Tropical Medicine and International Health

volume 5 no 1 pp 53–63 january 2000

Control of urinary schistosomiasis: an investigation into the effective use of questionnaires to identify high-risk communities and individuals in Niger State, Nigeria

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Summary Schistosomiasis is a public health problem in Nigeria. Although there is a national programme for its control, there is the need for reliable and simple means of rapidly diagnosing communities to provide a detailed map on the distribution of the disease in the country, in order to prioritize control activities, as well as to monitor the effectiveness of control operations. A rapid assessment technique using school questionnaires was tested in Borgu Local Government Area (LGA), Niger State, north-western Nigeria. Following a series of focus group discussions, the questionnaires were adapted before they were administered through the school system to 60 primary schools in Borgu LGA. Correctly completed questionnaires were returned from 58 schools (97%) within 4 weeks. Questionnaires were validated by reagent stick tests performed by trained teachers. Their results proved to be reliable compared to those obtained by our research team in 20 randomly selected schools. Overall prevalences of microhaematuria at 1+ and 2+ levels were 45.7% and 27.1%, respectively. Highly significant correlations were obtained between school prevalence of microhaematuria and reported schistosomiasis, as well as reported blood in urine. The diagnostic performance of the questionnaires at the 2+ level of microhaematuria was very good. The design of our study also allowed data analysis on an individual level, and multivariate analysis revealed highly significant odds ratios for reported schistosomiasis and reported blood in urine to detect an individual with urinary schistosomiasis. Our results are in good agreement with reports from other African countries, and questionnaires can be recommended for rapid identification of communities at highest risk of urinary schistosomiasis in Nigeria, so that scarce resources of the national control programme can be used most effectively.

keywords Nigeria, questionnaires, rapid assessment technique, *Schistosoma haematobium*, urinary schistosomiasis

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Introduction

Tools for schistosomiasis control are chemotherapy, health education, provision of safe water supplies, installation of adequate sanitation facilities and use of molluscicides for focal intermediate host snail control. However, the current aim of control is morbidity control, and chemotherapy is the most widely used strategy to achieve this goal (WHO 1993).

The most common method employed in diagnosing individuals and communities infected with urinary schistosomiasis has been detection and counting of eggs in urine. It is well acknowledged that this approach is time-consuming, requires trained personnel and is thus expensive. A considerable amount of research has therefore been focused on the development and validation of rapid and low-cost diagnostic tools. Reagent sticks to detect proteinuria and microhaematuria have been shown to be reliable in diagnosing urinary schistosomiasis (Wilkins *et al*. 1979; Mott *et al*. 1985; Savioli

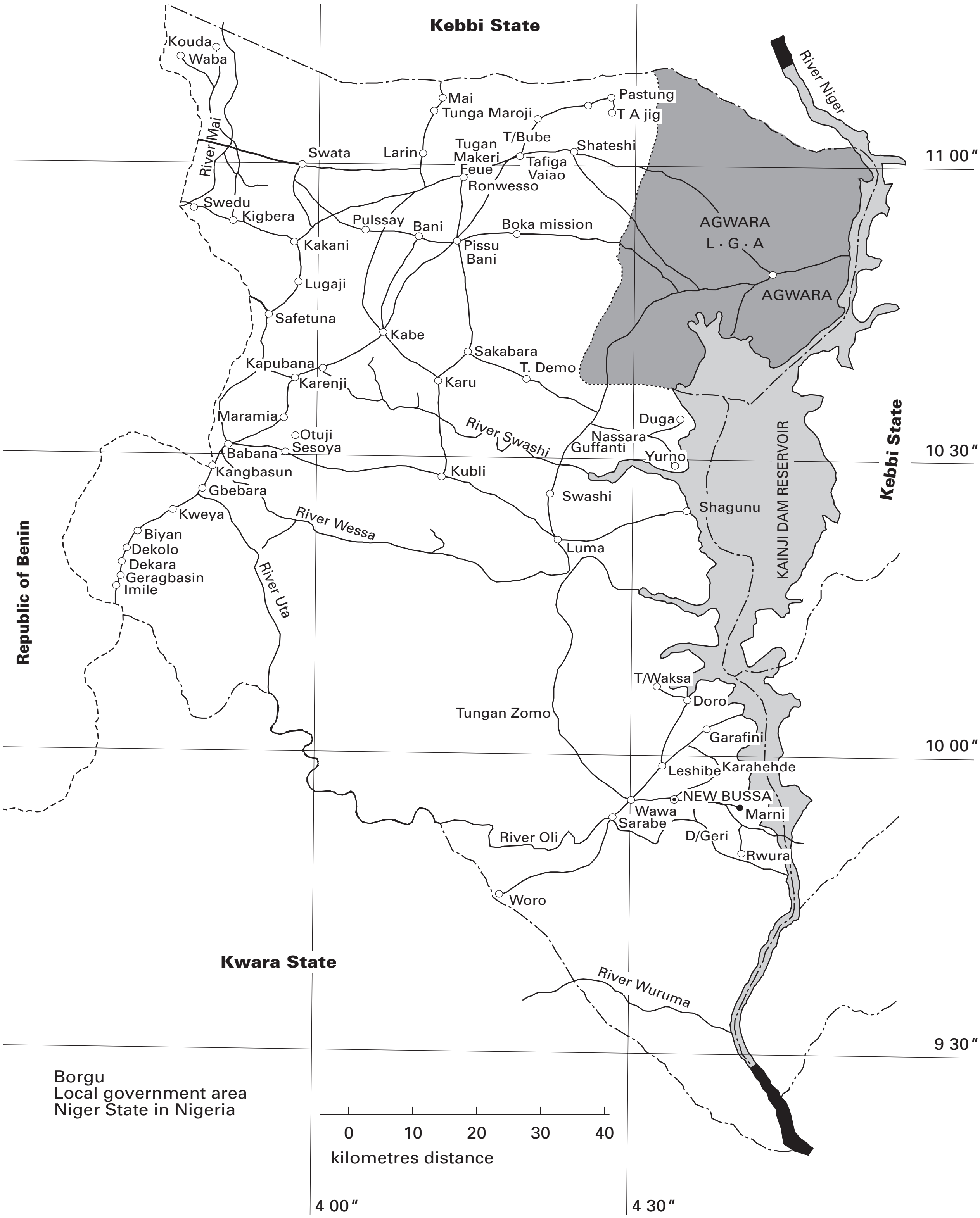

Figure 1 Map of the study area: Niger State, north-western Nigeria.

et al. 1989; Lengeler *et al*. 1993; Mafe 1997). More recently, it has been investigated whether indirect screening tools, such as simple questionnaires, may be used to identify communities at highest risk of urinary schistosomiasis. The idea was to rely on committed personnel at the grassroot level and outside the health sector, but within a well-established administrative system. The school system was identified as suitable with teachers interviewing their schoolchildren. The method was validated in several countries and its diagnostic performance was found to be good (Lengeler *et al*. 1991a,b; Red Urine Study Group 1995; Ansell *et al*. 1997; N'Goran *et al*. 1998).

In Nigeria, schistosomiasis constitutes a public health problem particularly in children. Both *Schistosoma haematobium* and *S. mansoni* are present, with the former being more widespread (Cowper 1973; Istifanus *et al*. 1988; Awogun 1990). Highest infection prevalences were observed among individuals aged 5–19 years who constitute 60–70% of all persons infected in the community (Cowper 1973; Tayo 1989). The distribution of schistosomiasis in the country is focal and at most times related to water development schemes, such as irrigation projects, rice/fish farming and dams.

Nigeria has a national schistosomiasis control programme that has the ultimate goal of eliminating schistosomiasis as a public health problem in the country. The age group 5–19 years has been defined as the target population for nationwide control through the school system. Considering the focal nature of the disease, the vast terrain of Nigeria, the large size of population at risk and the limited resources for control, it is vital that communities at highest risk be identified to ensure that resources are used in the most effective way. The rapid identification of disease pockets in the endemic states of the nation will define actual needs and identify priority areas for intervention in a phased control programme. Donor agencies could also be attracted to take some responsibility towards effective and sustainable implementation of control measures.

This report describes the development and validation of a questionnaire for rapid screening of communities at highest risk of *S. haematobium* infection in Borgu Local Government Area, Niger State. The design of the study also allowed to analyse the data on individual level, since individual answers to the questionnaire could be related to individual parasitological results.

Materials and methods

Study area

The study was conducted in Borgu Local Government Area (LGA), which is located in Niger State, north-western Nigeria (Figure 1), between March and December 1998. The total land area is 16 219 km^2 with a population estimated at 115 000 in 1994. Administratively, Borgu LGA is divided into 10 districts of varying sizes and populations, with the headquarters located in New Bussa town. Major ethnic groups are Bissans, Bokkos, Laru, Gungawa, Lupawa and Nupe, each with their own distinct language. However, Hausa is the language spoken by most, while the predominant religion is Islam. Borgu LGA falls within the savannah zone, with annual rainfalls of 1000–1200 mm. The Kainji Dam, which is the largest man-made lake in the country, was constructed in Borgu LGA between 1962 and 1968. The dam was built primarily for the generation of hydro-electric power, but it also is a major source of freshwater fish in Nigeria. The main occupation of the predominantly rural population is farming, while along the lake shores, fishing and trading play major roles. Pipe-borne water and electricity are only to be found in and around New Bussa, while the rest of the LGA rely on boreholes, wells and surface water bodies. The road network is poor and access to remote villages during the rainy season is difficult. Most villages have a primary school, but in some cases two or more villages share the same school. There are 64 primary schools in the LGA, 60 of which were enrolled in the study.

Schoolchildren's questionnaire

Throughout the survey, the study was presented as a general health survey of the Borgu LGA with particular interest in schoolchildren's health. The questionnaire used by Lengeler *et al*. (1991a,b) was employed as an entry point in developing a discussion guide for focus group discussions (FGD). They were conducted following the manual provided by Dawson *et al*. (1992), and used to probe for local terms for urinary schistosomiasis. Two FGDs were held with each of three different groups: primary schoolchildren, head teachers and health staff. For each group one FGD was conducted with males only and another with females only. The groups were representative with respect to ethnic groups, although with a higher representation of Bissan, the main ethnic group in the LGA.

The original questionnaire was modified using the information obtained from the FGDs. The term 'bilharzia' was used instead of 'schistosomiasis' and its most common local term was *fisari da jini*, which was inserted in brackets. Other terms were understood both in English and the main local languages Hausa, Bissang or Yoruba. The questionnaire was pretested in two schools to ensure correct understanding by teachers and children. After pretesting, FGDs were conducted in these two schools, with both interviewed children (7 of both sexes), and the teachers who conducted the interviews. No other modifications were necessary. The questionnaire can be obtained from the Correspondence.

The questionnaires were accompanied by two separate forms according to a procedure already used in Côte d'Ivoire (Utzinger *et al*. unpublished observation): instructions for teachers and blank class lists. First, the teachers were asked to read the instructions and then to fill in the names (alphabetical order), sex and age of their pupils in the class list. After completion of the list, children were interviewed individually according to alphabetical order. Answers were recorded as 'yes', 'no' and 'don't know' (counted as 'no' in the evaluation). This procedure allowed for data analysis at the individual level, since individual answers could be related to individual parasitological results.

Questionnaires were deposited at the office of the Education Secretary in New Bussa for delivery to the 60 primary schools. The head teachers of classes 3–5 interviewed children individually in English and local languages. Completed questionnaires were expected to be returned to the office of the Education Secretary within 4 weeks, from where they were retrieved by the research team. Questionnaires were screened in advance to assess the return rate, correct filling-in and to identify areas for clarifications before data entry.

Questionnaire validation: reagent stick testing by school teachers

All schools that returned correctly completed questionnaires were considered for biomedical validation. Letters were addressed to the head teachers of these schools inviting them to a one-day workshop. The objectives of the biomedical validation were explained and teachers were taught how to test for microhaematuria using reagent sticks (Sangur sticks, Boehringer Mannheim, Germany). It was emphasized that urine specimens should be collected only between 1000 and 1400 h. Test results were classified into four categories according to the manufacturer's instructions and were recorded as negative, 1+ , 2+ and 3+. At the end of the day, teachers were equipped with complete survey kits (copies of the listing sheets previously filled in with an empty column to record reagent stick test results, urine containers, gloves, reagent sticks, soap and plastic bucket). Head teachers confirmed that they would conduct the reagent stick tests as soon as possible and return results within 4 weeks.

Evaluation of teachers' reagent stick testing and treatment of infected children

Our research team returned to 20 randomly selected schools and performed biomedical tests using reagent sticks and standard urine filtration. Urine specimens were collected between 1000 and 1400 h and first tested by reagent sticks, as explained above. Then 10 ml of urine were filtered through Nucleopore paper filters. These were stained with a drop of Lugol and examined under light microscope for the presence and number of *S. haematobium* eggs. Results of this standard technique were considered as 'gold standard'. For those schools where at least 15 children were tested with both methods, a linear regression was drawn between the prevalence rate of *S. haematobium* (assessed by urine filtration) and the prevalence rate of microhaematuria at the 1+ and 2+ positivity level (assessed by reagent stick testing). Children with a positive reagent stick result obtained by the research team were directly treated with a single oral dose of praziquantel (under supervised administration) at the recommended standard dose of 40 mg/kg body weight (WHO 1993) (Figure 2).

Data management and statistical analysis

All questionnaire and parasitological data were double-entered and cross-checked using EpiInfo software (version 6.04; Centres for Disease Control and Prevention, Atlanta, Georgia, USA). The diagnostic performance of reagent sticks was assessed by comparison with the results of urine filtration. Results of teachers' reagent stick testing were compared with those of the research team in order to assess the reliability of teachers' testing.

At the community (school) level, the Spearman rank correlation was computed between the school infection prevalence of microhaematuria and the questionnaire positivity rates in each school. The diagnostic performance of the questionnaire to identify a school where the children are at highest risk of microhaematuria was calculated by computing the sensitivity, specificity and predictive values, including 95% confidence intervals. Logistic regression analysis was performed at the individual level for those children who had a reagent stick result and complete questionnaire answers, in order to assess the most reliable reported symptom(s) and/or disease(s) for individual diagnosis of *S. haematobium* infections.

Results

Focus group discussions

The terms 'bilharzia' and 'schistosomiasis' were unknown to the schoolchildren. However, local Hausa names such as *fisari da jini* and *boli da jini* were well known, the former being more widely understood than the latter. In Bissanya the term is *osoroku aruwo*. The meaning of these local names is 'blood in urine'. The large majority of teachers also were unfamiliar with the terms 'bilharzia' and 'schistosomiasis', however, they clearly understood the disease as passing of blood in urine, although many of them did not know the cause. All health staff were familiar with the two terms 'bil-

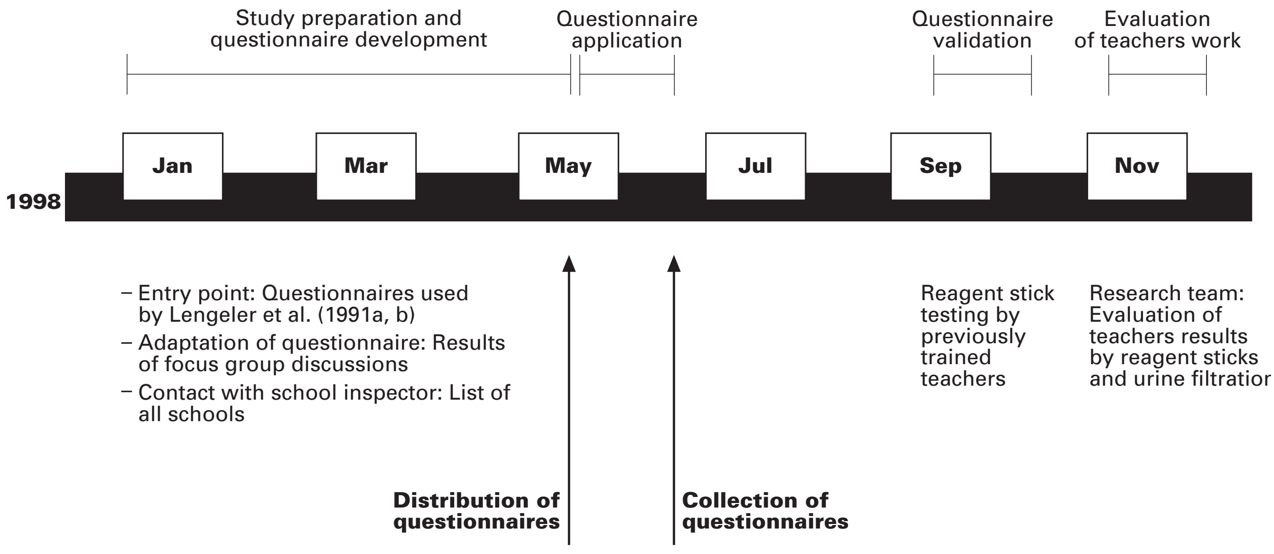

Figure 2 Study design.

harzia' and 'schistosomiasis'. Blood in urine was well understood and the same local terms as above were given.

A few teachers and a few children also attributed the symptom of blood in urine to gonorrhoeal infection and sexually transmitted diseases. Similar observations were made for 'pain when urinating'. Consequently, such conditions were strongly linked to prostitution.

Operational results

The return rate of school questionnaires was high, with 58 of the 60 schools (96.7%) returning correctly completed questionnaires within 4 weeks. A total of 3033 children were interviewed individually by their teachers: 1123 in class three, 956 in class four and 954 in class five. The mean age was 11.2 (2.1 years, and the sex ratio (male/female) 1.9. An average of 52 children were interviewed per school (range: 3–457). Overall, 24.8% (95% confidence interval (CI): 23.3–26.4%) of the children responded positively to the question about excretion of blood in their urine during the last month and 24.1% (95% CI: 22.5–25.6%) said that they had had bilharzia.

Fifty-six of 58 schools (96.6%) sent in their results of the reagent stick tests. One of the two schools that did not return the validation results had a fire accident that engulfed the school and its contents including the test documents and materials, while the second school claimed to have forwarded the results but these were never received. Teachers tested 2479 children (mean: 44 per school, range: 3–327). The mean age was 11.2 (2.1 years (range 5–23 years) and the male/female ratio was 2.0. The prevalence rate for microhaematuria at 1+ positivity level was 43.7% (95% CI: 41.7–45.7%), and 27.1% (95% CI: 25.4–28.9%) at 2+ positivity level.

Validation of reagent stick testing

Cross-checking was performed on 529 children in 20 randomly selected schools (mean number of children per school: 27, range: 4–76). Their mean age was 11.0 (1.8 years (range: 7–20) and the male:female ratio was 2.1, therefore giving a population similar to the one interviewed by questionnaires and tested by the teachers with reagent sticks. A comparison of filtration and reagent stick test results, both obtained by

Table 1 Comparison between urine filtration (considered as reference) and reagent stick testing both performed by our research team

	Urine filtration		
	+	–	Total
Reagent sticktesting			
+	134	61	195
–	38	296	334
Total	172	357	529

Sensitivity: 77.9% (95% CI: 70.8–83.7%). Specificity: 82.9% (95% CI: 78.5–86.6%). Positive predictive value: 68.7% (95% CI: 61.5–75.0%) Negative predictive value: 88.6% (95% CI: 84.6–91.7%) Kappa agreement 0.59 (0.04 ($P < 0.0001$).

Table 2 Comparison between reagent stick testing performed by our research team (considered as reference) and school teachers

	Research team		
	≥ 11	Negative	Total
School teachers			
≥ 1+	146	34	180
negative	31	275	306
Total	177	309	486

Sensitivity: 82.5% (95% CI: 75.9–87.6%). Specificity: 89.0% (95% CI: 84.8–92.2%). Positive predictive value: 81.1% (95% CI: 74.5–86.4%). Negative predictive value: 89.9% (95% CI: 85.8–92.9%) Kappa agreement 0.71 0.05 ($P < 0.0001$)

the research team, gave good sensitivity and specificity values, as well as a good κ agreement (0.59 0.04, $P < 0.0001$), showing the reliability of using reagent sticks (Table 1). Comparison between the reagent stick results obtained by the research team and the teachers gave good sensitivity and specificity values, and also a good κ agreement (0.71 0.05, $P < 0.0001$), although they were done on average 3 months apart (Table 2). These findings indicate the reliability of teacher's reagent stick results for the validation of the children's responses to the questionnaires.

Correlation between questionnaire results and teacher's reagent stick testing

Preliminary analysis of the data showed that very few children were interviewed and tested with reagent sticks in some schools. Those schools with the lowest number of children were removed gradually, and the analysis repeated at each step. This process revealed that schools with less than 15 children interviewed and/or tested with reagent sticks were less reliable in the correlation between the questionnaire positivity rate and school prevalence of microhaematuria. Therefore, only the 39 schools where at least 15 children were interviewed and tested by reagent sticks were used for final analyses. Spearman rank correlation showed highly significant associations between the overall school prevalence of microhaematuria and reported bilharzia and reported blood in urine, making these two the best questions in the study area. At microhaematuria positivity level of 1+ , reported bilharzia resulted in a rho-value of 0.48 ($P = 0.003$), which was slightly higher than the one measured for reported blood in urine (rho: 0.47, $P = 0.004$). Stronger correlations were obtained at the 2+ positivity level of microhaematuria, for both reported blood in urine and reported bilharzia, with corresponding rho-values of 0.63 ($P < 0.001$) and 0.59

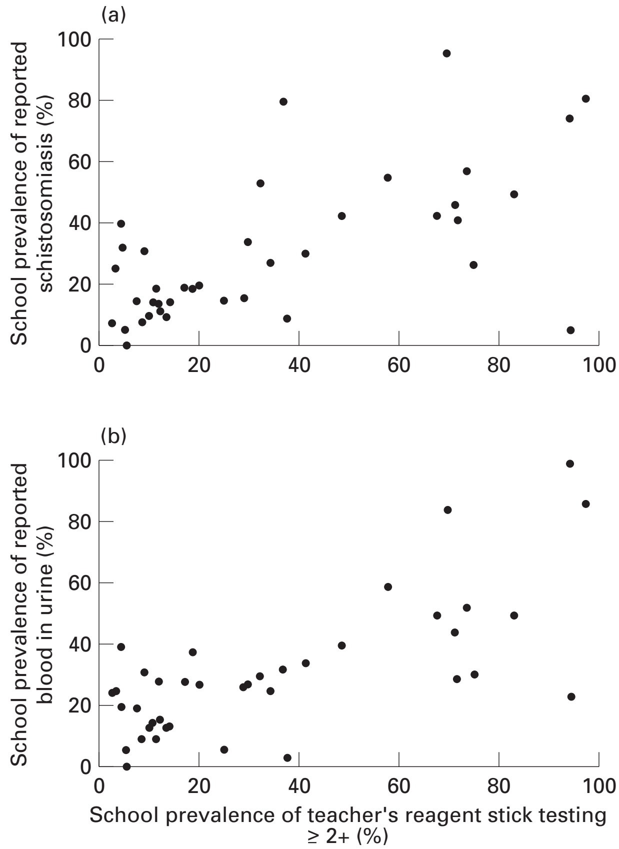

Figure 3 Relationship between school infection prevalence of microhaematuria ≥ 2+ and the prevalence of reported symptoms and/or diseases (only those schools with ≥ 15 children interviewed and tested with reagent sticks: $n = 39$). a, reported schistosomiasis; b, reported blood in urine.

($P < 0.001$), respectively. The relationship between overall school prevalence of microhaematuria at the 2+ level and the frequency of children with reported blood in urine and reported bilharzia is depicted in Figure 3.

Diagnostic performance of the questionnaire

In 13 schools more than 15 children were tested by our research team using standard urine filtration and reagent stick testing. The linear regression between the prevalence rate of *S. haematobium* (assessed by urine filtration) and the prevalence rate of microhaematuria (assessed by reagent stick testing) showed a significant correlation at both the 1+ and 2+ positivity level, with the correlation at the 2+ level being higher than at the 1+ level. To compare the standard urine

Table 3 Diagnostic performance of reported schistosomiasis and reported blood in urine at two detection thresholds for reagent stick testing (2+ to detect schools with a high risk of urinary schistosomiasis (n = 39 schools).

	Questionnaire cut-off (%)	Diagnostic performance % (95% CI) Sensitivity		Specificity		PV1		PV2	
Microhaematuria ≥ 2+ : 13.0% (urine filtration: 20%)									
Reported bilharzia	15	72	(50–87)	64	(36–86)	78	(56–92)	56	(31–79)
Reported blood in urine	25	80	(59–92)	79	(49–94)	87	(65–97)	69	(42–88)
Microhaematuria ≥ 2+ : 53.7%b (urine filtration: 50%)									
Reported bilharzia	40	82	(48–97)	86	(66–95)	69	(39–90)	92	(73–99)
Reported blood in urine	40	73	(39–93)	96	(80–100)	89	(51–99)	90	(72–97)

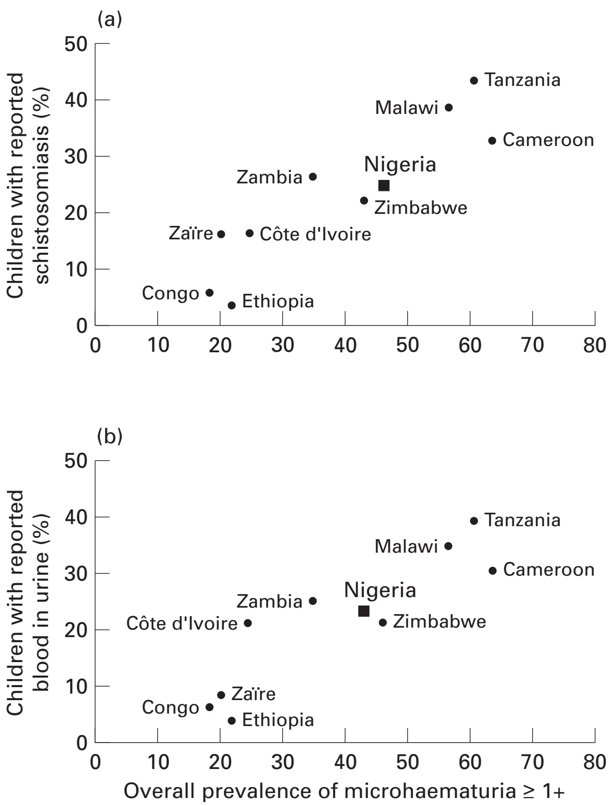

Figure 4 Review of all country studies to assess the relationship between the cumulative school infection prevalence of microhaematuria (≥ 1+) and the prevalence of reported schistosomiasis (a) and reported blood in urine (b). Data sources: Tanzania: Lengeler *et al*. 1991b; Côte d'Ivoire: N'Goran *et al*. 1998; Nigeria: our data; other countries: Red Urine Study Group 1995.

filtration screening method with the reagent stick testing results, the following linear transformation was computed:

Parasitological prevalence = 0.74 prevalence of microhaematuria (≥ 2+) + 10.4

According to Montresor *et al*. (1998), parasitological prevalences of 20% and 50% can be considered a threshold for moderate or high school infection rates. The linear transformation resulted in prevalence rates for microhaematuria (≥ 2+) of 13.0 and 53.7%, respectively.

Consequently, the diagnostic performance of the questionnaire was calculated at these two detection thresholds of microhaematuria (≥ 2+). The questions on reported schistosomiasis and reported blood in urine showed high sensitivities and specificities, especially at the high detection threshold. Of particular interest was the negative predictive value, i.e. a high negative predictive value permits the safe exclusion of schools where the risk of urinary schistosomiasis is low. At the high detection threshold, the negative predictive values were 90% and above for the two key questions (Table 3).

So far, the relation between microhaematuria estimated with reagent sticks and the positive responses to reported blood in urine and reported schistosomiasis (bilharzia) has been constant in Africa. Linear regression analysis between findings from Tanzania (Lengeler *et al*. 1991b), eight other African countries (Red Urine Study Group 1995; N'Goran *et al*. 1998) and our results from Nigeria show highly significant correlations between reported schistosomiasis and country microhaematuria (≥ 1+) prevalence (r = 0.90, P = 0.0003; Figure 4a), as well as between reported blood in urine and country microhaematuria (≥ 1+) prevalence (r = 0.90, P = 0.0004; Figure 4b).

Analysis at the individual level

Teachers' reagent stick testing results, as well as complete

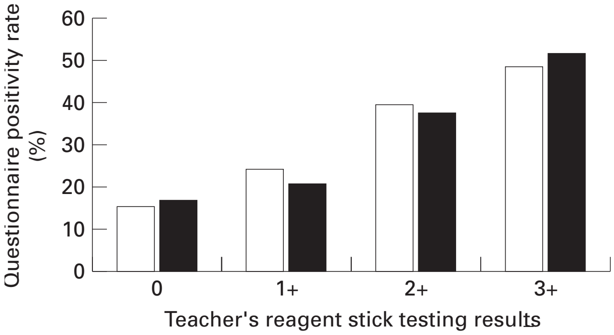

Figure 5 Percentage of children who reported having had schistosomiasis (□) and blood in urine (■) during the last month, in relation to intensity of reagent stick testing results.

answers to the questionnaire, were obtained for 2378 children. The frequency of reported blood in urine and reported bilharzia increased significantly with increasing intensity of infection (Figure 5). The χ^2-test for linear trend revealed very high values of 222.9 ($P < 0.0001$) for reported blood in urine and 217.8 ($P < 0.0001$) for reported schistosomiasis.

Logistic regression analysis at the individual level showed that an infection with *S. haematobium* (microhaematuria $\geq$ 1+) was significantly associated with sex (adjusted odds ratio 0.74, 95% CI: 0.61–0.89, $P = 0.001$), indicating that girls were more likely to be infected. There was also a significant association with age (adjusted odds ratio 1.08, 95% CI: 1.04–1.13-, $P < 0.001$), with older children more often infected. Multivariate analysis revealed significant odds ratios for reported bilharzia and reported blood in urine. The adjusted odds ratios were 2.55 (95% CI: 1.99–3.25, $P < 0.001$) and 1.95 (95% CI: 1.54–2.48, $P < 0.001$), respectively (Table 4). At the 2+ positivity level of microhaematuria, the adjusted odds ratios for these two questions were higher with 2.91 (95% CI: 2.36–3.94, $P < 0.001$), and 3.05 (95% CI: 2.36–3.94, $P < 0.001$), respectively.

Discussion

Towards the end of the 1980s, Lengeler *et al*. (1991a) presented a simple questionnaire that allowed rapid identification of communities at highest risk of *S. haematobium* infection in a rural Tanzanian district. Questionnaires were administered through the school system and found to be feasible and effective. The method was first validated in a neighbouring district (Lengeler *et al*. 1991b), and then in Cameroon, Congo, Democratic Republic of Congo (formerly Zaïre), Ethiopia, Malawi, Zambia and Zimbabwe (Red Urine Study Group 1995). Most recently, the questionnaire was validated in another Tanzanian district (Ansell *et al*. 1997), in Côte d'Ivoire (N'Goran *et al*. 1998) and is currently under validation in Guinée (P. Winch & M. Murray, personal communication). So far, with only the exception of Ethiopia (Jemaneh *et al*. 1996), highly significant correlations were found between the proportion of children with reported schistosomiasis, as well as reported blood in urine, and the proportion of children infected with *S. haematobium*.

In view of these findings, we concluded that questionnaires are rapid, easy to perform, reliable, nonintrusive and highly

Table 4 Multivariate analysis to assess the best reported symptoms and/or diseases for identification of individuals with a reagent stick result of $\geq$ 1+ or $\geq$ 2+, after adjusting for confounding factors (n = 2378 children).

	Reagent stick results $\geq$ 1+			Reagent stick results $\geq$ 2+		
Variable	Adjusted odds ratio (95% CI)		*P*-value	Adjusted odds ratio (95% CI)		*P*-value
Children surveyed						
Age	1.08	(1.04–1.13)	< 0.001	1.10	(1.05–1.15)	< 0.001
Sex	0.74	(0.61–0.89)	0.001	0.74	(0.60–0.92)	0.007
Reported symptoms and/or diseases						
Bilharzia	2.55	(1.99–3.25)	< 0.001	2.91	(2.36–3.94)	< 0.001
Blood in urine	1.95	(1.54–2.48)	< 0.001	3.05	(2.36–3.94)	< 0.001
Cough	0.71	(0.59–0.85)	< 0.001	0.74	(0.59–0.92)	0.006
Malaria	0.78	(0.64–0.94)	0.008	0.77	(0.61–0.95)	0.017
Diarrhoea	1.27	(1.04–1.54)	0.019	0.94	(0.74–1.18)	0.573
Intestinal worms	0.80	(0.66–0.98)	0.029	0.76	(0.60–0.95)	0.018
Vomiting	0.86	(0.71–1.04)	0.120	0.73	(0.59–0.92)	0.006
Blood in stool	0.92	(0.74–1.13)	0.421	0.71	(0.55–0.91)	0.006

cost-effective tools to screen for *S. haematobium*. However, the questionnaire should be validated further when it has been significantly modified or where strong arguments are needed to convince health authorities about the usefulness of the method (Chitsulo *et al.* 1995). In the case of Nigeria, this was done for both of those reasons. Although the original questionnaire provided by Lengeler *et al.* (1991a,b) was used as an entry point, it was considerably modified, following a series of focus group discussions conducted with schoolchildren, head teachers and health staff. Questionnaires were considered a promising tool for rapid identification of priority areas for schistosomiasis control in Nigeria, so that the national programme's limited resources can be used most effectively. A validation of questionnaires was therefore necessary to provide sound recommendations about the potential large-scale application of this method.

The design of the questionnaire validation used in this study followed that of previous surveys. Questionnaires were first modified, then pretested, finally adapted and lastly administered through the school system. Our approach was novel in that the questionnaire was modified on the basis of information obtained in focus group discussions. This procedure was effective and allowed for rapid identification of common local terms for passing blood in urine. Focus group discussions were also successfully used in Côte d'Ivoire to determine common symptoms and local terms to predict an infection with *S. mansoni* (Utzinger *et al.* 1998), as well as an infection with *Entamoeba histolytica*/*E. dispar* (Utzinger *et al.* 1999).

In the second step, questionnaires were validated with reagent stick tests performed by previously trained teachers. Validation by teachers had already been reported from Tanzania (Lengeler *et al.* 1991b), and from eight other African countries (Red Urine Study Group 1995; N'Goran *et al.* 1998). In summary, the teachers' performance and commitment was excellent and they consistently stated their pride in having received training on the use of reagent sticks. Magnussen *et al.* (1997) have suggested that teachers could play an important role in schistosomiasis control programmes, a point we would strongly support.

In a third step, a biomedical team was sent to a random sample of schools to check teachers' results by performing urine filtration and reagent stick tests. When the research team's results of urine filtration were compared with those obtained from reagent stick testing, high sensitivity (78%) and high specificity (83%) were obtained. This is in good agreement with previous studies (Wilkins *et al.* 1979; Mott *et al.* 1985; N'Goran *et al.* 1998; Savioli *et al.* 1989; Lengeler *et al.* 1993; Mafe 1997). Comparison of the reagent stick results between the research team and the teachers also showed high sensitivity (83%) and high specificity (89%). Therefore, teachers' reagent stick results were a reliable means for biomedical validation of school questionnaires.

In view of our findings, the results of this study, which is the first of its kind conducted in Nigeria, are in full agreement with those obtained from 9 other African countries, and further support the use of questionnaires for rapid screening of *S. haematobium*. It was interesting to note that the two key questions of reported blood in urine and reported schistosomiasis showed better correlations with the 2+ level of microhaematuria than with the 1+ level. This was also observed by Lengeler *et al.* (1991b), but is in disagreement with Lwambo *et al.* (1997).

However, there is one major concern which represents a serious issue in our study, namely the very low enrolment in several of the schools surveyed. For final analysis, schools with less than 15 children interviewed or tested with reagent sticks were removed, which represented a third (30%). Removing schools for statistical analysis is defensible, to recommend such an approach to schistosomiasis control managers is, however, unacceptable. Furthermore, since several of the schools removed from analysis had very high prevalences of microhaematuria, it may be advisable to interview all children rather than only classes 3–5 in small schools.

We believe that our survey contains an additional element which is novel and merits discussion. Questionnaires were accompanied by blank class lists, and teachers were asked to complete these forms prior to individual interviewing of the children. For data analysis, this enabled the determination of the diagnostic performance of the questionnaire not only on school but also on individual level. This idea was recently developed in Côte d'Ivoire and found to be well understood by teachers as they followed the instructions correctly (Utzinger *et al.* submitted). Logistic regression modelling revealed significant odds ratios for reported schistosomiasis and reported blood in urine. However, at the 1+ level of microhaematuria the adjusted odds ratios were rather low: 2.55 and 1.95 for these two key questions, respectively. In a previous study in Tanzania, reported blood in urine showed a much higher adjusted odds ratio of 7.71 (Booth *et al.* 1998). At the 2+ positivity level of microhaematuria, the adjusted odds ratios were considerably higher: 2.91 and 3.05, respectively. Another study conducted in Tanzania revealed that self-reported schistosomiasis was a valuable indicator to identify infected individuals, especially in schools with a high infection prevalence (Ansell *et al.* 1997). In light of these results, it seems advisable to further investigate whether questionnaires could also be used for individual diagnosis of *S. haematobium*, as is also suggested by Barreto (1998).

Acknowledgements

The authors acknowledge the cooperation and participation of the Education Secretary and the headmasters of the primary schools of Borgu LGA, Niger State. We thank the teachers of classes 3–5 and the schoolchildren who responded to the questionnaire and provided urine specimens. We also thank Mr Ogungbemi, Alhaji Aliyu Usman, Drs Manafa and Awolola, Mrs F. Balogun, Mr Duker, Mr Mohammed Gani, Ms Musa and Mrs Hajara for technical assistance. The contribution of Dr (Mrs) H. N. Mohammed of the Niger State Ministry of Health is duly acknowledged. Thanks is due to Dr C. Lengeler from the Swiss Tropical Institute for making useful comments on the manuscript.

The survey was undertaken while MAM and TvS were supported by the German Technical Cooperation, LAFIA PHC Project (GTZ). MAM also acknowledges the contribution of the Nigerian Institute of Medical Research. JU was supported by the Rudolf Geigy Foundation and EKN by the Swiss Academy of Natural Sciences.

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