Pilot study

This was performed on 5% of the recensused households of the two villages in 1992. Urine and stool examinations were carried out using nucleopore filtration and the Kato thick smear preparation technique, respectively. Since it was preferred not to depend on census data that was already available in health and other facilities in the region, the studied villages were censused by the project team before proceeding with research (1991). Prevalence rates of Schistosoma haematobium in both villages were found to be < 2%, and therefore
the in-depth study was restricted to *S. mansoni*.

**In-depth epidemiological study**
This was conducted from 1992 to 1994 on a calculated sample of households from both villages [4] totalling 1379 individuals (949 in El-Garda and 430 in Salamoniya in 1994) for the purpose of determining the schistosomiasis prevalence and incidence rates.

A water contact questionnaire was given to the chosen sample which investigated canal contact behaviour for domestic and occupational purposes. Questionnaires with non-specific answers about purpose or site of water contact were rejected from the water contact questionnaire sample and the final sample was 402 individuals (164 in Salamoniya and 238 in El-Garda).

Anthropological and laboratory findings were analysed to demonstrate existing relationships, which were interpreted using other collected relevant ecological data in the two villages.

**Results**

As a whole, schistosomiasis infection rates were much higher in Salamoniya village as related to water contact with its canals. Prevalence rates of *S. mansoni* during the study were 27.9% in Salamoniya and 8.1% in El-Garda.

Table 1 shows that in Salamoniya the occupational exposure of wheat washing was the activity related to the highest schistosomiasis infection rate (96.2%), followed by ablution (79.0%). Wheat washing is a procedure that takes place to prepare wheat for milling. Thus, wheat is soaked in canal water in large containers and then spread out to dry. It usually takes place either in water courses passing through fields or in front of wheat mills. It involves intermittent water contact for a considerable length of time. Ablution is the ritual washing prior to prayers and may be repeated several times a day. Many villagers perform this activity in the canal. In El-Garda, irrigation was the activity related to the highest rate of *S. mansoni* infection (37.9%), closely followed by ablution (35.3%).

Table 2 shows the habitual water contact canals and their relationship with *S. mansoni* infection in each village. In Salamoniya, the rate of *S. mansoni* infection was higher with El-Salmoniya canal contact (67.4%) than with Dla El-Kom canal contact (64.8%). However, the difference was not statistically significant. In El-Garda village, a significant difference existed between the infection rate in users of Kafr Tambidy canal (49.1%) and that in users of El-Garda canal (28.5%) ($P < 0.01$).

**Discussion**

In previous water contact studies in the Nile Delta, the risk of schistosomiasis infection was found to be related to the surface area of the body exposed to canal water. Moreover, the length of exposure time proved to be positively related to schistosomiasis infection. Together, these factors seem to have a role in determining the infection risk connected with different water contact activities. Kloos and Lemma [5] actually constructed an exposure index based on the product of frequency, duration and intensity of water contact (proportion of body surface exposed) which is used to predict infection.

The findings of the present study show that three main activities were related to the highest schistosomiasis infection rates—wheat washing, irrigation and ablution. The first two activities are occupational work...
<table>
<thead>
<tr>
<th>Activity</th>
<th>Total number</th>
<th>S. mansoni infection</th>
<th>$\chi^2$ (P value) against none</th>
<th>Total number</th>
<th>S. mansoni infection</th>
<th>$\chi^2$ (P value) against none</th>
<th>Total number</th>
<th>S. mansoni infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>86</td>
<td>63</td>
<td>73.26</td>
<td>124</td>
<td>47</td>
<td>37.90</td>
<td>18.31</td>
<td>0.00002</td>
</tr>
<tr>
<td>Fetching water</td>
<td>97</td>
<td>64</td>
<td>65.98</td>
<td>106</td>
<td>33</td>
<td>31.13</td>
<td>13.33</td>
<td>0.0003</td>
</tr>
<tr>
<td>Bathing</td>
<td>111</td>
<td>80</td>
<td>72.07</td>
<td>134</td>
<td>40</td>
<td>29.85</td>
<td>12.79</td>
<td>0.0003</td>
</tr>
</tbody>
</table>
| Washing clothes and uter
sils       | 97   | 64    | 65.98 | 106  | 33    | 31.13 | 13.33 | 0.0003  | 203  | 97    | 47.78 | 203  | 97    | 47.78 | 203  | 97    | 47.78 |
| Washing wheat and grain  | 26   | 25    | 96.15 | 19   | 4     | 21.05 | 5.72  | 0.0168  | 45   | 29    | 64.44 | 267  | 132   | 49.44 | 203  | 107   | 52.71 | 203  | 107   | 52.71 |
| Swimming                  | 127  | 89    | 70.08 | 140  | 43    | 30.71 | 13.41 | 0.0003  | 267  | 132   | 49.44 | 203  | 107   | 52.71 | 203  | 107   | 52.71 | 203  | 107   | 52.71 |
| Ablution                  | 81   | 64    | 79.01 | 122  | 43    | 35.25 | 16.33 | 0.0005  | 203  | 107   | 52.71 | 203  | 107   | 52.71 | 203  | 107   | 52.71 | 203  | 107   | 52.71 |
| None                      | 27   | 5     | 18.52 | 39   | 1     | 2.56  | 1.82  | 0.1788  | 66   | 6     | 9.09  | 66   | 6     | 9.09  | 203  | 107   | 52.71 | 203  | 107   | 52.71 |

Table 1: Schistosoma mansoni infection rate by water contact activity in two villages in Menoufia.
necessitating the immersion of the lower third to half of the body in the water course or irrigated field for several hours. Moreover, these activities involve frequent instances of having to go in and out of the water without drying, thus aiding cercarial penetration. This accounts for the high infection rates related to these exposures. On the other hand, Upathan and Sturrock [6] showed that exposure for over 16 minutes caused cercarial penetration in mice to drop, possibly as a result of protection by the skin reaction brought on by the first penetration. Ablution repeatedly exposes body parts which are highly prone to cercarial penetration [7,8]; washing following excretion has been shown to be a high-risk activity for infection in previous studies in the Nile Delta [3].

The degree of chemical and faecal pollution of the water courses differed greatly in the two villages and also within each village. This is probably due to the existence of the sewage disposal system in El-Garda village and its absence in Salamoniya [9]. In spite of the high pollution of water courses in Salamoniya, which appeared to have a lethal effect on the Schistosoma snail vectors and would thus affect schistosomiasis infection rates, the irrigation scheme of the village never allowed the canals to dry up. Thus, both Bulinus and Biomphalaria snails were found and were often infected. On the other hand, in El-Garda, in spite of the lower pollution of its water courses, which would have been expected to be associated with higher snail counts, particularly in Kafr Tambidy canal which was less chemically polluted, Bulinus truncatus was the only snail found and in very low counts. This could be attributed to the irrigation regime of El-Garda which involved complete drying up of the canals for several consecutive days every round and thus the death of snails, particularly Biomphalaria.

Upathan [10] showed that mice infection rates and worm burdens increased in direct proportion to cercarial concentrations in contact water, which in nature would be related to the viable snail population size. Moreover, Wilkins et al. [11] added the cercarial densities at different sites as a predicting factor in human infection. This could probably account for the difference in infection rates between the two villages, particularly in relation to ablution, which was the activity highly related to schistosomiasis infection in both areas.

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**Table 2 Schistosoma mansoni infection rates by habitual water contact canals in two villages in Menoufia**

<table>
<thead>
<tr>
<th>Schistosomiasis infection</th>
<th>Salamoniya village</th>
<th>El-Garda village</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dia El-Kom canal</td>
<td>El-Salamoniya canal</td>
</tr>
<tr>
<td>Number of positive cases</td>
<td>59</td>
<td>31</td>
</tr>
<tr>
<td>Total number in contact with water</td>
<td>91</td>
<td>46</td>
</tr>
<tr>
<td>Infection rate (%)</td>
<td>64.8</td>
<td>67.4</td>
</tr>
</tbody>
</table>

*Significant difference (P < 0.01)

$\chi^2 = 7.52, P = 0.006$
Conclusions and recommendations

Certain water contact activities appear to be significantly more related to schistosomiasis infection than others and thus they should be given priority in health education and control measures. Moreover, it is obvious that the irrigation system is an element of schistosomiasis control that should not be overlooked and should be planned with regard to crop cultivation and to minimizing the chances of schistosomiasis infection and reinfection. This emphasizes the importance of intersectoral coordination with the agricultural authorities if primary health care efforts are to be effective in combating reinfection with schistosomiasis.

Acknowledgements

This research was supported by the Egyptian Ministry of Health/USAID-funded Schistosomiasis Research Project, 263-0140.2 (Grant 04-05-38). I would like to thank Samiha El-Katsha and Susan Watts, investigators at the project’s host institution, the Social Research Centre at the American University in Cairo, for work on the baseline and water contact investigations and in facilitating this study.

References


9. El-Katsha S et al. The role of water supply and sanitation in transmission of


Schistosomiasis continued to be a public health problem in Egypt, Sudan and Republic of Yemen, particularly in areas where there are water development schemes. Further reduction of the prevalence of schistosomiasis was achieved by the national programmes in Morocco, Saudi Arabia and Syrian Arab Republic in areas with sustainable control activities.

WHO collaboration with endemic countries covered a variety of areas, including planning of control, strengthening of diagnostic facilities, provision of drugs for treatment, training of the national staff in methods of surveillance and control of schistosomiasis, distribution of materials for training and health education, and support for research.

WHO continued to collaborate in strengthening laboratory facilities for diagnosis of schistosomiasis in endemic countries. The WHO publication *Health Education in the control of schistosomiasis* was translated and published in Arabic. WHO supported applied research on the epidemiology of schistosomiasis in Egypt and the Republic of Yemen through the EMRO/TDR/CTD small grants scheme.