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# Diagnostic performance of screening methods for urinary schistosomiasis in a school-based control programme, in Ibadan, Nigeria

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| KEY WORDS: |
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| Urinary Schistosomiasis |
| Diagnostic performance |
| Screening methods |

## Abstract

**Background**: Indirect diagnostic methods in urinary schistosomiasis are widely used for screening high-risk populations in endemic areas. Their diagnostic performances, however, vary. The objective of this study was to assess their usefulness in the context of a school-based control programme

**Methods**: An assessment of screening methods of urinary schistosomiasis was carried out among junior students in a secondary school. Interview technique (unqualified haematuria, terminal haematuria and dysuria), visual examination of urine and chemical reagent technique were each compared with microscopic examination of urine for schistosome ova.

**Results**: Chemical reagent strip technique was the most sensitive of all indirect methods assessed with sensitivity of 68.3%, followed by unqualified haematuria (41.7%), terminal haematuria (38.2%), dysuria (25.0%) and visual urine examination (16.7%). In terms of specificity, terminal haematuria and visual examination were the most specific with values of 96.1 and 96.0% respectively.

**Conclusion**: The validity of screening methods agreed with previous observations. Their use, however, depends on the endemicity of schistosomiasis in a given area. There is therefore a need to evaluate screening methods on a sample of the target population before being used to estimate prevalence of disease.

## Introduction

Screening for urinary schistosomiasis has been conducted using various indirect diagnostic tests such as interview technique for unqualified haematuria, terminal haematuria and dysuria, visual examination of urine specimen for macrohaematuria, chemical reagent strip technique for microhaematuria and proteinuria, and immunological method using monoclonal antibody based (mab) dipstick assay. These methods have been found to be simple and reliable with their outcomes serving as useful indicators of schistosomal infection among children in endemic areas[1].

Many authors working in schistosomiasis-endemic areas have described the availability, diagnostic performance and cost per child of some of these methods[2-9]. The findings showed variation in their diagnostic performances, especially sensitivities. This has made other authors to suggest further studies on the effectiveness of the screening options in endemic areas before an informed conclusion can be made.[2]

A school-based schistosomiasis selective treatment programme was initiated by the authors in collaboration with the National Schistosomiasis Control Programme, Federal Ministry of Health. It was embarked upon based on the observation that some patients treated at the endemic disease clinic of the University College Hospital, Ibadan, the base of the investigators, in the first quarter of year 2000, were students of Oba Akinbiyi High School II Mokola, Ibadan. This school is located close to the course of a slow-moving 'dandaru' stream, an area which had previously been reported as having moderately high endemicity for schistosomiasis[10]. As part of this larger programme, the authors assessed the diagnostic performance of some indirect methods of screening for urinary schistosomiasis and compared these with direct microscopic examination of urine sediments. The findings of this study are presented in this paper.

## Materials and Methods

The study was carried out in October 2000. All students of the Junior Secondary classes (J S S) 2 and 3 in Oba Akinbiyi High school 11 Mokola, Ibadan participated in the exercise. These students had spent at least one year in the school. The J.S.S 1 students were not included in the study because they were newly admitted and had not resumed at the time of the study. The screening methods appraised were interview technique (unqualified haematuria, terminal haematuria and dysuria), visual examination of urine and chemical reagent dipstick technique. Microscopic examination of urine sediment for schistosome ova was

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used as the confirmatory diagnostic test.

Information was collected from each study participant using an interview schedule, which was validated by pre-testing in a neighboring school Oba Akinbiyi High School I. The interview schedule obtained information on bio-demographic data, unqualified haematuria, terminal haematuria and dysuria as well as findings on visual and chemical reagent examinations of urine. The bio-demographic data included information on the age, sex, religion and place of residence of the participants. Unqualified haematuria was defined as a positive response to a question *"do you currently pass blood or have passed blood in your urine in the last three months?"* while terminal haematuria was defined as an affirmative response to a question *"does the blood come with the last few drops of urine?"* as a follow up to a positive response to the previous question. Dysuria was defined as the presence of pain during micturition within three months preceding the date of the interview. Each study participant provided urine specimen in a labeled transparent 20mls specimen bottle between 12.30pm and 1.30pm, when the egg load is known to be optimal in urine sample. This period also coincided with the school's lunch break. Students were instructed earlier to drop the last part of their urine stream into the labeled bottle about half full. Each urine specimen was first examined by the investigators, visually for macro-haematuria. Secondly, a standard multistrip (combi 9) was dipped into each urine specimen and the resultant colour change compared and interpreted against appropriate colour code on the multistrip bottle.

Qualitative urine sedimentation technique was used for microscopic examination of each urine specimen at the University Colege Hosîtal microbiology laboratory. Each urine specimen was centrifuged for about 10 minutes using macro centrifuge machine. One or two drops of its sediments was placed on a glass slide with pasteur pipette, covered with a slip and examined under a high power field x40 and x100 objective lenses of a microscope for schistosome ova.

Ethical approval was obtained from the joint University of Ibadan and University College Hospital Ethical Committee. Consent of the school Principal and teachers of the selected classes, Parent-Teachers Association (PTA), and the participating students was obtained before the study commenced. All infected students were treated with praziquantel tablets, which were supplied by the National Schistosomiasis Control Programme, at a single dose of 40mg per kg body weight. In addition, a health talk on schistosomiasis and its control was conducted for the entire population of students at the end of the exercise.

Collected data were checked for consistency. Analysis was done with the use of Statistical Package for Social Sciences (SPSS) version 10.0-computer software package. Missing values due to non-response or invalid recordings were treated by pair wise deletion (i.e. subject eliminated from the analysis for variables where no data are available). Prevalence of schistosomiasis by indirect and standard diagnostic methods was estimated and their correlations assessed using contingency coefficients for

0.19 was taken as poor correlation, 0.20 to 0.39 as fair correlation, and 0.40 to 0.59 as moderate correlation, 0.60 to 0.79 as substantial correlation and 0.80 to 1.00 as almost perfect correlation.[11] Sensitivity, specificity, predictive values and diagnostic accuracy of screening methods were calculated using standard formulae.[11]

## Results

A total of 592 Junior Secondary School (JSS) students were interviewed and their urine examined. Three hundred and seventy four (63.2%) were in JSS class 2, while 218 (36.8%) were in JSS class 3.

Table 1 shows the age, gender and religious distributions of the respondents. Their ages ranged from 11 to 20 years. Three hundred and seventy nine (64.0%) were in the 10 - 14 year age range and had mean age of 14.05 $\pm$1.5 years. In addition, 323 (54.6%) of the students were males while 269 (45.4%) were females and more than half 332 (56.1%) were Christians.

| Table 1: Age, sex and religion distributions of the respondents by class in school | | |
|---|---|---|
| Charact eristics | Category | Total n=592(100%) |
| Age group | 10-14 | 379 (64.0%) |
| | 15-19 | 211 35.8% |
| | 20- > | 1 (0.2%) |
| Sex | Male | 323 (54.6%) |
| | Female | 269 (45.4%) |
| Religion | Christianity | 332 (56.1%) |
| | Islam | 260 (43.9%) |

Table 2 shows the summary of the prevalence of schistosomiasis by the screening methods and their diagnostic performances. Chemical reagent strip test was the most sensitive of all the methods with sensitivity of 68.3%. This was followed by unqualified haematuria (41.7%), terminal haematuria (38.2%), and dysuria (25.0%). Visual examination was the least sensitive (16.7%). Terminal haematuria had the highest specificity (96.1%), positive predictive value (56.5%) and diagnostic accuracy (89.2%). The prevalence of schistosomiasis among the study participants was 12.2%. The table also shows the correlation coefficient of the prevalence by each screening method. The prevalence by chemical reagent technique was moderately correlated (0.447) with the prevalence by microscopic examination of urine, while that of subjective haematuria and terminal haematuria were

fairly correlated with contingency coefficient of 0.378 and 0.369 respectively. Subjective dysuria and visual method showed poor correlation with coefficients of 0.117 and 0.180 respectively. All the contingency coefficients were statistically significant at p<0.05.

The diagnostic performances of the screening methods were assessed in terms of their sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy in relation to the microscopic examination of urine sediments. Chemical reagent strip

**Table 2: Diagnostic performances of screening methods for urinary schistosomiasis**

| Diagnostic test | Sensitivity % | Specificity % | Positive predictive value % | Negative predictive value % | Diagnostic accuracy % | Prevalence of Schistosomiasis by screening methods % | Contingency coefficient |
|---|---|---|---|---|---|---|---|
| Unqualified heamaturia | 41.7 | 93.1 | 45.5 | 92.0 | 86.8 | 11.7 | 0.378 |
| Terminal heamaturia | 38.2 | 96.1 | 56.5 | 92.1 | 89.2 | 8.0 | 0.369 |
| Dysuria | 25.0 | 87.5 | 21.7 | 89.4 | 79.9 | 14.0 | 0.117 |
| Visual examination | 16.7 | 96.0 | 37.5 | 89.0 | 86.1 | 5.5 | 0.180 |
| Chemical reagent strip | 68.3 | 90.1 | 47.3 | 95.6 | 87.6 | 16.6 | 0.447 |
| Microscopic examination | 100 | 100 | 100 | 100 | 100 | 12.2 | 1 |

## Discussion

The prevalences of schistosomiasis by terminal haematuria (8.0%) and unqualified haematuria (11.2%) were fairly correlated with the presence of schistosome eggs in urine specimens (p<0.05). This finding is contrary to that obtained in Ethiopia[2] in a study which assessed the usefulness of questionnaires directed at school children and routed through teachers for identification of communities at risk for urinary schistosomiasis. The study found that there was no significant correlation between the prevalence of 4.1% by unqualified haematuria (blood in urine) and the prevalence of 21.9% by reagent strips and by extension urine microscopic prevalence of 2.7%. The authors however suggested that the low prevalence of the condition in the study population might be responsible for the lack of correlation.

The prevalence of schistosomiasis by chemical reagent strip technique (16.7%) gave the highest and significant moderately correlated prevalence with urine microscopy (contingency coefficient = 0.447). This is consistent with findings from most other studies that reported a higher diagnostic performance for chemical reagent strip technique[3, 4, 6, 15]. Poor correlation was obtained with dysuria (14.0%), visual method (5.5%) prevalence of schistosomiasis and microscopy. Contingency coefficients were 0.117 and 0.180 for dysuria and visual methods respectively. The poor correlation of microscopy with dysuria was, however, in line with what was obtained in the study carried out in Ethiopia[2]. Visual method might have recorded a low prevalence either because the students might not have strictly followed instructions with regards to collection of terminal stream of urine which is expected to contain blood or because of the difficulty in interpreting colour of urine to determine if it contains blood or not which to a certain extent is subjective.

performed relatively better compared to other methods, having the highest sensitivity of 68.3% and negative predictive value of 95.6%. The specificity was 90.1% while the positive predictive value and the diagnostic accuracy were 47.3% and 87.6% respectively. These findings are within the sensitivity range of 67 to 86.3% and close to specificity range of 92.6 to 97% as well as diagnostic accuracy 90% described in previous studies in Zambia, Zimbabwe and Tanzania.[4, 6, 7]

Among methods employing interview technique, dysuria performed least with sensitivity of 25%. This is low compared to the range of sensitivities 44.0 to 73.9% reported in previous studies[3, 4]. This finding is not surprising because dysuria is a non-specific symptom of schistosomiasis and may be over or underestimated depending on the prevalence of urinary tract infections, either concurrent or secondary, and other long-term complications such as obstructive uropathy among the study population. However, other questionnaire approaches, subjective haematuria and terminal haematuria had their sensitivities of 41.7% and 38.2% respectively close to the sensitivity range of what had been earlier described[3, 4]. The specificity of 93.1% for subjective haematuria and 96.1% for terminal haematuria found in this study were comparably high as with previous findings[3,].

Visual method of screening performed least of all the diagnostic techniques, with sensitivity as low as 16.7 per cent, positive predictive value of 37.5%, negative predictive value of 89.0% and specificity of 96.0%. Previous studies[3-5] described sensitivity range of between 38.0 and 40.6% for this method. The low value of sensitivity might have been due to faulty technique in the collection of urine by the students. This may not support visual method to be operationally effective among the school children. However, the high specificity and negative predictive value may support its use in areas where prevalence is low.

## Conclusion

The validity of the screening methods assessed in this study agreed to a large extent with previous reported observations, their uses will however depend on the level of endemicity of the disease in a given area. Also, since the predictive values of screening tests depends on the prevalence of the disease, an evaluation of indirect methods among samples of target population where such methods are to be used to estimate prevalence of the disease will be necessary.

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