

Prevalence, infection intensity and associated risk factors of Intestinal Schistosomiasis among primary school Children in Lira District, Northern Uganda

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Research note

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Abstract

Abstract Objective: The aim of this cross-sectional study was to determine the prevalence, infection intensity and associated risk factors of intestinal schistosomiasis among primary school children in Lira district, Uganda. The study was conducted among 532 primary school pupils aged 6-16 years from eight randomly selected primary schools (March-May 2017). Stool samples were collected and examined for schistosomiasis using Odongo-Aginya method. Data on socio-demographic characteristics and risk factors were obtained using questionnaires. **Results:** The overall prevalence of *Schistosoma mansoni* was 35.7% indicating a moderate infection. Both males and females were equally affected with *S. mansoni*. Ogur sub county had highest prevalence (65.0%) than others. Akangi (65.5%) and Akano (64.5%) primary schools both had highest prevalence compared to the others. With regard to risk factors, source of drinking water, sub-county location and primary school were associated with prevalence of infection whereas only school location and home distance to water source was associated with intensity. Participants who fetch water from spring, dam and wells had higher infection than those who fetch from boreholes. The study recommends provision of safe water, periodic treatment of school-aged children with praziquantel and public health education to reduce prevalence of *S. mansoni*.

Background

Human schistosomiasis is a water-borne parasitic disease caused by *Schistosoma species*. Infection is contracted through contact with contaminated water containing the infective cercariae [1,11]. Globally, it's estimated that about 200 million people are infected with *Schistosoma species* in 74 tropical countries and that 500-600 million people are at risk of infection [2, 3,4,5]. Of the 200 million cases of infection, 120 million are symptomatic and 20 million have severe debilitating disease [6,7, 8,9,10]. In Uganda, *Schistosoma mansoni* is more widely distributed than *S. haematobium*, with highly endemic foci of infection around Lake Albert, Victoria and Kyoga, and along the Albert Nile [12,13,14]. Uganda has been described as a cradle of *S. mansoni* in Africa because the parasite is widely distributed than anywhere in the world, and the transmission pattern involves many snail hosts [12].

In developing countries, school children are particularly vulnerable to schistosomiasis because of their contact activities with contaminated waters, where they contract the infection. A study conducted along river Anyau in Arua recorded prevalence of *S. mansoni* of 62% [14]. Males were more infected than females, and school children had higher infection rates (71.1%) compared to the villagers (62.8%) living along the shores. Also, along the Albert Nile in Uganda, high prevalence of *S. mansoni* was recorded at 81.5% [15]. The residence of Rhino camp and Obongi fishing villages excreted high egg count of ≥ 500 Epg and the infection was highest in individuals aged 11-20 years [15].

Lira district is among the moderately burdened districts with schistosomiasis in Uganda [16] where MDA is administered every two years with praziquantel. However, published data indicating the actual prevalence among primary school children is lacking. This survey was undertaken to determine the

prevalence, infection intensity and associated risk factors of intestinal schistosomiasis among primary school children in Lira district, Uganda.

Methods

Study area and period

The study was conducted in randomly selected primary schools in Lira District, Uganda, from March-May 2017.

Study design and population

A cross-sectional study design was conducted. All participants whose guardians or parents signed a written informed consent and who were available and registered in their school during the study period and who gave stool sample were included in the study. Children who were severely ill or who were on anti-helminthic drug or treatment within three weeks prior to data collection and study subjects who refused to provide stool samples at the time of sampling were excluded from the study.

Sample size determination

Sampled size was determined using Kish [17] formula considering: Prevalence rate (p) of 50%, 95% confidence interval and 5% margin of error. Adding 39% none response rate the total sample size was 532.

Sampling procedure and techniques

Eight primary schools were selected from four sub-counties (Table 1). Pupils aged 6-16 years voluntarily enrolled in the study. In each school, proportionate sample was allotted according to the number of the pupils in each class. The registration list was used as the sampling frame.

Study variables

Independent variables: socio-demographic and risk variables (gender, age, sub-county, primary school, water source, distance of home from water source).

Dependent variable: *S. mansoni* infection.

Data collection

Socio-demographic data and risk factors

School children participated in the study were interviewed with pre-tested questionnaires to collect information on socio-demographic data and associated risk factors. The questionnaire was prepared in English and translated to Luo. Pre-testing was done in 5% of school children that were not included in the study and appropriate correction applied.

Stool sample collection and processing

Each participant was provided with a wide-mouthed, clean, leak proof stool container labeled with participant's code, laboratory number, date of collection. Each participant collected approximately 10gm of stool and delivered to the laboratory within one hour. Specimen processing and examination was done at LRRH laboratory using the Odongo-Aginya method [18, 34]. The prepared slides were examined microscopically within 5 min of collection. Samples with eggs were recorded as positive while those without eggs were taken to be negative. For positive samples, eggs were counted and each average count was recorded as number of eggs per gram of faeces (epg). Intensity of infection was categorized by age group and gender into light (1–99 epg), moderate (100–399 epg), and heavy (epg \geq 400) infections according to WHO [6].

Statistical analysis

Demographic data was analyzed using descriptive statistics. Chi-square in SPSS version25 was used to identify association between prevalence of schistosomiasis and risk factors. To identify factors associated with the intensity of *S.mansoni* infection, we utilized a negative binomial generalized linear model with a loglink function.

Results

Socio-demographic characteristics

A total of 532 participants aged 6-16 years were enrolled in this study. 267 (50.2%) were males and 265 (49.8%) were females (Table 1). The mean age (\pm standard deviation) of the study participants was 12 years. The highest number of participants (290, 54.5%) were from the age group of 10-14 years and the least (74, 13.6%) was from 6-9 years. Aromo (218, 40.9%) and Agali (95, 17.9%) sub-counties had the highest and least number of participants, respectively.

Table 1 Socio-demographic characteristics and risk factors associated with *S. mansoni* infection in Lira district, northern Uganda (n = 532)

Variable	Infection, n (%)		χ^2 (df)	P value
	Positive	Negative		
Gender				
Male	94 (36.0%)	171 (64.0%)	0.014 (1)	0.907
Female	96 (35.5%)	171 (64.5%)		
Age (years)				
6-9	31 (41.9%)	190 (58.1%)	1.448 (2)	0.485
10-14	100 (34.5%)	109 (65.5%)		
15-16	59 (35.1%)	43 (64.9%)		
Sub county				
Aromo	56 (25.7%)	162 (74.3%)	60.375 (3)	P<0.001
Ogur	80 (65.0%)	43 (35.0%)		
Barr	27 (27.0%)	73 (73.0%)		
Agali	27 (29.7%)	64 (70.3%)		
Primary school				
Oketkwer	27 (24.3%)	84 (75.7%)	66.329 (7)	P<0.001
Akore	29 (27.1%)	78 (72.9%)		
Akano	40 (64.5%)	22 (35.5%)		
Akangi	40 (65.5%)	21 (34.4%)		
Barr	18 (36.7 %)	31 (63.3%)		
Okile	13 (27.1%)	35 (27.9 %)		
Abongorwot	16 (34.0%)	31 (66.0%)		
Olilo	7 (14.9 %)	40 (85.1%)		
Water source				
Borehole	63 (24.9%)	190 (75.1%)	26.355 (3)	P<0.001
Dam	6 (64.2%)	7 (53.8%)		
Spring	85 (48.3%)	91 (51.7%)		
Well	36 (40.0%)	54 (60.0%)		

Distance of home from water source				
Less than 500m	42 (37.8%)	69 (62.2%)	9.084 (4)	0.059
500≤1000m	36 (35.6%)	65 (64.4%)		
1000≤1500m	55 (28.9%)	135 (71.1%)		
1500≤2000m	36 (48.0%)	39 (52.0%)		
≥2000m	21 (38.2%)	34 (61.8%)		

Prevalence and intensity of S. mansoni infection

The overall prevalence rate of *S. mansoni* among primary school children was 35.7% (190/532). Males and females were nearly equally infected (36.0% versus 35.5% each). With regard to age group, school children aged 6-9 years were the most infected (41.9%) compared to the other age groups although it was not statistically significant (Table 1). Prevalence of infection was significantly associated with sub-county location ($\chi^2 = 60.4$, $df = 3$, $P < 0.001$) and primary schools ($\chi^2 = 66.3$, $df = 7$, $P < 0.001$). Ogur sub-county (80, 65.0%) had the highest prevalence and the least was from Agali (27, 29.7%) and Barr (27, 27.0%) sub-counties, respectively (Table 1). Among primary schools, Akangi (40, 65.5%) and Akano (40, 64.5%) both had the highest prevalence, and the least were from Oketkwer (27, 24.3%) and Olilo (7, 14.9%), respectively. Also, the overall prevalence of *S. mansoni* infection was significantly associated with source of water ($\chi^2 = 26.4$, $df = 3$, $P < 0.001$). Participants who fetch water from spring (85, 48.3%), well (36, 40.0%) and dam (6, 64.2%) had higher infection rates than those who fetch water from boreholes, 63, 24.9% (Table 1).

The intensity of infection was associated only with school location (Generalized linear model, $\chi^2 = 45.5$, $df = 7$, $P < 0.001$) and distance of home from water source ($\chi^2 = 28.5$, $df = 4$, $P < 0.001$). The individuals in the age group of 14-16 years and 10-14 years had heavy infections with epg of 600 and 565 eggs, respectively compared to those aged 6-9 years (Table 2). Among those who were positive for *S. mansoni*, 25.8% (49/190), 5.3% (10/190), and 68.9% (131/190) had light, moderate and heavy infections, respectively (Table 2). Both males and females had heavy infection with *S. mansoni* and mean egg count of 532 and 602, respectively.

Table 2. Intensity of infection with *S. mansoni* by age groups and gender

	Light (1-99 Epg)	Moderate (100-399 epg)	Heavy (>400 epg)	Total
Age group	No. infected (mean egg count)	No. infected (mean egg count)	No. infected (mean egg count)	
6-9yrs	12 (84)	19 (240)	0	31
10-14yrs	22 (72)	71 (244)	7 (565)	100
15-16yrs	15 (72)	41 (207)	3 (600)	59
Sub Total	49	131	10	190
Gender				
Male	32 (72)	78 (239)	6 (532)	116
Female	17 (84)	53 (234)	4 (602)	74
Sub Total	49	131	10	190
Infection intensity (%)	25.8	68.9	5.3	100

Discussion

In this study, the overall prevalence of *S. mansoni* infection among the school children was 35.7%. This is categorized as moderate risk [19]. This prevalence is low compared to those obtained from western Kenya (76.8%), and in Tanzania (64.3%) [24, 26]. This low prevalence in Lira district could be due to the massive administration of preventive chemotherapeutic praziquantel (in Aromo subcounty only) and Albendazole to the school children by MOH Uganda two years prior to the study. This finding is similar with results from studies conducted among communities in islands of Lake Victoria, Uganda [20,21] and in Northwest Ethiopia and west Africa [22, 23], respectively. Nevertheless, the prevalence obtained in this study is higher compared to 20.1%, 4.6%, 4.3% reported in Gulu municipality, Uganda [30] and in Jos, Nigeria [36], respectively. This could be attributed to differences in geographical locations and in control interventions.

The prevalence of *S. mansoni* infection varied significantly with sub-county location and primary schools. Highest infections were recorded in Ogur sub-county and in Akangi and Akano primary schools (both in Ogur subcounty). This could be attributed to the numerous swamps around Ogur sub-county which contain a lot of infected snails (Byagamy pers. obs), and the absence of praziquantel treatment intervention in the area. Ogur subcounty was considered by MOH as a low prevalence area and MDA was administered only in Aromo subcounty. Similar variation in infection prevalence of *S. mansoni* by geographical location has been reported in previous studies in Gulu, northern Uganda [30], which have been attributed to variation in intensity of parasite transmission and frequency of exposure to cercariae contaminated water bodies [30].

Children aged 6-9 years were more infected (41.9%) than children aged 11-14 years (34.5%) and 15-16 years (35.1%). Studies conducted elsewhere have reported similar results, for example, in rural Yemen, the prevalence of schistosomiasis was significantly higher among children aged ≤ 10 years (37.6%) compared to those aged >10 years (27.0%) [30]. However, in contrast to the present results, highest

prevalence was found among the 6-10 years old (90.4%) in Ethiopia than in those 11-15 years 89.7% [28]. This might be attributed to the behavioral patterns of different age groups with respect to water contact activities and poor personal hygiene. Children aged 10-14 years were older and often got in contact with infected water bodies through various water activities such as swimming, fetching water, playing with shallow water and fishing, washing clothes and farming. However, children older than 14 years have lower risk of being infected as they are less likely to be engaged in recreational water-contact behaviors compared to younger children. Other studies have indicated that age acquired immunity to reinfection contributes to the drop in the prevalence rates among children aged 15 years and above [29].

Even though some studies reported that prevalence among males was higher than females [30], in the present study no difference was observed in the prevalence between males and females. This could be due to the socio-cultural set-up activities where both males and females are equally actively involved in water-related activities like swimming, fishing, grazing in the swamps, bathing and playing with shallow water, collecting rids from swamps and farming [30]. In Los, Nigeria, for example, prevalence of *S. mansoni* infections were higher in males (22.2%) than in females (3.7%) [31,35,36]. Another report of higher prevalence rate in boys was given in Gulu municipality, Uganda (boys: 65.2%; girls: 34.8% [30]. The results of this survey further contradicted the findings in Northwest Ethiopia (boys:33.7%; girls: 42.2%) [22] and in Tanzania (boys 61.65%; girls 65.80%) [27] which could be due to different geographical locations and socio-cultural factors in those communities.

The high infection rate among children who collect water from the spring (48.3%), dam (64.2%) and well (40.0%) compared to those who fetch water from borehole (24.9%) could be because these are open sources that are prone to contamination with faeces containing eggs of schistosomes and provide favorable breeding sites for snails. This finding is in agreement with several previous studies [30,32, 33]. Domestic water collection and swimming keep children in water for a prolonged time, which increases the chances of cercarial skin penetration.

Finally, the findings in this study have shown that almost 5.3% of the *S. mansoni* infections are heavy intensity infections and approximately 68.9% are of moderate intensity. This finding is higher than the one in Gulu Municipality which showed only 20.1% moderate infection [35]. This difference may be due to repeated exposure of school children to water bodies infested with infective stage in Lira district. Additionally, children aged 14-16 and 10-14 years had heavy infections compared to their younger counterparts (6-9). This might be due to the fact that older children frequently go to the open water sources to play and fetch water as reported elsewhere [37]. These children spend more time in the infested waters compared to their younger ones, thus increasing the exposure time for infection of *S. mansoni*.

Overall, this study showed that Lira District is endemic for *S.mansoni*. Therefore, there's urgent need for provision of safe water, periodic treatment of all school-aged children with Praziquantel and public health education to reduce the prevalence of *S. mansoni*.

Limitations

This study was conducted among school children in Lira district and the school-aged children in the community were excluded. Furthermore, a single stool sample was collected and analyzed, which may underestimate the prevalence of schistosomes as the chance of detecting parasites increases with examining multiple samples.

Abbreviations

DEO	District Education Officer
DHO	District Health Officer
GUREC	Gulu University Research Ethics Committee
epg	Egg per gram of stool
LRRH	Lira Regional Referral Hospital
MOH	Ministry of Health
SPSS	Statistical Package for Social Scientists
WHO	World Health Organization

Declarations

Authors' contributions

BJP, MGM, RE, AH and EIOA conceived the study. BJP collected data, performed laboratory analyses and wrote the draft of the manuscript. BJP and MGM did statistical analyses of data. All authors' read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Consent for Publication

Not Applicable

Ethical approval and consent to participate

The study was approved by the Gulu University Research Ethics Committee (No. GUREC 04/03/2017). Permission to conduct this study was later granted by the DHO, DEO and management of selected primary schools in Lira district. Written (signed) informed consent and assent were sought from class teachers and each participant before conducting the interviews and sample collection. Data collected from each study participant and results of laboratory tests were kept confidential and codes rather than participant's name were used. Children found infected were treated with praziquantel for free.

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