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ORIGINAL RESEARCH

Knowledge, Attitudes, and Practices Related to Schistosomiasis Among Children in Northern Senegal

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Abstract

BACKGROUND Schistosomiasis is a highly prevalent parasitic disease in Senegal. The early symptoms are hematuria and dysuria. Children's comprehension of the disease is fundamental to preventing the infection.

OBJECTIVES The aim of this study was to investigate the knowledge attitudes, and practices related to schistosomiasis among schoolchildren in 2 rural villages in Northern Senegal and to evaluate their impact on the disease.

METHODS A cross-sectional study was conducted. Data about children's knowledge of schistosomiasis, behavior, and preventive measures were collected through a questionnaire.

FINDINGS Questionnaire responses from 575 schoolchildren were analyzed. Correct answers about risky behavior for schistosomiasis were associated with early symptoms ($P = 0.010$). Wearing shoes and washing hands with soap were associated with not having hematuria and dysuria ($P = 0.007$ and 0.049, respectively). Playing in rivers was associated with the aforementioned symptoms ($P < 0.001$). Children who had good knowledge of schistosomiasis reportedly did not have symptoms ($P = 0.002$). A logistic regression model showed that female sex (odds ratio = 0.35; $P = 0.01$) and attending a primary school (odds ratio = 0.13; $P < 0.001$) were significant predictors of a lower risk of the early symptoms of urinary schistosomiasis.

CONCLUSIONS This study revealed that the level of knowledge among children in North Senegal about the causes, transmission, prevention, and treatment of schistosomiasis warrants implementing educational intervention.

KEY WORDS attitude, children, knowledge, practices, schistosomiasis, Senegal

Schistosomiasis, a neglected tropical disease, is a parasitic infection characterized by intestinal and urogenital forms. *Schistosoma intercalatum*, *Schistosoma japonica*, *Schistosoma mansoni*, and *Schistosoma mekongi* cause the intestinal infection, while *Schistosoma haematobium* causes the urogenital form.[1] This disease has infected 207 million people, mostly in sub-Saharan Africa,[1,2] causing a disability rate ranging from 0.5% to 15%.[3,4] The prevalence in the north of Senegal was 61% for *S mansoni* and

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50% for *S haematobium* infection.[5] For urinary schistosomiasis, the reported prevalence among children aged 7 to 15 years was 57.6%.[6] Children aged between 5 and 15 years have a higher infection rate, with a consequent reduction in the adult population.[3,7-10] The reported risk of infection was higher in women,[5] but in other studies,[11,12] male children were more likely to be infected than female children were.[8-10] Socioeconomic status, level of education, and untreated water and sanitation were associated with transmission of the pathogens.[1]

In the pediatric population, the early symptoms of urinary schistosomiasis are haematuria, with a prevalence ranging from 15.8% to 52.4%,[13,14] and dysuria, with a prevalence ranging from 19.5% to 54.3%.[15] Urinary schistosomiasis is a debilitating chronic illness that causes hydronephrosis and sequelae such as bladder calcification and bladder cancer. It also increases the risk of HIV infection.[14,16] The main consequences of this public health challenge are disturbed growth, impaired cognitive development, and reduced capacity to work.[17]

Three diagnostic methods have been reported as effective. The microscopic detection of eggs in urine is considered the gold standard. Indirect diagnosis can be performed with hematuria dipsticks or simple questionnaires. These tools are easy and inexpensive for rapid screening in endemic areas.[7] The World Health Organization recommends questionnaires as the first step in controlling schistosomiasis.[13,18]

The intervention strategies for this disease are safe water, hygiene, education, and preventive treatment with praziquantel.[1] In particular, inculcating the habit of washing hands with soap and playing away from rivers and other water sources is fundamental.[14,19] Working and playing near a river was significantly associated with *S haematobium* infection.[10,20] Another important strategy is fostering knowledge about the disease. In a study in Zimbabwe in 2011, Midzi et al. reported that 32% of children knew the causes of schistosomiasis and 22% knew the preventive actions. A questionnaire that targets knowledge, attitudes, and practices (KAPs) is the most recognized method for investigating awareness of disease.[8-10,21]

To our knowledge, no studies have used KAPs for schistosomiasis Senegal. Thus, the aim of this study was to describe the KAPs around the early symptoms of schistosomiasis among schoolchildren in 2 rural villages in Northern Senegal and to evaluate the impact these KAPs had on the disease.

METHODS

Study Setting. Kassak North is one of the largest villages in the Saint Louis region in northern Senegal, with 3200 inhabitants. Roughly 10 km downstream, Kassak South has 1390 inhabitants. Both villages have primary schools, but students progress to the only secondary school present, in Kassak North. Power is transmitted to both villages by lines from the dam, but it is not available to the whole village. Chlorine-treated, chargeable water is conveyed from the river to the mainly brick or mud-and-straw houses through municipal pipelines. Each village has a health post run by a nurse and a maternity service managed by experienced mothers. The nearest clinic is 40 km away, and the nearest hospital is 75 km away. Both villages are near a stream. At Kassak South, the stream is less accessible due to irrigation dams.

Study Design and Participants. A cross-sectional study recruiting primary and secondary school children in Kassak North and Kassak South was carried out during school classes over 3 days in May 2014. All children present at school were recruited with no age limits.

Data Collection. In this study, the knowledge, behavior, and preventive measures related to schistosomiasis were investigated. Socioeconomic data and data on the presence of hematuria and dysuria in the previous month were collected, as reported by children. Local residents helped to improve the readability and comprehensibility of the questionnaire, which pooled 22 queries that followed examples in the literature.[13,15] All items were in a "yes" or "no" format. The present authors tested the questionnaire among 10 schoolchildren to evaluate its readability, clarity, and conciseness. The questionnaire was then approved by directors and teachers. Teachers actively helped the researchers to administer the questionnaire.

Statistical Analysis. Statistical analysis was carried out using STATA V.13 (Stata Corp, College Station, TX). A descriptive analysis of the sample was conducted, according to the presence of the early schistosomiasis symptoms (hematuria and dysuria) and considering the distribution of gender, classroom, village, school, knowledge of schistosomiasis, previous diagnosis of schistosomiasis, and socioeconomic status. Results were expressed in frequencies and percentages. Finally, multivariate analysis was conducted using a logistic regression model to assess the potential predictors of early symptoms of urinary

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schistosomiasis. The results were expressed as odds ratios with 95% confidence intervals, and a 2-tailed probability value of less than 0.05 was considered significant.

Categories. Socioeconomic status was identified by the ownership of 10 goods (concrete house, radio, television, refrigerator, fan, water pump, bicycle, motorcycle, and car) and their relative frequencies of distribution among the population. The scores, which ranged from 0 to 5.5 points, were categorized in 3 socioeconomic classes as follows: low (0—1.5 points), medium (1.6—3.0 points), and high (3.1—5.5 points).

The present authors collected and categorized the children's knowledge of risky behavior related to schistosomiasis. Six questions were asked: 1) Do you wear shoes? 2) Do you wash your hands before eating? 3) Do you wash your hands after using the toilet? 4) Do you wash your hands with soap? 5) Do you play near the river? 6) Do you use water from the river?

The authors created a variable called "correct answers on risky behavior," which used four categories: a) all answers were correct; b) 4 to 5 answers were correct; c) 2 to 3 answers were correct, and d) 0 to 1 answers were correct.

To investigate the children's knowledge about schistosomiasis prevention, the present authors asked the children, "How can you be infected by schistosomiasis?" and offered the following answers: 1) playing in the river; 2) drinking salt water; 3) eating a lot of salt; 4) through worms in the water; 5) entering the toilet without shoes; 6) through snails; 7) stepping on urine; 8) eating green mangoes; 9) playing with fire; 10) not wearing shoes; 11) walking in a place that belongs to witches; and 12) urinating in water. The authors called the variable "correct answers on prevention of schistosomiasis" and sorted the answers into 3 categories of knowledge: good (10-12 correct answers), medium (7-9 correct answers), and poor (0-6 correct answers).

To investigate the children's knowledge about treatment for schistosomiasis, the authors asked, "What can you do if you are infected by schistosomiasis?" and offered the following answers: 1) take medication, 2) go to the health office, 3) take herbs, or 4) boil the roots of plants. A variable called "correct answers on treatment of schistosomiasis" was created, identifying 3 categories of knowledge: good (4 correct answers), medium (2-3 correct answers), and poor (0-1 correct answers).

Ethical Considerations. Ethical approval was obtained from the National Ethics Committee for Health Research of the Ministry of Health and Social Action in Senegal. All the procedures followed the ethical standards of the Helsinki Declaration of the World Medical Association. All the data were anonymized, and a written consent was obtained from the Directeur de l'École Primaire, Kassack North, Senegal, and the children's parents.

RESULTS

The sample included 575 schoolchildren. No child refused to participate in the study. Of the participants, 275 were male (48.4%) and 293 (51.6%) were female. The mean age of the sample population was 13.1 ± 2.5 years (range, 7-20 years). Most of the children (327; 58.9%) lived in Kassak North, followed by 159 (28.7%) in Kassak South, and 69 (12.4%) in other villages. The number of males who reported that they had been infected by schistosomiasis (195; 82.3%) was higher than the number of females who reported they had been infected (172; 67.9%) ($P = 0.001$).

Hematuria and dysuria were reported to have been higher during the previous month in male children than in female children. Hematuria was reported by 156 (58.9%) boys and 137 (48.6%) girls ($P = 0.016$). Dysuria was reported by 129 (49.1%) boys and 109 (39.1%) girls ($P = 0.019$). The percentage of boys who declared that they played in the river was higher than the percentage of girls (66.54% vs 56.99%; $P = 0.022$).

Table 1 presents the characteristics of the sample set, analyzed according to the early symptoms of urinary schistosomiasis. Male children reported the early symptoms of urinary schistosomiasis (hematuria + dysuria) significantly more often than did female children ($P = 0.010$). Residency in North Kassak was also associated with hematuria and dysuria ($P < 0.001$). Knowledge of schistosomiasis and a previous diagnosis were associated with early symptoms ($P = 0.013$ and $P < 0.001$, respectively).

Table 2 presents the behavior that the children reported. Correctly answering all the questions about risky behavior was associated with early symptoms ($P = 0.010$). Wearing shoes and washing hands with soap were associated with absence of hematuria and dysuria ($P = 0.007$ and $P = 0.049$ respectively), while playing in the river was associated with the symptoms ($P < 0.001$).

The majority of the children had good or medium knowledge about preventive behavior (77.2%). Almost all of the children (90.4%) knew that playing in the river was risky. Most (63.6%)

Table 1. Description of the Sample According to the Early Symptoms of Urinary Schistosomiasis

Characteristic	Early Symptoms of Urinary Schistosomiasis*		*P* value
	No, % (n)	Yes, % (n)	
Sex			
Male	44.28 (151)	55.78 (111)	0.010
Female	55.72 (190)	44.22 (88)	
Age, y (mean ± SD)	12.04 ± 2.11	13.92 ± 2.44	<0.001
School level			
Primary	35.59 (121)	82.76 (168)	<0.001
Secondary	64.41 (219)	17.24 (35)	
Residence			
Kassak North	51.92 (176)	69.27 (133)	<0.001
Kassak South	32.45 (110)	22.92 (44)	
Other	15.63 (53)	7.81 (15)	
School place			
Kassak North	81.63 (280)	83.74 (170)	0.531
Kassak South	18.37 (63)	16.26 (33)	
Knowledge of schistosomiasis			
Yes	82.18 (272)	90.21 (175)	0.013
Previous infection by schistosomiasis			
Yes	67.50 (216)	90.32 (140)	<0.001
Socio-economic status			
Poor	45.90 (140)	51.59 (81)	0.196
Medium	36.39 (111)	28.03 (44)	
High	17.70 (54)	20.38 (32)	

SD = standard deviation.
* Numbers/percentage may not add up to the total number due to missing data.

understood that urinating in water was risky behavior and that the infection could be caused by worms (66.1%) and snails (40.5%). One third of the children (33.5%) knew that not wearing shoes and stepping in urine (31.4%) were bad behavior. A minority of children still believed popular myths, for example, that stepping in places that belong to witches (18.3%), eating green mangoes (15.8%),

Table 2. Description of Practice Related to Schistosomiasis According to the Self-Reported Hematuria

Children in this Category Answered "Yes" to these Questions About Preventive Methods	Early Symptoms of Urinary Schistosomiasis*		*P* value
	No, % (n)	Yes, % (n)	
Do you wear shoes?	97.34 (329)	92.27 (179)	0.007
Do you wash your hands before eating?	98.51 (331)	97.37 (185)	0.356
Do you wash your hands after using the toilet?	94.61 (316)	91.35 (169)	0.151
Do you wash your hands with soap?	81.68 (272)	74.32 (136)	0.049
Do you play in the river?	51.93 (175)	77.49 (148)	<0.001
Do you use river water?	76.65 (256)	73.26 (137)	0.389
Score			
All answers correct	28.66 (90)	43.03 (71)	0.010
4-5 correct answers	67.20 (211)	52.12 (86)	
2-3 correct answers	3.82 (12)	4.85 (8)	
0-1 correct answers	0.32 (1)	0.0 (0)	

* Numbers/percentage may not add up to the total number due to missing data.

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Table 3. Knowledge about Prevention and Treatment of Schistosomiasis According to Whether Children Did or Did Not Have Symptoms of the Disease

	Early Symptoms of Urinary Schistosomiasis*		*P* value
	No, % (n)	Yes, % (n)	
Children in this category answered "yes" to whether they could be infected with schistosomiasis			
Playing in the river	88.76 (300)	95.00 (190)	0.014
Drinking salt water	44.28 (147)	43.62 (82)	0.884
Eating too much salt	11.25 (37)	19.15 (36)	0.013
From worms in the water	63.66 (212)	70.43 (131)	0.118
Entering the toilet without shoes	25.60 (85)	44.04 (85)	<0.001
From snails	32.83 (109)	51.35 (95)	<0.001
Stepping in urine	26.75 (88)	34.76 (65)	0.055
Eating green mangoes	10.33 (34)	21.28 (40)	0.001
Playing with fire	6.21 (21)	15.87 (30)	<0.001
Not wearing shoes	16.86 (57)	22.11 (42)	0.139
Stepping in places that belong to witches	11.11 (37)	27.37 (52)	<0.001
Urinating in water	60.65 (205)	68.78 (130)	0.063
Score for prevention knowledge			
Good	6.86 (19)	11.43 (16)	0.083
Medium	68.23 (189)	71.43 (100)	
Poor	24.91 (69)	17.14 (24)	
Children in this category answered "yes" to whether they could treat schistosomiasis by these methods			
Take medication	97.37 (333)	95.34 (184)	0.211
Go to the health center	97.37 (333)	91.75 (178)	0.003
Take herbs	7.96 (27)	17.62 (34)	0.001
Boil herbal roots	15.29 (52)	21.99 (42)	0.052
Score for treatment knowledge			
Good	78.34 (264)	64.84 (118)	0.002
Medium	15.73 (53)	21.98 (40)	
Poor	5.93 (20)	13.19 (24)	

* Numbers/percentage may not add up to the total number due to missing data.

and playing with fire (11.2%), would cause schistosomiasis. Most of the children (91.1%) had good or medium knowledge about the treatment for schistosomiasis. In particular, 96.0% of the children knew that taking medication would help heal the disease, and 95.1% knew that going to the health center was correct.

Table 3 reports the knowledge of prevention of and treatment for schistosomiasis among the children who reported having the symptoms of the disease. The majority thought that people acquired schistosomiasis by eating a lot of salt or green mangoes ($P = 0.013$ and $P = 0.001$, respectively). Children with symptoms also believed that playing with fire and stepping in places that belong to witches could cause schistosomiasis ($P < 0.001$). There was a significant association between children who reported playing in the river ($P = 0.014$) or entering the toilet without shoes and the presence of schistosomiasis symptoms ($P < 0.001$). Finally, the knowledge that snails host *Schistosoma* was associated with hematuria and dysuria ($P < 0.001$). Children who had good knowledge of the treatment of schistosomiasis did not report symptoms ($P = 0.002$).

The logistic regression model of the multivariate analysis (Table 4) showed that female sex (odds ratio = 0.35; $P = 0.01$), attending a primary school (odds ratio = 0.13; $P < 0.001$), and living in Kassak South (odds ratio = 0.45; $P = 0.024$) were significant predictors of a lower risk of the early symptoms of urinary schistosomiasis. The analysis also revealed that poor knowledge of the treatment of schistosomiasis was associated with a higher risk of early symptoms of infection (odds ratio = 6.06; $P = 0.001$).

DISCUSSION

The aim of this study was to describe the KAPs associated with schistosomiasis-related early

Table 4. Potential Predictors of Early Symptoms of Urinary Schistosomiasis

Characteristic	OR adjusted	95% CI	*P* value
Sex			
Male	Ref	-	-
Female	0.35	0.19-0.65	0.001
School level			
Primary	Ref	-	-
Secondary	0.13	0.06-0.25	< 0.001
Residence			
Kassak North	Ref	-	-
Kassak South	0.45	0.23-0.90	0.024
Other	1.14	0.48-2.72	0.770
Knowledge of schistosomiasis			
Yes	1.44	0.67-3.09	0.355
Previous infection by schistosomiasis			
Yes	1.83	0.95-3.54	0.071
Correct answers on risk behavior			
All answers correct	Ref	-	-
4-5 correct answers	1.01	0.54-1.89	0.978
2-3 correct answers	0.87	0.14-5.24	0.875
0-1 correct answers	-	-	-
Socioeconomic status			
Poor	Ref	-	-
Medium	1.05	0.54-2.02	0.893
High	0.90	0.41-1.99	0.793
Prevention of schistosomiasis knowledge			
Good	Ref	-	-
Medium	1.37	0.45-4.20	0.584
Poor	1.05	0.31-3.56	0.941
Treatment of schistosomiasis knowledge			
Good	Ref	-	-
Medium	1.19	0.55-2.59	0.654
Poor	6.06	2.04-17.94	0.001

CI = confidence interval; Ref = reference; OR = odds ratio.

symptoms in schoolchildren of 2 rural villages in North Senegal. KAPs are investigated widely in developing countries. KAPs of hygiene are essential in African countries.[10,22] Other studies have used KAP surveys to inquire into schistosomiasis among schoolchildren. In particular, Midzi et al.[9] evaluated KAPs related to schistosomiasis, malaria, and soil-transmitted helminthiasis in primary school children, while Suzuki et al.[23] used a similar survey in Zimbabwe in 2005. KAP investigations have been used in relation to schistosomiasis in other countries, such as Kenya, Cote d'Ivoire, and Ethiopia.[10,24,25]

Questionnaires have been used for diagnostic screening of schistosomiasis for decades.[13,26] As reported in the literature, questionnaires are one of the best approaches for field use when diagnosing infectious disease.[27] In this study, school directors and teachers helped improve the effectiveness of the survey.[18]

Some studies have assessed the validity and reliability of questionnaires as they relate to schistosomiasis, but most of these looked only at hematuria and did not include dysuria.[13,18,20] Gryseels[7] specified that the early symptoms of urinary schistosomiasis in schoolchildren are hematuria and dysuria. Accordingly, this study investigated both symptoms.

This study confirmed earlier research[10,11] that indicated male children were exposed to the disease more than female children, according to reported infection by schistosomiasis and the presence of hematuria and dysuria. Boys played in the river more than girls did, confirming previous studies

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that reported that playing in the river was associated with the infection.[6,10,20] The significance of living close to the river as a risk factor for schistosomiasis was confirmed in our study. Children living in Kassak North, where the river was more accessible, reported higher levels of schistosomiasis than did children who could not approach the river as easily.[12]

Unlike other studies,[1,12] socioeconomic status was not associated with the presence of symptoms in this investigation.

This study observed that washing hands without soap before eating and after using the toilet increased the likelihood of the infection, which was in line with other studies.[19,28]

Wearing shoes was associated with less schistosomiasis in this study. Alemu et al. reported similar results.[29]

As noted, the potential predictors of early symptoms of schistosomiasis were related to the demographic characteristics of the study population. Knowledge about disease treatments could be considered a high potential predictor. Compared to the population investigated in the Midzi et al. study[9] that was conducted in Zimbabwe in 2011, the children sampled in this work reported greater knowledge about the prevention and treatment of schistosomiasis. Unexpectedly, in this study, knowing what schistosomiasis was and having had a previous schistosomiasis infection were not potential predictors.[9,10]

Limitations. Further studies with a larger sample should reevaluate these results. The alleged difficulty of some children in responding to the questionnaire was critical. The teachers' help may have influenced some of the answers.

CONCLUSIONS

This study revealed that the level of knowledge among children in North Senegal about the cause, transmission, prevention, and treatment of schistosomiasis warrants implementing educational intervention. Increasing knowledge among children about schistosomiasis is fundamental for the eradication of the disease. All forms of intervention, for children and adults, should be integrated and include pharmacological treatment, infrastructure improvements, and health education. Future research should include social science approaches, for example, exploring the cultural significance of waterways.

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