Prevalence of Urogenital Schistosomiasis and Water, Sanitation and Hygiene Risk factors for transmission among Primary School Children in an urban endemic area of Kinondoni Municipality in Dar es Salaam, Tanzania

Yonah Yangaza
Muhimbili University of Health and Allied Sciences
Vivian Mushi (vmushi31@gmail.com)
Muhimbili University of Health and Allied Sciences https://orcid.org/0000-0001-9732-3057
Abdallah Zacharia
Muhimbili University of Health and Allied Sciences https://orcid.org/0000-0001-9380-6158

Research Article

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Abstract

Objectives: To determine the prevalence of urogenital schistosomiasis and water, sanitation, and hygiene risk factors for transmission among primary school children in an urban endemic area of Kinondoni Municipality in Dar es Salaam, Tanzania.

Methods: A quantitative cross-sectional study was conducted between June and August 2020 to determine the prevalence of *S.haematobium*. A total of 250 urine samples were collected from primary school children, examined for haematuria using urinalysis test strips, and *S.haematobium* infection and intensity using the urine filtration technique. A structured questionnaire was used to collect information on water, sanitation, and hygiene risk factors that could influence the transmission of urogenital schistosomiasis. Data were entered and analyzed using SPSS version 22.

Results: Out of 250 primary school children recruited, 13(5.2%) had haematuria, 3(1.2%) had *S.haematobium* ova, and all were light-intensity infections. Among the risk factor assessed the following were significantly associated with the transmission of urogenital schistosomiasis; type of latrine used at home (p=0.044), frequency of swimming (p=0.030), the children who never swallowed praziquantel (p<0.00), experienced side effects (p<0.00), type of side effects experienced (p=0.037), and reasons for not taking praziquantel in the last round of mass drug administration (p=0.007).

Conclusions: The low prevalence of urogenital schistosomiasis indicates the ongoing transmission of the disease among primary school children. Frequency of swimming, type of latrines used at home, and non-uptake of praziquantel are the risk factors for the infection among primary school children. Therefore there is a need to provide health education to promote the uptake of praziquantel.

Introduction

Urogenital schistosomiasis is a disease of public health concern. The majority of urogenital schistosomiasis cases occurred to people living in Sub-Saharan Africa. It's estimated that 436 million people are at risk of acquiring urogenital schistosomiasis in Sub-Saharan Africa, and 112 million people are already infected with *Schistosoma haematobium* (*S.haematobium*).[1] Urogenital schistosomiasis is responsible for the morbidity and mortality among the vulnerable population, whereby 103 million people had haematuria and dysuria, 100 million people had bladder morbidity, 19 million had kidney problems, and 0.162 mortality due to bladder and kidney cancers per year.[1]

Tanzania is among urinary schistosomiasis endemic countries with different levels of endemicity across the country.[2] Urinary schistosomiasis is regarded as a disease of rural communities where the majority of residents are of poor socioeconomic status, with an inadequate supply of clean water, unimproved sanitation, and poor hygiene.[2] However, evidence showed that urban settings are also affected by

Dar es Salaam is among cities with historical evidence of urinary schistosomiasis infection. In the early 1980s, the prevalence of urinary schistosomiasis in Dar es Salaam varied from 4% to 25% among school-aged children.[2] As the years went on, the prevalence of urogenital schistosomiasis was increasing in Dar es Salaam up to 47.6% in the 1990s.[6] The high burden of urogenital schistosomiasis in Dar es Salaam alerted the need for preventive chemotherapy (PC), and hence, was one of the first regions in Tanzania (mainland) to implement school-based PC using praziquantel under the national schistosomiasis and soil-transmitted helminths control program in 2006. [7]

A study conducted in 2011 to assess the status of schistosomiasis in school-aged children after two rounds (2006 and 2007) of PC intervention in Dar es Salaam indicated a decrease in the prevalence of the disease,[8,9] since then, little is known about the status of urogenital schistosomiasis among school-aged children in Dar es Salaam. However, studies have been conducted in preschool-aged children and infants in 2015 and 2016, which reported the prevalence ranging from 1.2% to 1.9%, indicating the ongoing transmission of urogenital schistosomiasis in Dar es Salaam.[10,11] Therefore, this study was conducted to determine the current status of urogenital schistosomiasis, water, sanitation, and hygiene (WASH) risk factors, and uptake of praziquantel among primary school children in an urban endemic area of Kinondoni Municipality in Dar es Salaam, Tanzania. The information collected will be useful for modification of the existing schistosomiasis control program to ensure sustainable control of the disease as we are aiming for attaining the 2030 sustainable development goal three of health and wellbeing for all.

Subjects And Methods

Description of the study area

This study was conducted in Kinondoni municipality, one of the five municipalities of the Dar es Salaam region. According to the census of 2012, the municipality has a total population of 1,775,049 (914,247 females and 860,802 males) with more than 446,504 household.[12] The Municipality is boarded to the east by the Indian Ocean, to the north and west by the Coast Region. The area of Kinondoni has favorable climatic and ecological conditions that influence the survival of the *Bulinus* snail intermediate host of *S.haematobium* parasite. Kinondoni Municipality was selected because it's one of the few urban endemic areas for urogenital schistosomiasis in Tanzania, with the ongoing praziquantel treatment program for more than ten years.[10]

Study design

A school-based cross-sectional study involving a quantitative method of data collection was conducted between June and August 2020 to investigate the prevalence of urogenital schistosomiasis and WASH risk factors for transmission among primary school children in an urban endemic area of Kinondoni Municipality in Dar es Salaam, Tanzania.

Study population, inclusion and exclusion criteria

The study population was primary school children from class four to six and aged seven to 15 years. All primary school children resident of Kinondoni municipality, aged seven to 15 from class four to six whose parents/guardian signed written informed consent form were eligible to participate. The students who were sick apart from urogenital schistosomiasis and whose parents/ guardians did not sign the written informed consent were excluded from participating in this study.

Sample size determination and sampling procedure

The sample size for this study was calculated from a formula for estimating sample size in a single cross-sectional survey.

$$n = \frac{z^2\, p\,(1-p)}{d^2} \qquad (1)$$

n = sample size

z = level of confidence according to the standard normal distribution (for a level of confidence of 95%, z = 1.96)

p = proportion of *S. haematobium* (p =19.3%) found in previous study.[10]

d = tolerated margin of error

$$\text{Thus, } n = \frac{(1.96)^2\,(19.3\%)\,(100-19.3\%)}{(5)^2} = 239$$

$$239$$

Assuming 10% non-response rate, adjusted sample was

$$n = (1/R \times 239) + 239$$

$$n = (10/100 \times 239) + 239$$

$$n = 263$$

The calculated sample size was 263 primary school children. Kigogo ward was purposively selected somiasis endemicity for three and a half decades.[10] Simple

random selection was employed to select the representative school for sample collection, whereby Kigogo primary school was selected. Students from class four to six were sampled according to the total number of students in each class, meaning the class with a higher number of students contributed to higher sample size. A total of 100,120 and 30 students were sampled from classes four, five, and six respectively.

Urine collection and laboratory analysis

All of the sampled students were provided with labelled wide mouth dry plastic containers for the collection of the urine samples and were instructed on how to collect terminal urine. The collected urine samples were transferred to the Parasitology and Medical Entomology Laboratory of Muhimbili University of Health and Allied Sciences on the same day for the laboratory analysis.

In the laboratory; microhaematuria analysis was done using a chemical reagent strip (Cybow 10 Urinalysis Test Strip). For each sample, the reagent strip was dipped into the mixed urine for three minutes then removed and read. The change of strip colour was compared to the colour chart on the container of the strips to estimate the amount of blood in the urine. The results of microhaematuria were recorded as negative or positive.

Microscopic examination was done for each urine sample for detection of S.*haematobium* ova. The nuclepore membrane filtration technique was performed whereby 10mls of each urine sample was drawn using a 10ml plastic syringe and passed through a polycarbonate filter with a pore size of 12um to recover the eggs. All urine filters were carefully removed from filter holders and placed on the microscope slides then stained with Lugols iodine, and examined under the microscope with the magnification X10 and X40. The *S.haematobium* eggs were counted and reported as the number of eggs per 10 ml of urine. The intensity of *S.haematobium* infection was differentiated according to WHO categories of 1-49 eggs/10 ml as light infection and >50 eggs/10 ml as heavy infection.[13]

Questionnaire survey

A structured questionnaire was prepared and used to collect information from primary school children. The questionnaire had three sections; the first section collected information on social-demographic characteristics of school children, the second section collected information on the uptake of praziquantel for prevention of urogenital schistosomiasis, and the third section collected information on WASH risk factors associated with the ongoing transmission of urogenital schistosomiasis among school children. Interviews were carried out after the collection of urine samples.

Data analysis

Data were checked for completeness, coded, entered, and cleaned using Statistical Package for the Social Sciences (SPSS) version 22. Descriptive statistics were computed to describe the prevalence of microhaematuria, prevalence, and intensity of *S.haematobium* ova according to social-demographic

characteristics. The chi-square test (x^2) or Fisher's exact test and their related p-values at a significance level of 0.05 were used to measure the association between the dependent variable (prevalence of urogenital schistosomiasis), and independent variables including social-demographic characteristics (age, sex, and class), uptake of praziquantel and WASH factors.

Ethical considerations

The ethical clearance was requested and obtained from the Muhimbili University of Health and Allied Sciences Institutional Review Board before the commencement of the study. Permission to conduct the study in Kinondoni Municipality was sought from the regional to district and school authorities. The written consent forms describing the objectives of the study, benefits and harms of participating in this study, and withdrawing rights from participation were distributed to eligible children to be given to their parents to read and sign if they consent their child to participate in this study. The children who were found positive for microhaematuria and *S.haematobium* were referred to a nearby dispensary for a further check-up, and treatment respectively.

Results

Social demographic characteristics of the primary school children

A total of 263 primary school children from class four to six were recruited in this study. However, only 250 provided urine samples and participated in the interview. Therefore, the rate of response was 93.9%. Of the 250 children who participated; more than half (53%) were males, the majority (74%) were aged between 11 to 14 years, and nearly half (48%) belonged to class five as shown in **table one.**

Prevalence of microhaematuria among primary school children

Table two shows the prevalence of microhaematuria among primary school children. The overall prevalence of microhaematuria was 5.2%, being higher on females (3.2%), children aged between 11 to 14 years, and class five children (2.8%). There was a statistically significant association between the prevalence of microhaematuria and age groups of the children ($p<0.00$).

Prevalence of urogenital schistosomiasis among primary school children

The overall prevalence of urogenital schistosomiasis among primary school children was 1.2%. Males (0.8%) of class five and aged between 11 to 14 years were more affected compared to females. There was no statistically significant association between the prevalence of urogenital schistosomiasis and sex, age groups, or class of the student as presented in **table three**.

Intensity of urogenital schistosomiasis among primary school children

All infected primary children had light infection intensities as described by World Health Organization (WHO) on the categories for classification of *S.haematobium* infection intensities. The intensity of

urogenital schistosomiasis among primary school children ranged from 6 to 8 eggs/10mls of urine with the overall geometric mean of 6.95 eggs/10 mL of urine.

Water, Sanitation and Hygiene Risk factors Associated with transmission of urogenital schistosomiasis among primary school children

Out of 114 children living nearby water bodies, 61.4% were living near the Msimbazi river. More than half of the children were using piped water (62.4%) and flush toilets (58.8%). Of 137 children who had the habit of swimming in the Msimbazi river, 7.3% had the frequency of swimming daily. Only 70 children reported the habit of playing nearby water bodies, with 40% playing barefooted as shown in **table four.** Of all the risk factors assessed for association, only type of latrines used at home (p=0.044) and frequency of swimming (p=0.030) were associated with transmission of urogenital schistosomiasis.

The uptake of praziquantel among primary school children in the last round of mass drug administration (MDA)

The majority of the children (77.2%) were able to participate in the last round of MDA. For children who did not participate in the last round of MDA the leading reasons were; fear of side effects (57.9%) and being sick (22.8%). Also, the majority of the children (84.4%) who participated in MDA reported experiencing the side effects of the praziquantel, nausea (65%) being the leading side effect as shown in **table five**. There was a statistically significant association between prevalence of urogenital schistosomiasis with the children who have never swallowed praziquantel (p<0.00), experienced side effects (p<0.00), type of side effects experienced (p=0.037), and reasons for not taking praziquantel in the last round of MDA (p=0.007).

Discussion

Our findings indicate the low prevalence (1.2%) of urogenital schistosomiasis among school children, and all infections were of light intensities. There is a decrease in the prevalence of urogenital schistosomiasis among school-aged children in Kinondoni Municipality from 41.6% in 1992 to 1.2% from this study.[6] The decrease in prevalence could be due to a decade of praziquantel administration,[7,14] high coverage of piped water supply, and latrine facilities. Despite the observed low prevalence, it's evident that transmission is still going on, and the primary school children could serve as a source of transmission to other community members.

Hematuria is a recognized clinical feature and morbidity indicator of *S.haematobium* infection.[15] The prevalence of microhaematuria was higher (5.2%) than the overall prevalence of urogenital schistosomiasis (1.2%). The observed low prevalence of *S.haematobium* infection compared to the prevalence of microhaematuria is possible in low endemic settings where the shedding of eggs is low and thus difficult to detect eggs by the single filtration of a urine sample. Also, the high prevalence of microhaematuria could be due to the residual of menstruation blood, considering that the higher [illegible]ales aged 11 to 14 years. Studies have reported the

menstruation blood and persistence of bladder lesion for a long period than the actual time for shedding *S.haematobium* eggs as the reason for the high prevalence of microhaematuria.[16–18]

Inadequate water supply, poor sanitation and hygiene are among the risk factors for transmission of urogenital schistosomiasis in endemic settings.[19–21] The findings from our study revealed that all of the infected students were not using the piped water, and most of them were living near the Msimbazi river. The frequent exposure to the water of the Msimbazi river when swimming, fetching water, crossing, playing barefooted, and utilization of water from the river for bathing were the risk factors identified from the students for the ongoing transmission of urogenital schistosomiasis in the study area despite the ongoing mass deworming. The findings are comparable with the previous studies on Tanzania, Nigeria, Senegal.[6,19,22,23]

The types of latrine used at home were statistically significantly associated with the prevalence of urogenital schistosomiasis. In this study, most of the affected children came from households with flush toilets. The owning and using the flush toilets at home does not prevent the children from acquiring urogenital schistosomiasis, especially if there are still frequent contacts to the river. There is the possibility that the children acquired the infection when swimming, bathing, or playing in the Msimbazi river. The findings of this study are in agreement with the study conducted in South Africa, which reported that all of the urogenital schistosomiasis-infected children came from the household owning different types of toilets. [24]

The frequency of swimming was statistically significantly associated with the prevalence of urogenital schistosomiasis. All of the infected students reported daily or weekly swimming in the Msimbazi river. Children tend to urinate in the water sources while swimming hence if the child is infected can contaminate the water sources.[25] It has been reported that the frequency of water contact activities such as swimming to increase the risk of transmitting or acquiring the infection in endemic settings.[26–28]

Acceptability and uptake of praziquantel among primary school children are crucial for the control of urogenital schistosomiasis and for the prevention of long-term morbidity.[29] The study findings revealed a statistically significant association between the uptake of the praziquantel and the prevalence of urogenital schistosomiasis. All of the infected students' self-reported never taking praziquantel drugs with the reason being; parents did not allow or absent at the school during praziquantel administration. The observed prevalence in this group is due to the fact that they have never taken the praziquantel in their lifetime. Studies have reported fear of side effects of the praziquantel, absent from the school during praziquantel distribution, parents not allowing their children to participate without specific reasons, and inadequate communication with the parents on the rationale of the praziquantel uptake as among the reasons that affect the acceptability and uptake of praziquantel treatment.[30,31]

The self-reported uptake of praziquantel was above the WHO target.[32] This could be due to the ongoing neglected tropical diseases control program campaigns before the distribution of praziquantel. The

de effects due to the uptake of praziquantel. The side effects

attributed by the uptake of praziquantel tends to affect the acceptability and hence coverage of the praziquantel in the endemic settings.[30]

Study Limitations

The study had the following limitations; the urine samples were collected only once, which might have underestimated the prevalence of urogenital schistosomiasis among primary school children in the study area. Another limitation was recall bias; some of the questions required the primary school children to recall the previous year's information, such as the uptake of praziquantel treatments and side effects experienced this might have affected the accuracy of the information provided. Also, some information regarding WASH practices reported by children may be subjective and unreliable compared to observing them using a checklist.

Abbreviations

PC Preventive Chemotherapy

MDA Mass Drug Administration

SPSS Statistical Package for the Social Sciences

WASH Water, Sanitation and Hygiene.

Declarations

Conflict of interest statement

We declare that we have no conflict of interest.

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Authors' contributions

YY and VM conceptualized the study, YY did data collection and laboratory work, VM analyzed the data, and VM and AZ drafted the manuscript. All authors read and approved the manuscript.

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Tables

Table 1: Social-demographic characteristics primary school children (n=250)

Variable	n (%) 95%CI	
Sex		
Females	117(46.8)	40-54
Males	113(53.2)	46-60
Age group		
7-10 years	49(19.6)	14.5-25.0
11-14 years	185(74)	68.1-79.5
15-18 years	16(6.4)	3.6-9.5
Class		
Class four	100(40)	33.6-45.6
Class five	120(48)	42-53.5
Class six	30(12)	7.6-16

Table 2: Prevalence of microhaematuria among primary school children (n=250)

Social-demographic characteristics	Total	Microhaematuria present	Fisher's exact	P-value
Total	**250**	**13 (5.2)**		
Sex				
Females	117	8(3.2)	1.332	0.539
Males	133	5(2)		
Age group				
7-10 years	49	2(0.8)	12.054	0.00
11-14 years	185	8(3.2)		
15-18 years	16	3(1.2)		
Class				
Class four	100	3(1.2)	6.313	0.049
Class five	120	7(2.8)		
Class six	30	3(1.2)		

Table 3: Prevalence of urogenital schistosomiasis among primary school (n=250)

Social-demographic characteristics	Total	Microscopic observation of *S.haematobium*	Fisher's exact	p-value
Total	**250**	**3(1.2)**		
Sex				
Females	117	1(0.4)	0.221	0.638
Males	133	2(0.8)		
Age group				
7-10 years	49	1(0.4)	1.084	0.775
11-14 years	185	2(0.8)		
15-18 years	16	0(0.0)		
Class				
Class four	100	1(0.4)	0.486	0.734
Class five	120	2(0.8)		
Class six	30	0(0.0)		

Table 4: Water, Sanitation and Hygiene Risk factors Associated with transmission of urogenital schistosomiasis among primary school children (n=250)

Variable	n(%)	*S.haematobium* positive	Fisher's exact	p-value
Live nearby water body				
Yes	114(45.6)	2(0.8)	0.543	0.461
No	136(54.4)	1(0.4)		
Type of water body near home				
Pond	44(38.6)	0(0.0)	1.887	0.301
River	70(61.4)	2(0.8)		
Source of the water at home				
Piped water	156(62.4)	0(0.0)	4.151	0.292
Dug well	38(15.2)	1(0.4)		
River	33(13.2)	1(0.4)		
Water kiosk	23(9.2)	1(0.4)		
Type of latrines at home				
None	11(4.4)	0(0.0)	5.491	0.044
Pit latrine	60(24)	1(0.4)		
Flush toilet	147(58.8)	2(0.8)		
San plat latrine	32(12.8)	0(0.0)		
Habit of swimming				
Yes	137(54.8)	2(0.8)	0.173	0.678
No	113(45.2)	1(0.4)		
Frequency of swimming				
Daily	10(7.3)	1(0.4)	6.222	0.030
Weekly	30(21.9)	2(0.8)		
>Weekly	97(70.8)	0(0.0)		
Play nearby water bodies				
Yes	70(28)	2(0.8)	2.252	0.133
No	180(72)	1(0.4)		
Type of shoes worn while playing near water bodies				
Closed shoes	25(35.7)	0(0.0)	5.406	0.144
Open shoes	17(24.3)	1(0.4)		
No shoes(barefooted)	28(40)	2(0.8)		
Doing activities in water sources				
Yes	242(96.8)	3(1.2)	0.1	0.751
No	8(3.2)	0(0.0)		
Type of activity done in water sources				
Fetching water for domestic and irrigation	57(23.5)	1(0.4)	4.66	0.458
Washing dishes	36(14.8)	0(0.0)		
Washing clothes	87(36)	0(0.0)		
Cross point	42(17.4)	1(0.4)		
Bathing	20(8.3)	1(0.4)		

Table 5: Self-reported uptake of praziquantel in the last round of MDA (n=250)

Variable	n(%)	*S.haematobium* Positive	Fisher's exact	p-value
Never swallowed praziquantel during MDA				
Yes	34 (13.6)	3(1.2)	19.3	0.000
No	216 (86.4)	0(0.0)		
Swallowed praziquantel in the last round of MDA				
Yes	193(77.2)	0(0.0)	3.32	0.048
No	57(22.8)	3(1.2)		
Reasons for not taking praziquantel in the last round				
Sick	13(22.8)	0(0.0)	9.6	0.007
Fear of side effects	33(57.9)	0(0.0)		
Parent did not allow	6(10.5)	2(0.8)		
Absent from the school	5(8.8)	1(0.4)		
Experienced praziquantel side effects				
Yes	211(84.4)	0(0.0)	16.428	0.000
No	39(15.6)	3(1.2)		
Praziquantel side effects experienced				
Nausea	137(65)	0(0.0)	13.495	0.037
Vomiting	26(12.3)	0(0.0)		
Dizziness	12(5.7)	0(0.0)		
Sweating	9(4.2)	0(0.0)		
Malaise	8(3.8)	0(0.0)		
Headache	8(3.8)	0(0.0)		
Upset stomach	6(2.8)	0(0.0)		
Itching	5(2.4)	0(0.0)		