Rapid, low-cost, two-step method to screen for urinary schistosomiasis at the district level: the Kilosa experience

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The operational and diagnostic performance of a two-step method for the cost-effective screening of urinary schistosomiasis was investigated in the Kilosa District of east-central Tanzania. In the first step a simple questionnaire was administered to 15073 primary schoolchildren by their class teachers over a 4-week period. The answers to the questionnaires had a high negative predictive value for schistosomiasis, and this permitted the safe exclusion of schools where the risk of the disease was low.

In the second step, the head-teachers of the 49 high-risk schools and of 26 low-risk schools were instructed on the use of reagent sticks to detect haematuria. Each head-teacher then performed this test on 80 children selected at random in their schools (5750 children were screened within 6 weeks). Cross-checks of the results in 18 schools confirmed the reliability of the head-teachers' testing and their findings were therefore used to prepare an epidemiological map of the district and to arrange for treatment of positive children.

This two-step approach relied entirely on the existing school system and permitted screening of a rural district of area 15 000 km² (population, 350 000) over a 4-month period at a cost of only US$ 3000.

Introduction

Schistosoma haematobium is endemic in 43 of the 52 African states in the African, European, and Eastern Mediterranean Regions of WHO (1). Only 11 of these countries have so far set up nationwide control programmes, while three more have completed comprehensive screening activities to gain an overview of the distribution and importance of the disease. In the remaining 29 endemic countries, the presence of the disease has been unsystematically reported, usually by many different sources over a few decades (2), and large areas remain whose urinary schistosomiasis status is unknown.

Because of the marked focal nature of transmission of schistosomiasis (3), a comprehensive epidemiological investigation has to be carried out before rational decisions can be made about controlling the disease. It is essential to concentrate available resources on detecting, treating, and protecting patients in high-risk areas, rather than screening and protecting mostly unaffected individuals in low-risk areas (4). In this regard, the threshold of positivity, above which the use of specific financial and human resources is justified, is critical and has to be defined according to the results of longitudinal morbidity surveys and assessment of community priorities. Recent reviews of the medical and socioeconomic impact of schistosomiasis (5, 6) have indicated that for both intestinal and urinary schistosomiasis no simple criteria exist for defining this positivity threshold. As far as the setting of health priorities by communities is concerned, one Tanzanian study has compared the disease perception of the leaders of political parties and school head-teachers with the results of parasitological surveys; this permitted definition of a high-priority threshold, a prevalence above which almost all respondents placed urinary schistosomiasis among the top four diseases for control (7).

Once such a threshold has been defined, a rapid and cost-effective diagnostic strategy should be worked out to classify the community units (schools, hamlets, villages, political units, etc.) into high-risk or low-risk groups. In the latter, any control, if needed, should be restricted to case detection within the existing health services (8). In the high-risk groups, active case detection for treatment and
other control measures could be introduced. In the United Republic of Tanzania school questionnaires proved to be rapid and very cost-effective for this preliminary, area-wide screening (7); however, the results obtained permitted neither quantification of the infection rate nor the identification and treatment of infected children. A second step, consisting of application of a simple quantitative test, was therefore necessary.

Because of their operational simplicity, reagent sticks for the detection of blood in urine were considered to be the ideal tool for this purpose. Such sticks are highly specific, and, although they are less sensitive than urine filtration for detecting *S. haematobium* infections (9, 10), recent studies have shown that the cases not detected were mostly very light infections (< 10 eggs/10 ml) and that reagent sticks are as efficient as urine filtration in detecting infections of ≥ 50 eggs per 10 ml (11). The sticks also have higher predictive values for macro pathology visualized using sonography (12), and should therefore play a major role in a morbidity control approach (11–13). The operational value of reagent sticks for a control programme based on primary health care (PHC) has already been demonstrated in a study on Pemba Island (13).

Although PHC-driven schistosomiasis control should be integrated into existing health care structures (1), the health personnel in most endemic areas are overwhelmed by day-to-day clinical duties and can hardly be asked to perform systematic community screening. In the present study, we therefore asked non-health personnel to carry out the reagent stick testing. During previous surveys we found that school teachers were very concerned about health issues, and they volunteered to participate actively in the present study, within the framework of the existing school health programme. Since age–infection curves are similar in most settings where schistosomiasis is endemic (3), the screening of schoolchildren was expected to give results that were representative for the whole community.

Discussions between health and education representatives at the regional and district levels resulted in the following overall strategy: the screening would be carried out by the district education department, while the treatment of the positive children would be the responsibility of the district health office. The role of the investigating team was restricted to planning, technical support, and evaluation (feasibility and cost-effectiveness). This approach matched the need for increased intersectoral collaboration in community development programmes.

**Methods**

**The study area**

The study was undertaken in Kilosa District (area, 15 000 km²), Morogoro Region, east-central Tanzania. The southern part of the district lies in the Kilombero river plain, while central Kilosa consists of dry grassland plains, bounded in the west by the Rubeho Mountains. The north of the district borders the dry plains of the Dodoma Region.

In the 1988 census the population of Kilosa District was 347 000 (annual increase, 2.6%). Agriculture is the chief economic activity. In the central and northern zones large sisal estates and cattle ranches are important, with maize as a subsistence crop, while in the wetter southern zone, sugar cane and rice predominate. Kilosa, the main town (population, 40 000), is about 280 km by road from Dar es Salaam. Primary schooling is compulsory and the compliance rate is estimated to be 90%. More details on the study area are available elsewhere.

Malaria is holoendemic in the southern and central zones, whereas its transmission is lower in the cooler northern zone (14). The study was begun at the request of the regional medical officer and the district medical officer, because schistosomiasis was known to be a problem, but no endemicty figures were available.

**Study design**

**Step 1.** As a first step, (Fig. 1), school questionnaires analogous to those used in the neighbouring Kilombero District (7), and aimed at head-teachers and schoolchildren, were sent in August 1988 to all 168 primary schools in Kilosa District. All forms were distributed via the normal mailing system. Only the district education officer (DEO) was informed about the project’s interest in schistosomiasis; the study was presented to the teachers as an investigation of community problems and to the children as an overall health study. Within 4 weeks, 164 completed questionnaires were returned to the

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*c* See footnote a.
Rapid method to screen for urinary schistosomiasis at the district level

Fig. 1. Schematic illustration of the two-step method used to screen for urinary schistosomiasis in Kilosa District.

<table>
<thead>
<tr>
<th>168 Schools (whole district)</th>
<th>Step 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>All children in classes 1, 3, and 5</td>
<td>School questionnaires sent via District Education Office</td>
</tr>
<tr>
<td>164 Schools responded (97.6%)</td>
<td>Classification</td>
</tr>
<tr>
<td>115 negative schools</td>
<td>Threshold = 35% of children who answered</td>
</tr>
<tr>
<td>49 positive schools</td>
<td>&quot;I have had schistosomiasis&quot;</td>
</tr>
<tr>
<td>26 randomly selected schools</td>
<td>Step 2:</td>
</tr>
<tr>
<td>All schools</td>
<td>Reagent stick testing by teachers</td>
</tr>
<tr>
<td>75 schools (80 children per school)</td>
<td>Validation</td>
</tr>
<tr>
<td>Cross-checks in 18 randomly selected schools</td>
<td>Outcome</td>
</tr>
<tr>
<td>Map of Schistosoma haematobium distribution</td>
<td></td>
</tr>
<tr>
<td>Positive children treated</td>
<td></td>
</tr>
</tbody>
</table>

DEO. Based on the data from Kilombero District, the school positivity threshold was set at 35.0% for positive recall of an episode of schistosomiasis on the children’s questionnaires.

**Step 2.** For the second step, we selected the 49 “positive” schools, and as controls 26 randomly selected “negative” schools. At the beginning of October 1988 the head-teachers of these 75 schools were asked by the DEO to attend a one-day seminar. Three such seminars were organized in the northern, central, and southern zones. The head-teachers attended a short lecture on schistosomiasis and were then instructed on the recognition of gross haematuria (macrohaematuria) and on the use of reagent sticks to detect microhaematuria. At the end of the seminar, the head-teachers were supplied with survey forms and enough reagent sticks to test 80 children selected at random (classes two–four) in their schools. They were asked to record any cases of macrohaematuria. At an expected positivity rate of 50% and a 90% confidence interval (CI), it was calculated that 68 children would have to be tested per school to estimate the prevalence of haematuria to within ±10%. A slightly larger sample was chosen to ensure this minimum sample size during the subsequent validation step, when drop-outs were expected.

Six weeks later, 73 schools (97.3%) had returned the completed survey forms to the DEO.

**Validation.** To cross-check the quality of the head-teachers’ testing, we selected at random 18 of the 73 schools that had returned completed forms, and retested with reagent sticks all the children who had already been screened by the teachers and who were in school on the day of our visit. Because of the circadian variation in haematuria, care was taken to perform the tests at the same time of day as had the teachers (15, 16).

**Treatment.** During cross-checking, all children who were positive for haematuria received on-the-spot treatment with praziquantel (20 mg/kg body weight). Positive children in the remaining 55 schools were treated with praziquantel in the schools or in a local health centre by a team from the district medical office.

**Questionnaires**

**Head-teacher’s questionnaire.** The questionnaires have been described in detail elsewhere. The

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*d* See footnote a, p. 180.
questionnaire for the head-teachers probed the following:

(1) the ranking of the diseases most prevalent among schoolchildren (to be chosen from abdominal problems, diarrhoea, malaria, skin diseases, eye diseases, schistosomiasis, respiratory infections, measles, nutritional problems, and worms);
(2) the ranking of the signs and symptoms most prevalent among schoolchildren (chosen from coughing, itching, headache, fever, abdominal pain, wounds, blood in urine, joint pains, blood in stool, diarrhoea, and convulsions);
(3) the ranking of priority diseases for control (no proposed list); and
(4) and (5) two questions not related to schistosomiasis screening, on the ranking of village problems and availability of water.

For each question six lines were provided for answers, and explanations were given in a short introduction at the beginning of the form. The list of proposed diseases and symptoms was established following extensive community health surveys in the neighbouring Kilombero District (17, 18).

Children’s questionnaire. The children’s questionnaire was administered to all schoolchildren in classes one, three, and five who were present on the day the survey was conducted. The class teachers asked the children individually whether during the last month they had experienced any of the listed symptoms (coughing, itching, headache, fever, abdominal pain, blood in urine, blood in stool, or diarrhoea) or conditions (malaria, diarrhoea, skin diseases, eye diseases, schistosomiasis, respiratory infections, worms, or abdominal problems). The teachers recorded the children’s replies as “yes”, “no” or “don’t know” (counted as “no” in the evaluation). The answers from the whole class (up to 60 children) were written down on a single sheet of paper (both sides). The prevalences of positive answers for blood in urine and schistosomiasis per class and per school were calculated later by the investigating team.

Reagent stick testing
Reagent stick testing was performed according to the manufacturer’s instructions,* and readings were recorded as negative, 1+, 2+, or 3+. In the analysis, we calculated two school prevalences: the first, for a 1+ positivity limit (i.e., all positives); and the second, for a ≥ 2+ positivity limit (those with 2+ and 3+ results).

To permit comparison with the standard urine filtration screening method, we converted the 25% and 50% parasitological prevalences to reagent stick (≥ 2+) prevalences using the following linear transformation, defined elsewhere for this area:†

Parasitological prevalence = 1.26 × haematuria (≥ 2+) prevalence + 1.67

In this way, a parasitological prevalence of 25%, which can be taken as a threshold for moderate school infection rates in the United Republic of Tanzania, became 18.5% haematuria (≥ 2+) prevalence (95% CI, 14.4–22.6%). Also, a parasitological prevalence of 50%, which can be taken as a threshold for high infection rates, became 38.4% haematuria (≥ 2+) prevalence (95% CI, 30.7–46.1%). The 2+ positivity limit for the reagent stick test was selected in preference to the 1+ limit, because the linear correlation with the parasitological results was better. The 2+ limit was also used for most other evaluations at school level; however, we also reviewed all relations based on the 1+ reagent stick limit to ensure that individual case detection had been performed correctly.

Financial costing and data analysis
Financial costs, such as transport, equipment, allowances, salaries, travel and other expenses, were systematically recorded. We did not include the cost of teachers’ working time in the assessment, since this was considered to be part of their duties within the framework of the school health programme. The cost of praziquantel was also excluded to permit assessment of the screening costs alone.

The survey data were analysed using the SPSS/PC+ statistical package§ on a IBM-AT-compatible personal computer, after extensive data entry checks (comparison with original documents, range and consistency checks).

Consent
Because of the study design, no formal consent could be obtained from the children tested or their parents; however, the issue was discussed with the head-teachers during their seminars. Since reagent stick testing is a non-invasive technique, this course of action was considered to be sufficient by the regional and district medical officers.

* Sangur™ sticks, Boehringer Mannheim, Mannheim, Germany.
† See footnote a, p. 180.
§ SPSS Inc., Chicago, IL, USA.
Results

Operational results

The head-teachers’ and children’s questionnaires from 164 of the 168 schools were returned to the DEO within 4 weeks. A total of 15,073 children were screened (5904 in class one, 4762 in class three, and 4407 in class five). The male : female ratio was 0.96, the mean age, 12.0 ± 2.3 years, and the mean number of children interviewed per school, 91.9 ± 12.8 (range, 18–182). All the head-teachers’ questionnaires were filled in properly and only two of the children’s questionnaires were incomplete, so that they could not be analysed.

Reagent stick testing was carried out by the head-teachers in 73 of the 75 schools selected (97.3%), and 5750 children were screened within a period of 6 weeks (mean, 78.8 ± 5.8 children per school). Only in four small schools were less than the required 80 children screened: 3478 children were positive at the 1+ limit (60.5%), 2857 at the 2+ limit (49.7%), and 1980 (34.4%) at the 3+ limit. The mean age of the screened children was 11.7 ± 1.8 years and the sex ratio, 0.94, which are similar to the values for the children interviewed.

Validation

A total of 1167 children in 18 schools (20% of the total) were retested (mean, 64.8 ± 5.5 children per school; range, 58–76). At the 1+ limit, 59.5% (95% CI, 56.7–62.3%) were positive, compared with the 56.3% (95% CI, 53.7–58.8%) found positive by the teachers. At the 2+ limit, 50.8% (95% CI, 47.9–53.7%) were positive compared with the 45.6% (95% CI, 43.1–48.2%) found positive by the teachers. The validation was carried out 6 weeks after the teachers’ testing, during the disease transmission season, and thus slightly higher infection rates during our visit were to be expected.

Linear regression analysis indicated a very significant correlation between the prevalences of schistosomiasis as measured by the teachers and by our investigation team: with 1+ as the reagent stick positivity limit, Pearson’s coefficient of correlation (r) was 0.98 (P < 0.0001); with 2+ (Fig. 2), Pearson’s r was 0.97 (P < 0.0001).

The nonparametric McNemar’s test for paired values was also used to compare the two testings. At the thresholds for moderate and high levels of infection (18.5% and 38.4% prevalence, respectively, for reagent stick ≥2+), no statistical difference was found between the head-teachers’ testing and the cross-checks (P = 1.0). Based on the head-teachers’ testing only one school at each threshold was misclassified (school A for moderate infection rates and school B for high infection rates, Fig. 2). The same results were obtained if the reagent stick positivity limit was set at 1+. This confirmed the accuracy of the head-teachers’ testing and permitted the use of their results as reference data for the questionnaire evaluation and for endemicity mapping.

The comparison between the teachers’ testing and cross-checking was not performed at the individual level, because of the day-to-day fluctuations

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Fig. 2. Correlation between cross-checks and head-teachers’ reagent stick testing in 18 schools in Kilosa District (with regression line); A and B = schools misclassified at the moderate and high infection rate thresholds, respectively.
in haematuria for a given child. Analysis of the teachers’ observations of visible blood in urine showed that this concept had not been well understood, and that a few teachers had confused micro- and macrohaematuria.

**Reagent stick testing**

Details of the reagent stick testing in the 73 schools in the study have been reported elsewhere. A total of 56 schools had at least a moderate infection rate and in 51 schools the infection rate was high. In 12 schools the prevalence of haematuria ($\geq 2+$) was $\geq 80\%$. The median prevalence among the 73 schools tested was 50.0\%. Based on the data, a map of the distribution of urinary schistosomiasis in schools in Kilosa District was drawn (Fig. 3). High infection rates occurred east of the Kilombero sugar estate (schools No. 125, 127, 128, and 130), around Mikumi town (No. 109, 110, and 113), in the plain at the foot of the Rubeho Mountains (around Kilosa town), around Dumila town (No. 59, 60, 62, 63, and 65) and east of Gairo town. The Rubeho Mountains, as well as the very dry north-west hills area exhibited lower infection rates. Transmission seemed to occur mainly in the small rivers flowing down from the hills, which have a very low water level in the dry season (August–November).

**Diagnostic performance of the questionnaires**

The results of Spearman’s rank correlation test indicated that the answers to all the questions on both questionnaires were highly significantly correlated with the prevalence of haematuria in schools at the 1+ and 2+ limits: $P < 0.0001 (n = 73)$. For the children’s questionnaire, the correlations for classes 1, 3 and 5 taken separately were as significant as the correlation for pooled results for the whole school ($P < 0.0001$ for all combinations).

The sensitivity, specificity, predictive values, and diagnostic efficiency of the “best” question (i.e., the highest test efficiency) of each questionnaire (question 1 in the head-teacher’s questionnaire, question 2 in the children’s questionnaire) are shown in Table 1 ($n = 73$). Both questions showed high sensitivity and specificity for the detection of schools with moderate and high levels of infection.

Predictive values were calculated using Bayes’ theorem (19). For this purpose, the prevalences (or pre-test probabilities of positivity) used were the positivity rates for schools where the infection rate was moderate or high throughout the whole district, and not only in the 73 schools where reagent stick testing had been carried out. The proportion of positive schools among the 89 that were excluded after the questionnaire screening (step 1) was extrapolated from the number that were positive among the 26 taken as negative controls: the values obtained were 55.5\% (moderate) and 42.1\% (high).

The diagnostic efficiency was around 90\% for both questionnaires at both thresholds. In view of the proposed screening strategy, the high negative predictive values were particularly important, since they confirmed that the questionnaires excluded “negative” schools with acceptable safety at step 1.

Fig. 4 shows the relation between the school haematuria ($\geq 2+$) prevalence rate and the frequency of the children’s answer “I had schistosomiasis during the last month” (question 2) in the 73 schools tested. The threshold for high school infection rates (38.4\% haematuria $\geq 2+$) and the questionnaire positivity cut-off (35\%) are drawn as broken lines. Only five haematuria-positive schools out of 51 were classified wrongly as negative by the questionnaire (sensitivity, 46/51 = 90.2\%); and only two haematuria-negative schools out of 22 were classified wrongly as positive (specificity, 20/22 = 90.9\%).
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Table 1: Diagnostic performance of the questionnaires for the detection of schools at moderate or high risk of urinary schistosomiasis (n = 73)

<table>
<thead>
<tr>
<th>Prevalence threshold:*</th>
<th>Question 1 (teachers' questionnaire)*</th>
<th>Question 2 (children's questionnaire)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderate (18.5%)</td>
<td>High (38.4%)</td>
</tr>
<tr>
<td>Cut-off on questionnaire</td>
<td>rank 5</td>
<td>rank 5</td>
</tr>
<tr>
<td>Sensitivity (%)</td>
<td>83.9</td>
<td>90.2</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>88.2</td>
<td>86.4</td>
</tr>
<tr>
<td>Positive predictive value (%)</td>
<td>89.7</td>
<td>82.8</td>
</tr>
<tr>
<td>Negative predictive value (%)</td>
<td>81.8</td>
<td>92.4</td>
</tr>
<tr>
<td>Diagnostic efficiency (%)</td>
<td>84.9</td>
<td>89.0</td>
</tr>
</tbody>
</table>

* Taken as (>2+) haematuria prevalence.
* Rank of schistosomiasis.
* Child answered: "I had schistosomiasis during last month".

The answers to the head-teachers’ questionnaire provided information on the prevalence above which most teachers held schistosomiasis to be a high priority for control ("high-priority limit"). When the prevalence of haematuria (≥2+) was >42%, 43 out of 45 head-teachers considered schistosomiasis to be one of the top four priority diseases for control (Fig. 5); when its prevalence was <42%, only seven head-teachers out of 27 considered it to be in this category (P < 0.0001). The median rank of schistosomiasis was seven (95% CI, 6–8) when its prevalence was < 42% and one (95% CI, 0.8–1.2) when its prevalence was > 42%.

Costs of screening

The costs were calculated for the questionnaire action and the teachers' reagent stick testing as well as for the whole two-step approach (Table 2). For purposes of comparison, the cost of district-wide screening by urine filtration was also estimated; it was calculated that 130 schools needed to be screened to obtain a reliable distribution map of the disease. In all cases the costs of the biomedical support and/or investigation team were calculated for staff who came from outside the district. This is realistic, since specialized teams are almost never

Fig. 4. Correlation between the prevalence of haematuria (≥2+), determined using the reagent sticks in the 73 schools where such testing was performed, and the proportion of the children who admitted having had schistosomiasis. The broken lines indicate the questionnaire cut-off (horizontal line, 35.0%) and the school positivity threshold (vertical line, 38.4%).
Fig. 5. Correlation between the prevalence of haematuria (≥ 2+), determined using the reagent sticks in the 73 schools where such testing was performed, and the rank assigned by the head-teacher (question 3) to schistosomiasis for control priority: the high priority limit corresponds to a 42% prevalence of haematuria (≥ 2+).

Discussion

The main aspects of the questionnaire approach have been discussed elsewhere (7). Although aimed at schistosomiasis data collection, the method used was problem-specific rather than disease-specific. The teachers and children did not tend to overrate the importance of the target disease, and elements of prioritization could be expressed and considered. This placed schistosomiasis in the context of other health determinants (20). The questionnaire forms seemed to be adequate, since all the head-teachers’ questionnaires were completed properly and only two children’s questionnaires were incomplete. Also, less than 5% of the children’s answers were

Table 2: Costs (excluding treatment) of different approaches for urinary schistosomiasis screening used in the study as well as for urine filtration

<table>
<thead>
<tr>
<th></th>
<th>School questionnaires (step 1)</th>
<th>Teacher reagent stick testing (step 2)</th>
<th>Step 1 + step 2</th>
<th>Urine filtration*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost (US$)</td>
<td>1040</td>
<td>2440b</td>
<td>3080b</td>
<td>20000</td>
</tr>
<tr>
<td>No. of schools screened</td>
<td>164</td>
<td>73</td>
<td>164</td>
<td>130</td>
</tr>
<tr>
<td>No. of children screened</td>
<td>15073</td>
<td>5750</td>
<td>15073</td>
<td>10000</td>
</tr>
<tr>
<td>Cost per surveyed child (US$)</td>
<td>0.07</td>
<td>0.42</td>
<td>0.20</td>
<td>2.00</td>
</tr>
<tr>
<td>Cost per surveyed school (US$)</td>
<td>6.3</td>
<td>33.4</td>
<td>18.8</td>
<td>153.8</td>
</tr>
<tr>
<td>No. of times cheaper than urine filtration (schools)</td>
<td>× 24</td>
<td>× 5</td>
<td>× 8</td>
<td>—</td>
</tr>
<tr>
<td>Screening time (weeks)</td>
<td>4</td>
<td>6</td>
<td>16</td>
<td>34</td>
</tr>
</tbody>
</table>

* Estimates for district-wide screening.

b Of which US$ 1400 was for the reagent sticks.
“don’t know”, which suggests that they understood the questions.

The diagnostic performance of both questionnaires was good in view of their preliminary screening function. At the limits for moderate and high infection rates, they showed sensitivities, specificities, and negative predictive values near or above 90.0%. However, these values were calculated on a sample of only 73 schools, and because of the sampling procedure, sensitivities were overestimated and specificities underestimated. An extrapolation of the results to include all 164 schools showed that similar diagnostic values were obtained, provided that the positivity thresholds of the questionnaires were lowered: rank 6, instead of rank 5 for the teachers’ questionnaire and 25.0% instead of 35.0% positive answers to question 2 of the children’s questionnaire. At the given sensitivities and specificities, the negative predictive values will remain above 90% provided the proportion of positive schools is below 50%. In practice this is almost always the case if large areas are screened. These results are similar to those reported for the neighbouring Kilombero District (7), where urine filtration, performed by a biomedical team, was used as a reference technique.

Interestingly, a positive answer to “schistosomiasis” was a better indicator of schistosomiasis than “blood in urine” in the questionnaires. Clearly, haematuria is not the only symptom perceived by patients with urinary schistosomiasis, but the predictive power of others, such as pain in the lower abdomen and dysuria, was not investigated in the study.

In the United Republic of Tanzania, and most endemic areas, villagers associate blood in urine with schistosomiasis (3, 27). The rationale of looking for minute amounts of blood in urine is therefore easily understood by lay persons. Any doubts about whether the handling of the children’s urine would be acceptable to the teachers were not substantiated. During validation, the teachers were still interested in the study, and gave positive feedback about their experiences in carrying out the tests. The accuracy of their results, as assessed by the cross-checks in 18 schools, confirmed that they organized and carried out the testing in a very satisfactory way.

The testing also provided a good basis for practical- and disease-oriented health education. Since the teachers were actively involved, both their awareness and interest were high.

The efficiency of the method relied heavily on a well-structured and efficient administrative system, which ensured competent handling and a high coverage rate. Based on the high rates of return of questionnaires and on the quality of the replies, these criteria were met by the Tanzanian primary education system. In areas where the schooling rate is too low to ensure an acceptable coverage, alternative administrative systems, such as political parties, traditional chiefs, villagers’ associations, etc., could be used; for example, in the United Republic of Tanzania questionnaires aimed at political leaders have also worked well in this respect (7). Further investigations of the present study design are being carried out in a multi-country study.

A similar methodology to screen for S. mansoni infections is not yet available. Unfortunately, there are no sensitive and specific signs for this disease (5), and for intestinal schistosomiasis no diagnostic tool as simple and efficient as reagent stick testing is currently available.

The financial costs suggest that the proposed approach is very cost-effective compared with screening using standard urine filtration. Since the cost of the reagent sticks alone made up half the total screening costs, limited funding by an external funding agency or the central government (sticks and drugs) could lower the case detection costs to an amount affordable at the district level. Also, visual examination of urine for signs of blood prior to reagent stick testing might reduce substantially the number of sticks required, provided that easily understood criteria are defined (10).

Our results open up new possibilities for the PHC approach to disease control for the treatment of target disease(s) that can be dealt with at the dispensary level. Political and administrative support must also be provided by local and central government. A crucial issue is the motivation of non-health staff to carry out new tasks within the framework of their professional duties, which are usually narrowly defined. The feasibility of reagent stick testing by non-health professionals in a long-term control programme, involving repeated testing and treatment cycles, remains, however, to be demonstrated on a large scale.

Acknowledgements

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Résumé

Méthode rapide, de faible coût, en deux phases, pour dépister la schistosomiase urinaire au niveau du district: l'expérience de Kilosa

Dans de vastes régions d'Afrique, la situation de la schistosomiase est encore inconnue et pourtant, des données complètes sur la distribution de cette maladie sont un préalable indispensable à la planification des programmes de lutte. Par conséquent, nous avons examiné la valeur opérationnelle et diagnostique d'une méthode de dépistage en deux phases, basée essentiellement sur le système scolaire existant. L'étude a été effectuée dans le district de Kilosa, dans la partie centre-est de la République-Unie de Tanzanie.

La première phase consistait en l'envoi de questionnaires simples destinés aux instituteurs et à leurs élèves. Les questionnaires ont été distribués par le système scolaire. Au total, 15 073 élèves d'écoles primaires ont été interrogés par leur instituteur, dans 164 des 168 écoles du district (taux de réponse: 97,6%) pendant une période de quatre semaines. En raison de leur valeur prédictive négative élevée pour les taux d'infection scolaire modérés et élevés, les questionnaires permettaient d'exclure avec assez de certitude les écoles où le risque de maladie était faible. Les ressources disponibles pouvaient donc être concentrées sur les écoles où les taux d'infection étaient élevés. Le seuil de positivité scolaire a été fixé à 50,0% de prévalence parasitologique, valeur qui a été trouvée comme étant équivalente à un taux de prévalence d'hématurie (≥ 2+) de 38,4%, mesuré par des bandelettes réactives.

Dans la seconde phase, les instituteurs des 49 écoles positives et de 26 écoles négatives choisies au hasard comme témoins, ont appris à utiliser des bandelettes réactives pour dépécter l'hématurie. Par la suite, chaque instituteur a examiné 80 enfants dans son école: 5750 enfants ont été examinés en six semaines dans 73 des 75 écoles (taux de réponse: 97,3%). Une vérification effectuée dans 18 écoles par une équipe biomédicale a confirmé l'exactitude des examens faits par les instituteurs. Les enfants positifs ont reçu un traitement par le biais des services de santé existants.

Les résultats obtenus par examen à l'aide de bandelettes réactives ont été utilisés comme données de référence pour évaluer la valeur diagnostique des questionnaires utilisés dans la première phase.

La sensibilité, la spécificité et la valeur prédictive négative du questionnaire destiné aux enfants pour la détection des écoles à haut risque de schistosomiase étaient supérieures à 90%. Il a été également démontré que le rang de priorité de la schistosomiase pour l'organisation d'activités de lutte était fortement dépendant de la prévalence de cette maladie: à plus de 42% d'hématurie (≥ 2+), 44 des 46 instituteurs la considéraient comme faisant partie des "quatre premières maladies" et 7 instituteurs la considéraient comme étant la maladie absolument prépondérante pour l'organisation d'activités de lutte.

La méthode en deux phases décrite ici reposait entièrement sur le système scolaire existant et a permis le dépistage de 350 000 habitants dans un district rural de 15 000 km² en quatre mois pour seulement US$3 000. Cette méthode était deux fois plus rapide et huit fois moins coûteuse que le dépistage par la méthode standard de filtration de l'urine. De plus, la méthode peut être organisée et supervisée au niveau du district, sans qu'il y ait besoin d'avoir recours à des équipes spécialisées.

References


