WATER DEMAND AND SCHISTOSOMIASIS AMONG THE GUMAU PEOPLE OF BAUCHI STATE, NIGERIA

OLADELE B. AKOGUN

Received June 13 1988/Accepted April 17 1989

Abstract: A helminthological study of stool and urine samples collected from 1,037 people from four rural communities in Gumau District of Bauchi State, Nigeria was carried out using formo-ether concentration and direct centrifugation methods respectively. The study is the first parasitological survey to be carried out in the district. Thirty-nine per cent of examined persons were infected. Ova of Ascaris lumbricoides, Schistosoma haematobium, Schistosoma mansoni and Trichuris trichiura were most common. Hookworm, tapeworm and Strongyloides stercoralis were also encountered. 17.9% and 10.8% of examined persons had S. haematobium and S. mansoni infections respectively. Water demand index (number of persons per well) for each community was calculated as a ratio of the total population to the number of safe water sources available in that community. A significant relationship was found between water demand index and S. haematobium ($r = 0.95$) on one hand, and S. mansoni ($r = 0.88$) on the other ($P < 0.01$). Such relationship was not found in soil borne helminth infections. A similarly significant association was found between distance from river and prevalence of S. haematobium ($r = 0.94$) on one hand and S. mansoni ($r = 0.95$) on the other ($P < 0.01$) but not found in soil-borne helminth infections. These findings seem to suggest that water demand index may be an important factor in the epidemiology of Schistosome infections in rural communities. Water demand index may also be a useful field technique for estimating and comparing the rates of water associated helminth infections in rural communities with comparable environmental conditions.

INTRODUCTION

The source of drinking water is regarded as one of the most important epidemiological factors in helminth infections. It has been suggested that the provision of potable water is a possible solution to the problem of helminthiasis (Gilles, 1964; Cowper, 1967; Akoh, 1980). This suggestion is based on the fact that human activities are associated with helminth infections and that prevalence of helminthiasis is a measure of the extent to which the source of water is contaminated with waste. However, there are indications that the provision of water alone is not enough to combat the increasing rate of water-associated helminthiasis, especially in rural areas where the demand for potable water needs to match its supply to an ever rising population.

Department of Biology, Federal University of Technology, Yola, Nigeria
MATERIALS AND METHODS

Description of study area: The Gumau district of Bauchi State lies between 1,000 and 1,300 m above sea level in the northern Guinea Savannah of Nigeria (Figure 1). The annual rainfall ranges between 1,270 and 1,828 mm while the annual temperature ranges between 20°C and 30°C (Kowal and Knabe, 1972). The studied communities are situated at the following locations:

1. Gumau (10°15'N 9°06’E)
2. Laru (10°03'N 9°16’E)
3. Badiko (10°09'N 9°13’E)
4. Magama (10°02'N 9°17’E)

A great deal of human activity (bathing, laundry and fishing) takes place along rivers Delimi, Badiko and Bindiri at specific sites which retain water throughout the year.

Methods: Procedures for the collection and examination of stool and urine specimens were those described by King (1972). The population estimate of each community was obtained from the district office which keeps a record of tax-paying adults, birth and death and of school enrolment. The number of safe water sources was obtained by personally counting them with the assistance of the district Clerk and the Social Welfare Officer. The main criteria for determining safe wells were

Figure 1 Map of study area: Gumau District, Bauchi State.
a) depth must be at least 7.5 m
b) there must be an extension slab at the mouth end which must be 0.5 m above ground level, and
c) the well must have a metal or wooden cover. These criteria are the approved standards by the Local Government Council.

The water demand index (the number of persons per well for each community) was calculated as a ratio of the total population to the number of safe water sources in that community. The distance from the village centre to the nearest major alternative water source was determined.

Data analysis: Simple Chi-square test and Friedman's two-way ANOVA by ranks were used to analyze the results for heterogeneity and significant variations.

RESULTS

The water demand index of each community is shown in Table 1. Table 2 shows the prevalence and distribution of each helminth in each of the four communities. S. haematobium and S. mansoni were the only species of Schistosomes that were encountered. The prevalence of S. haematobium was analyzed separately but included in Table 2. Distribution of prevalence of infection does not seem to be even ($X^2$; $P < 0.01$). The distances from the village centre to the nearest major alternative water source are shown (Table 2).

The water demand index differed between villages. There seemed to be a significant association between water demand index and S. haematobium prevalence ($r = 0.95$, t-test, $P < 0.01$) on one hand and S. mansoni ($r = 0.95$, t-test $P < 0.01$) on the other (Figure 2). An association was also observed between Taenia sp. and water demand index ($r = 0.70$, t-test, $P < 0.05$) but not in any other helminth.

A similarly significant association seems to exist between the distance from river and S. haematobium ($r = -0.94$, t-test $P < 0.01$) on one hand and S. mansoni ($r = -0.88$, t-test, $P < 0.01$) on the other. Such an association was not observed between distance from river and any other helminth.

DISCUSSION

The type of association between Ascaris infection and water which was suggested by Bidinger et al. (1981) was not observed in this study. The remarkable association between

<table>
<thead>
<tr>
<th>Community</th>
<th>Nearest river</th>
<th>Population estimate</th>
<th>No. of wells</th>
<th>No. of persons per well*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gumau</td>
<td>Delimi</td>
<td>10,000</td>
<td>26</td>
<td>384.6</td>
</tr>
<tr>
<td>Badiko</td>
<td>Badiko</td>
<td>4,900</td>
<td>14</td>
<td>350.0</td>
</tr>
<tr>
<td>Laru</td>
<td>Bindiri</td>
<td>2,000</td>
<td>7</td>
<td>285.7</td>
</tr>
<tr>
<td>Magama</td>
<td>Bindiri</td>
<td>3,800</td>
<td>32</td>
<td>118.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20,700</strong></td>
<td><strong>79</strong></td>
<td></td>
<td><strong>262.0</strong></td>
</tr>
</tbody>
</table>

*: Water demand index.
Table 2  Distribution of each helminth in the district *

<table>
<thead>
<tr>
<th>Helminth</th>
<th>Gumau Inf. (%)</th>
<th>Badiko Inf. (%)</th>
<th>Laru Inf. (%)</th>
<th>Magama Inf. (%)</th>
<th>Total Inf. (%)</th>
<th>Water demand and parasite</th>
<th>River distance and parasite</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. haematobium†</td>
<td>125 (24.0)</td>
<td>38 (18.0)</td>
<td>14 (9.5)</td>
<td>4 (2.6)</td>
<td>181 (17.5)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>A. lumbricoides</td>
<td>112 (21.5)</td>
<td>51 (23.9)</td>
<td>41 (27.7)</td>
<td>29 (18.7)</td>
<td>233 (2.5)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>S. mansoni</td>
<td>80 (15.4)</td>
<td>23 (10.8)</td>
<td>6 (4.0)</td>
<td>3 (1.9)</td>
<td>112 (10.8)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Hookworm</td>
<td>17 (3.3)</td>
<td>18 (8.5)</td>
<td>6 (4.0)</td>
<td>5 (3.2)</td>
<td>46 (4.4)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Taenia sp.</td>
<td>6 (1.2)</td>
<td>2 (0.9)</td>
<td>2 (1.4)</td>
<td>5 (3.2)</td>
<td>15 (1.4)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>H. nana</td>
<td>4 (0.8)</td>
<td>7 (3.3)</td>
<td>3 (2.0)</td>
<td>3 (1.9)</td>
<td>17 (1.6)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>T. trichiura</td>
<td>4 (0.8)</td>
<td>3 (1.4)</td>
<td>9 (6.1)</td>
<td>—</td>
<td>16 (1.5)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>S. stercoralis</td>
<td>4 (0.8)</td>
<td>—</td>
<td>—</td>
<td>4 (0.8)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

No. Exam. 521, Prevalence (%) 39.9
Water demand index 384.6, Distance from nearest river (m) 600

*: These figures include mixed infection. †: Urinary Schistosomiasis was analyzed separately.
‡: P<0.05  §: P<0.01  ‖: negative correlation.

Figure 2  Prevalence of some helminths and water demand index.
water demand index and Schistosome infection in the district is self evident. The results suggest that the rate of Schistosome infections tend to increase with increase in water demand index. The explanation for these observations may be due to the contamination of alternative sources of water. This may lead to an increase in the number of Schistosome intermediate hosts which become infected as a result of contamination. The number of cercariae that are released by the intermediate hosts increases thus increasing the chances of human–parasite contact and so enhancing a subsequent rise in the prevalence of disease among the human population who in turn further contaminate the alternative water source through continual contact. Water demand index may be a major factor in the transmission of water-associated helminths. The association between Taenia sp. (which has no direct association with water) is not well understood and may likely be due to sampling error.

It is literally possible to have almost the entire community infected as a result of the association between water demand, the environment and Schistosomes. This explanation is especially likely since the distances from the rivers seem to have a negative association with only S. haematobium and S. mansoni infections in this study. This may be due to human behaviour; the easier the access to the alternative source, the more the number of people who may contaminate it in a community with large water demand index and the greater the chances of contact with infective stage of Schistosomes. The distance from river does not seem to affect the prevalence of other helminths in this study.

Although the findings of the present study may not be conclusive regarding the relationship between water demand of a community and its rate of Schistosome infections, the results do reveal an interesting association between them. This association may be a useful field technique for estimating and comparing the rate of Schistosome infections in communities with similar environmental conditions.

ACKNOWLEDGEMENT

This study is part of a research project which was supervised by Dr. V.N. Okwuosa to whom I am very grateful for useful advice. The assistance of the Gumau District Office is gratefully appreciated.

REFERENCES