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Prevalence of *Schistosoma mansoni* and its clinical relevance at a primary health care level in rural lake zone of Tanzania: a cross sectional study

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Abstract

Introduction

Intestinal schistosomiasis is still endemic in most countries in sub Saharan Africa including Tanzania. It is associated with unacceptably high morbidity and mortality especially due to its long term complications. These complications could potentially be prevented through early diagnosis and timely treatment of *Schistosoma mansoni* infection. However, in Lake Zone only a small proportion of patients present to tertiary level hospital in early stages of the disease and schistomal status at primary health care level is not described in Lake Zone. The aim of this study was to determine the prevalence of S*chistoma mansoni* and its clinical relevance at a primary health care level.

Materials and methods

A cross sectional study including all patients attending Sengerema DDH with abdominal pain and/or diarrhea was done. Their stool samples were examined by routine wet mount preparation and the data of study interest were analyzed including stool sample results, demographic data, clinical symptoms and risks for Schistosomal exposure using stata version 12 to determine the prevalence of *Schistosoma mansoni* in this study population.

Results

A total of 1255 stool samples were examined parasitologically for presence of intestinal parasites. Most of the study participants were females 783(62.39%) with a mean age of 30 (IQR 2-80) years. Of the 1225 stool samples examined, 561 (44.7%) were parasitologically positive for intestinal parasites where *Schistosoma mansoni* was recovered in 141 (11.24%) of the study participants being the second most common intestinal parasite after *Entamoeba histolytica*. Of the positive stool samples *Schistosoma mansoni* was found in 25.1% of the samples and was strongly associated with a male gender (OR=1.5, p=0.017), age younger than 20 years (OR= 3.4, p<0.001), and being involved in fishing (OR=1.9, p=0.043) and rice pad activities (OR=3.1, p<0.001).

Conclusions

The current study indicates that *Schistosoma mansoni* transmission still occurs in Lake Zone, however probably the symptoms due to intestinal Schistosoma infections are frequently common among young people. On clinical aspects these findings are important suggesting that transmission of S. *mansoni* could significantly be reduced by praziquantel (PZQ) mass drug administration (MDA) targeting those at risk including ages below 20years, but this may need a sustained and more regular frequent PZQ doses a year.

Key words: *Schistosoma mansoni*, wet mount stool examination, primary health care level, north-western Tanzania

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Introduction

Schistosomiasis has been known since 1851[1] and it is still an ongoing public health problem especially in resource restricted countries causing a significantly high morbidity and mortality from long term Schistosomal related complications. Worldwide there are more than 200 million people infected with schistosomiasis of whom more than 90% reside in Sub-Saharan Africa (SSA) [1, 2]. As of now there are more than 700 million people who are at risk of infection with schistosomiasis [2], and Tanzania is the second most affected country after Nigeria in SSA [2, 3].

Symptomatic intestinal schistosomiasis frequently presents with diarrhea alternating with constipation and abdominal pains among others [4]. Schistosoma ova are usually recovered from stool samples of these symptomatic patients [5]. The World Health Organization (WHO) report shows that of the estimated 200 million people who are infected with schistosomiasis globally, 120 million are symptomatic and 20 million have severe disease [6]. In Lake Zone most patients also have been found to present to tertiary level hospital in advanced stage of the disease. For example of the patients who underwent Oesophagogastroduodenoscopy (OGD) for bleeding varices, 60% had associated active Schistosomal infection [7]. This suggests that symptoms due to Schistosomal infection are tolerable in most patients in endemic areas and as such they are prone to chronic infections leading to long term complications like portal hypertension from peri portal fibrosis. A tertiary hospital based study by Mazigo et al. examining the prevalence of intestinal parasites in 3152 stool samples *Schistosoma mansoni* was recovered in only 177 (5.6%) of the stool samples being the second commonest parasite after hookworm infection [8].

In Tanzania, both intestinal and genitourinary schistosomiasis is very prevalent. Of the two widespread species; *S. mansoni* is most prevalent in the main land part of Tanzania especially around the lake zone while *S. hematobium* is more prevalent in Zanzibar [9]. The transmission of *S. mansoni* occurs through contact with infected water mainly through water related activities inclusive of fishing and bathing in lake, involving in rice pads agricultural activities, and use of water for domestic purposes (washing and bathing) [5]. Community based parasitological studies have reported a substantially high prevalence of S. *mansoni* especially from areas that are closer to the lake shores as compared to in hospital based studies. For example, earlier in 2006 among

more than 900 pregnant women who were examined parasitologically, more than 63% of them were found to be infected with *S. mansoni* [10]. A study done in 2012 involving 360 school children in Ukerewe found that 62% and 57.7% of male and female children were infested with *S. mansoni* [11]. The proportion of patients with intestinal schistosomiasis who attend primary care facilities is not described in Tanzania. This study therefore aimed at describing the prevalence of *S. mansoni* among patients attending a district hospital in north western lake zone of Tanzania. The information from this study will add to the existing body of knowledge regarding health seeking behavior and the probable status of *Schistosoma mansoni*, and it will also suggest on the potential preventive interventions in Lake Zone.

Materials and methods

Study design

This was a cross sectional clinic based study which involved all out patients who presented with abdominal pains and or diarrhea at Sengerema Designated District hospital (DDH).

Study setting

Sengerema DDH is one of the district level hospitals situated in the western part of Lake Victoria serving a population of about 700000 people with a bed capacity of about 300. Sengerema DDH runs both inpatients and outpatient activities on daily bases serving between 200 and 300 patients a day.

Study population

The study involved all patients who presented to Sengerema DDH outpatients' department with diarrhea and/or abdominal pains during the study period.

Sample size and patients' enrollment

A minimum sample size of 368 was estimated from cross sectional studies' formula by Leslie Kish, assuming 40% of patients presenting to hospital with abdominal symptoms have intestinal schistosomiasis from previous in hospital prevalence of *S. mansoni* which ranges from 5.6-60%

[7, 8]. In this study we enrolled all patients who presented with abdominal pain and/ or blood diarrhea or non blood diarrhea between March 2015 and February 2016.

Data collection and data analysis

Patients were invited and requested for consent to participate in the study. The parents or guardians were asked to consent for their sick children. After informed consent about 2g of fresh stool were collected in plastic containers for immediate wet mount preparation examination by two experienced laboratory technicians. Approximately 2 mg of the stool sample were placed on a slide using an applicator, then normal saline (0.9 %) drops was used to emulsify diarrheic and semi solid or Iodine for formed stools, covered with cover slide and examined under microscope using first 10 × objectives and then 40 × objectives and all negative samples were re examined by a third technician. Wet mount stool examination is a routinely used technique at Sengerema for detection of intestinal parasites as it is true with most of hospitals in resource limited countries. Though less sensitive it is time serving as compared to Kato Katz which can only be used on research bases. A special tool was used to collect information of study interest including demographic data, presenting symptoms, risk for Schistosomal exposure and stool examination results. Data were computerized using Epi data version 3.1 and STATA version 12 (Stata Corp, College station, Texas, USA) was used for data analysis. Continuous variables were expressed as means with interquartile range (IQR), while categorical data were expressed as proportions and percentages. The proportion of patients with *S. mansoni* was calculated and logistic regression model was performed to determine the odds ratios of different factors to assess the degree of association to the outcome of interest with 95%CI. And in all our calculations the factor was said to be associated with the outcome of interest if the p value was <0.05

Ethical clearance

The permission to conduct and publish the results from this study was sought from Sengerema DDH administration and the joint Bugando Medical Centre (BMC)/Catholic University of Health and Allied Sciences (CUHAS) ethics review board. Patients who were found to have schistosomiasis were treated with praziquantel at strength of 40mg/kg and educated on the preventive measures. Those who did not consent were not denied of the services. Identifiers of

patients including the names and numbers were not included to maintain confidentiality. The study adhered to all the principles of studies involving human subjects as stated in the Helsinki declaration.

Results

Description of the study populations

During study period a total of 1255 patients were included and submitted stool samples which were examined parasitologically for presence of intestinal parasites. Most of the study participants were females 783 (62.4%) with a female to male ratio of 1.6:1 and the mean age was 30 (IQR 2-80) years. About 37% of the study participants were younger than 20 years and most of them 667(53.15%) presented with non blood diarrhea (table 1a).

Prevalence of *Schistosoma mansoni* and other intestinal parasites

Of the 1225 stool samples examined, 561(44.7%) were parasitologically positive for intestinal parasites including *Entamoeba histolytica* in 218 (17.37%) followed by *Schistosoma mansoni* in 141 (11.24%) of the study participants. *Giardia lamblia*, hook worms, *Strongyloides stercolaris* and *Ascaris lumbricoides* were recovered in 101 (8.0%), 66 (5.3%), 29 (2.3%) and 6 (0.5%) respectively of the submitted stool samples. Of the patients with *S. mansoni* non blood diarrhea was he common presenting complaint, 75 (53.2%) followed by abdominal pains23 (16.3%) (table1b). Of the positive stool samples *Entamoeba histolytica* and Schistosoma mansoni were found in 38.9% and 25.1% of the samples (table 1a). The odds of recovering *Schistosoma mansoni* was strongly predicted by a male gender (OR=1.5, p=0.017), age younger than 20 years (OR= 3.4, p<0.001), and being involved in fishing (OR=1.9, p=0.043) and rice pads activities (OR=3.1, p<0.001)**.** The difference in distribution of other factors was not statistically significant including the marital status and the presenting symptoms as summarized in table 2.

Discussion

The aim of this study was to determine the prevalence of *Schistosoma mansoni* among patients who attended primary health care level with abdominal symptoms. The prevalence of *Schistosoma mansoni* in this study was found to be 11.2% making 25.1% of all positive stool samples examined during study period. This rate is higher than what was reported by Mazigo et al. at Bugando medical center in 2012 which was 5.6% [8], however it is also smaller than what

was reported previously from community based parasitological studies with prevalence ranging between 57-63% in different study settings [10, 11].

This smaller rate could partly be explained by a probable effect of mass drug administration (MDA) control program. In Tanzania mainland mass drug administration started a way back 2008 [12], targeting mostly the school children and part of the communities with high Schistosomal endemicity regardless of their infectivity status before which the prevalence of intestinal schistosomiasis was in excess of 50% in most studies [10, 11]. Although its' efficacy is yet to be reported in Tanzania, studies from countries with prior high endemicity of intestinal schistosomiasis report a significant reduction of transmission rate reflected by reduced prevalence in community based studies after MDA. For example in 2012 one study from Sierra Leon had reported a 44% reduction of *Schistosoma mansoni* from a pre MDA prevalence of 69.0% to a post MDA prevalence of 38.2% among school children after six months of MDA. In this study among those children with moderate to heavy *Schistosoma mansoni* infection there was a reduction from a pre MDA rate of 35.6% to a post MDA prevalence of 9.9% with a significant reduction of egg per gram of stool [13]. In south Côte d'Ivoire a study involving pre-school children documented a 88.6% of cure rate of *S. mansoni* with egg reduction rate of 96.7% after 3 months of praziquantel [14].

In most studies the cure rate is partly affected by the number and frequency of praziquantel dosages given. For example, in 2011 a systematic review of peppers from Africa observed cure rates for *S. mansoni* of 69-91% after two doses of praziquantel from 42-79% after one dose of praziquantel [15]. Also a study in villages from Senegal basin with first round of praziquantel had indicated a very high cure rate of up to 96% from a prevalence of 79-100% with egg reduction rate of 97-99% in all villages, however with a rapid re-infection rate [16]. In another study in Ghana the cure rate was about 83% with 3 weekly dosing of 40 mg/kg among school children followed up for a year at 6 monthly interval the re-infection rate was 24% at most [17]. In Sierra Leon having maintained the MDA program among school children for 3 years the reduction of Schistosoma mansoni was between 56-98% depending on the MDA coverage rate that was 70-98% in most districts [18]. These studies suggest that the cure rate increases with a

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significant reduction of re infection when multiple and frequent doses of praziquantel are administered.

But even with these reported effect of praziquantel MDA we clearly note that the prevalence of intestinal schistosomiasis in our index study is still much smaller than most of the rates reached in other countries after MDA. With this observation our current finding could be reflecting the proportion of patients in the community with symptomatic infection alone. Literatures have indicated that in patients who have never been infected before with *Schistosoma mansoni* the infection occurs as acute illness with acute intestinal symptoms among others and when this infection is not interrupted by chemotherapy a chronic infection develops which is frequently asymptomatic [4]. The acute phase is shown to be attended by cell mediated immunity against soluble Schistosoma egg antigens (SEA) with high levels of Th1and Th2 cytokines and IgG and IgE antibodies [4, 19]. The chronic form on the other hand is predominantly attended by Th2 with low levels of IFN-γ, IL 10 and IgG, IgM and IgE against Soluble adult worm antigens (SWA) and SEA which are responsible for Hepato-splenic disease and Fibrosis [4, 20].

Immunological studies among patients from high Schistosomal endemicity areas, suggest that this form of mixed cellular and humoral immunity is responsible for a natural form of resistance against re infection with *Schistosoma mansoni* and symptoms variation [19, 21-24]. In these areas the peak Schistosoma prevalence occurs within the first two decades (childhood and adolescence) showing a trend to decline towards adulthood [25], suggesting that *Schistosoma mansoni* induces a slowly developing protective immunity depending on the exposure of the Schistosomal antigens to the immune system. A large amount of Schistosomal antigens is usually released when the adult worms die after their natural life span [26, 27] of about 10 years or when the worms are killed with use of Schistosomicidal drugs [28, 29] enhancing the immune response and dramatically increasing the resistance to re infection [30]. This literature is also consistent with our current finding that more than 63% of all Schistosoma positive stool samples occurred among patients younger than 20years (OR 3.4, $p<0.001$), with a small proportion of patients who were older than 20 years. The small proportion of adult patients with symptomatic infection in this study might also be representing those patients who were newly infected since

most of the re infected patients after the second decade are immune enough and usually less symptomatic [4].

Though there is a lack of gold standard test for diagnosis of intestinal parasite one drawback of wet mount parasitological stool examination is lack of a quantitative component and low sensitivity of the test. A study in Ethiopia evaluating the performance of different diagnostic tests found that the prevalence of Schistosoma mansoni was only 39.6% by a single wet mount preparation as compared to 74.6 % by single Kato Katz examination [31]. This suggests that the prevalence of *Schistosoma mansoni* in our index study would have probably been higher with use of Kato Katz method. This is also suggested by a recent community based study involving 625 school children by Florah et al. which showed that the prevalence of *Schistosoma mansoni* infection was 36.6% with a significantly high infection intensity after five years of MDA [32] suggesting a rapid re infection after treatment or discontinuation of MDA program. The Schistosomal infection in this study was shown to be more common in communities that were much closer to the lake which is a similar observation to our study that patients who were involved in constant lake water contact (fishing) in addition to rice pad cultivations were more likely to have Schistosomiasis.

Conclusion

This study suggests that intestinal schistosomiasis is still prevalent in Lake Zone but probably only a small proportion of patients are symptomatic enough to seek early medical attention. These findings are clinically important that of the available preventive measures, a sustained regular and frequent praziquantel mass drug administration could potentially reduce the transmission of *Schistoma mansoni* payable to its high cure rate and its immune boosting effect, but also supporting the recommended target age group of school age children and other at risk groups including those who are engaging in fishing and rice pad activities. Targeting diagnosis at the primary health care levels will enhance early diagnosis and treatment and minimize the risk of future development of the associated complications.

Conflict of interest

Authors declare to have had no conflict of interest

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Authors contribution

DWG: conceived and designed the study, acquired the data, did data analysis and interpretation, did literature search and drafting the manuscript. **CMM**: involved in designing the study, and critically reviewed the study for its intellectual contents. **SBK:** assisted data analysis, interpretation and critically reviewed the manuscript for its intellectual contents. **FAB:** assisted data interpretation and critically reviewed the manuscript for its intellectual content. **BCM:** assisted data analysis, interpretation and critically reviewed the manuscript for its intellectual content.

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Table 1a: **The demographic, clinical and laboratory characteristics of the 1255 study partic**

Factor	Frequency of observations	Percentage or Mean
Sex		
Male	472	37.6
Female	783	62.3
Age (years)	1255	30 [2-8
Age groups (years)		
<20	471	37.5
20-40	441	35.1
40-60	241	19.2
>60	102	08.1
Marital status		
Married	260	20.7
Not married	995	79.2
Abdominal symptoms		
Abdominal pains alone	175	13.9
Pains &blood diarrhea	39	3.11
Pains & non blood diarrhea	171	13.6
Blood diarrhea	203	16.1
Non blood diarrhea	667	53.1
Risk factors of Schistosomal acquisition		
Late water for domestic use	74	5.90
Bathing or swimming in lake	233	18.5
Fishing activities	69	5.50
Involving in rice activities	172	13.7
No risk is apparent	708	56.4
Microscopic Stool results		
Positive	561	44.7

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Negative	694	55.3
Parasite prevalence in 1255		
Entamoeba Histolytica	218	17.3
Schistosoma mansoni	141	11.2
Giardia Lamblia	101	08.0
Hook worm	066	05.2
Strongyloides s stercolaris	029	02.3
Ascaries lumbricoides	006	00.4

Abbreviations: IQR: interquartile range.

Table 1b: **The Parasitological results of stool samples with demographic, clinical and risk factor di**

Factor	**Stool Microscopy Results by frequency (percentage)**					
	NEG	**SM**	**Strong**	**G. L**	**HW**	**EH**
Sex						
Male	261 (37.6)	66 (46.8)	16 (55.2)	38 (37.6)	20 (30.3)	071 (3
Female	433 (62.4)	75 (53.2)	13 (44.8)	63 (62.4)	46 (69.7)	147 (6
Age (mean)yrs	31[17-43]	31[16-44]	30 [14-42]	29[14-42]	29[14-42]	30[14-
Age group (yrs)						
< 20	225 (32.4)	90 (63.8)	11 (37.9)	37 (36.6)	20 (30.3)	086 (3
20-40	270 (38.9)	34 (24.1)	11 (37.9)	28 (27.7)	16 (24.2)	078 (3
40-60	146 (21.1)	16 (11.4)	07 (24.1)	22 (21.8)	16 (24.2)	034 (1
> 60	053 (07.6)	01 (00.7)	00 (00.0)	14 (13.9)	14 (21.2)	020 (0
Marital status						
Married	153 (22.1)	021 (14.9)	07 (24.1)	28 (27.7)	14 (21.2)	036 (1
Not married	541 (77.9)	120 (85.1)	22 (75.9)	73 (72.3)	52 (78.8)	182 (8
Abdominal symptom						

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Abdominal Pain	095 (13.7)	23 (16.3)	07 (24.1)	12 (11.9)	08 (12.1)	030 (1
Pain/Dysentery	022 (03.2)	04 (02.8)	00 (00.0)	02 (02.0)	02 (03.0)	009 (0
Pain/Non Dysentery	096 (13.8)	17 (12.1)	05 (17.2)	11 (10.9)	11 (16.7)	029 (1
Dysentery	101 (14.5)	22 (15.6)	07 (24.2)	16 (15.8)	09 (13.6)	047 (2
Non Dysentery	380 (54.8)	75 (53.2)	10 (34.5)	60 (59.4)	36 (54.6)	103 (4
Lake water contact						
Domestic	047 (06.8)	07 (05.0)	01 (03.5)	08 (07.9)	01 (01.5)	009 (0
Bath/swim	124 (17.8)	26 (18.4)	06 (20.6)	14 (13.9)	17 (25.8)	043 (1
Fishing	035 (05.0)	13 (09.2)	00 (00.0)	03 (03.0)	04 (06.0)	013 (0
Rice pad agriculture	087 (12.5)	41 (29.1)	01 (03.5)	11 (10.9)	05 (07.6)	027 (1
No risk is apparent	402 (57.9)	54 (38.3)	21 (72.4)	65 (64.3)	39 (59.1)	126 (5

Abbreviations: EH: Entamoeba hystolica; **GL**: Giardia Lamblia; **HW**: Hook worm; **NEG**; negativ examination; **strong:** strongyloides; **SM**: Schistosoma mansoni. The number are
NOTE: Some patients had more than one abdominal symptoms

Table 2: **A table showing univariate analysis for factors associated with positive stool test for**

Factor	**Schistosoma Mansoni**		
	NO	**YES**	**OR(95%CI)**
Sex			
Male	406 (36.45)	66 (46.81)	

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Female	708 (63.55)	75 (53.19)	1.5 (1.1-2.2)
Age (mean)years	31.4[16-44]	19.8 [8-28]	0.9 (0.9-1.0)
Age groups(years)			
<20	381 (34.20)	90 (63.83)	3.4 (2.4-4.9)
20-40	407 (36.54)	34 (24.11)	0.6 (0.4-0.8)
40-60	225 (20.20)	16 (11.35)	0.5 (0.3-0.9)
>60	101 (09.07)	01 (00.71)	0.1 (0.0-0.5)
Marital status			
Married	239 (21.45)	021 (14.89)	
Not married	875 (78.55)	120 (85.11)	0.6 (0.4-1.0)
Abdo symptoms			
Abdominal pain	152 (13.64)	23 (16.31)	1.2(0.8-2.0)
Pain & dysentery	035 (03.14)	04 (02.84)	0.9(0.3-2.6)
Pains & no dysentery	154 (13.82)	17 (12.06)	0.8(0.5-1.5)
Dysentery	181(16.25)	22 (15.60)	0.9(0.6-1.5)
Non dysentery	592 (53.14)	75 (53.19)	1.0(0.7-1.4)
Lake water contact			
Domestic use	067 (06.01)	07 (04.96)	0.8(0.4-1.8)
Swimming	207 (18.58)	26 (18.44)	1.0(0.6-1.6)
Fishing	056 (05.03)	13 (09.22)	1.9 (1.0-3.6)
Rice pads agriculture	131 (11.76)	41 (29.08)	3.1(2.0-4.6)
No risk is apparent	654 (58.71)	54 (38.30)	0.4(0.3-0.6)

Abbreviations: Abdo: abdominal, **CI:** Confidence Interval**; OR:** Odds ratio

Note: The stool results are recorded as frequencies and percentages