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Risk factors associated with the prevalence of *Schistosoma mansoni* and soil-transmitted helminths among primary school children (10-14 years) in Buyende district, Uganda

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Abstract

Introduction: Schistosomiasis is a water-based disease transmitted by schistosomes. Schistosomes usually co-infect their hosts with soil-transmitted helminths (STHs) parasites due to overlapping poverty-related factors favoring their distribution.

In Uganda, infestations of STHs and schistosomiasis commonest in primary school children are ranked 2nd and 3rd, respectively, among the top 10 causes of morbidity despite classified as NTDs in the HSSP aggravated by low financial allocation budget for their control.

Objective: To determine the prevalence of *Schistosoma mansoni* and STHs parasites among primary school children, 10-14 years and the associated risk factors in Buyende district.

Methods: Stool samples from 400 children distributed in eight randomly selected primary schools were processed for *Schistosoma mansoni* and STHs before a face-face standardised interview guide was administered to ascertain factors responsible for perpetuating the parasites in the communities.

Results: Overall prevalence of 32% for *Schistosoma mansoni* in 2011 and 16% in 2018 was recorded while 1.25%, 0.2% in 2011 and 0.38%, 0% respectively. Hookworm was not reported in 2011, but a prevalence of 6.7% was recorded in 2018. There was a strong association of nature of housing materials OR: 1.61, CI: 1.02-1.40) education level of the caretakers (p-value <0.001; aOR: 17.5, CI: 5.35-50.96) and the swimming frequency of the child respondent aOR: 2.44 95% CI: 1.56-4.23) as the most important risk factors.

Conclusion: Illiteracy of caretakers being the critical risk factor should prompt increased health education with information, education and communication (IEC) materials urgently for intervention especially among individuals of low socioeconomic status in fishing communities.

Keywords: *Schistosoma mansoni*, helminths, Uganda

Introduction

Infestations caused by soil-transmitted helminths (STHs) and schistosomes are among the most prevalent afflictions of humans in endemic areas. Globally, 78 countries are known to be infested with schistosomiasis predominantly caused by *Schistosoma mansoni* with 200,000 deaths annually, of which 90% occur in Africa [1]. The parasite usually co-infect with STHs, thereby increasing severity that includes impairment of physical and mental growth in children, prevention of educational advancement, and hindrance of economic development. STHs including *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus* and *Ancylostoma duodenale* [2] are endemic in 20% of the global communities characterized by poor hygiene, sanitation and inadequate water supply [3] 1819 million are suffering from chronic debilitating morbidity due to these parasites [4]. However, despite this level of severity, the infestations caused by these parasites are classified among the neglected tropical diseases (NTDs). In Uganda, reports indicate that about 5.4 million people are infected with schistosomiasis while 13.9 million are at risk of the infestation [5]. *Schistosoma mansoni* infestations recorded in 73 of the 112 districts [6]. *Ascaris lumbricoides* and *Trichuris trichiura*, though most prevalent in south-western Uganda, with at least 89% prevalence, hookworm is predominantly reported in eastern Uganda with a prevalence of 60% [7]. The most recent intervention efforts against these parasites have been through mass drug administration (MDA) first initiated in the districts of Buyende and Panyimur in 2003 due to the high prevalence reported [8].

However, to-date, the infestations are still being reported for which the study aimed to investigate the associated risk factors. The increased fishing activity involving diversified ethnicities, almost from every part of Uganda, and outright compliance to the MDA programme right from its initiation, preferred Buyenda to Panyimur for this study.

Buyende borders Lake Kyoga and covered by a mixture of forest remnants and savannah vegetation. The district experiences a bimodal type of rainfall with peaks in mid-March to May as well as August–November with an annual average of 1350 mm. Close to the lake are grass-thatched houses made of mud and wattle. Further away inland, more

semi-permanent houses are present. The people living within a distance of at least a kilometre depend on lake water for all domestic uses especially in Nkondo, Kagulu, Kidera and Buyende sub-counties. Particularly around landing sites, pit latrines are extraordinarily scarce but progressively improve in hinterland communities, which also have more boreholes for safe water. Economic activities include agriculture followed by fishing, with some limited trading.

Materials and Methods

Study Area

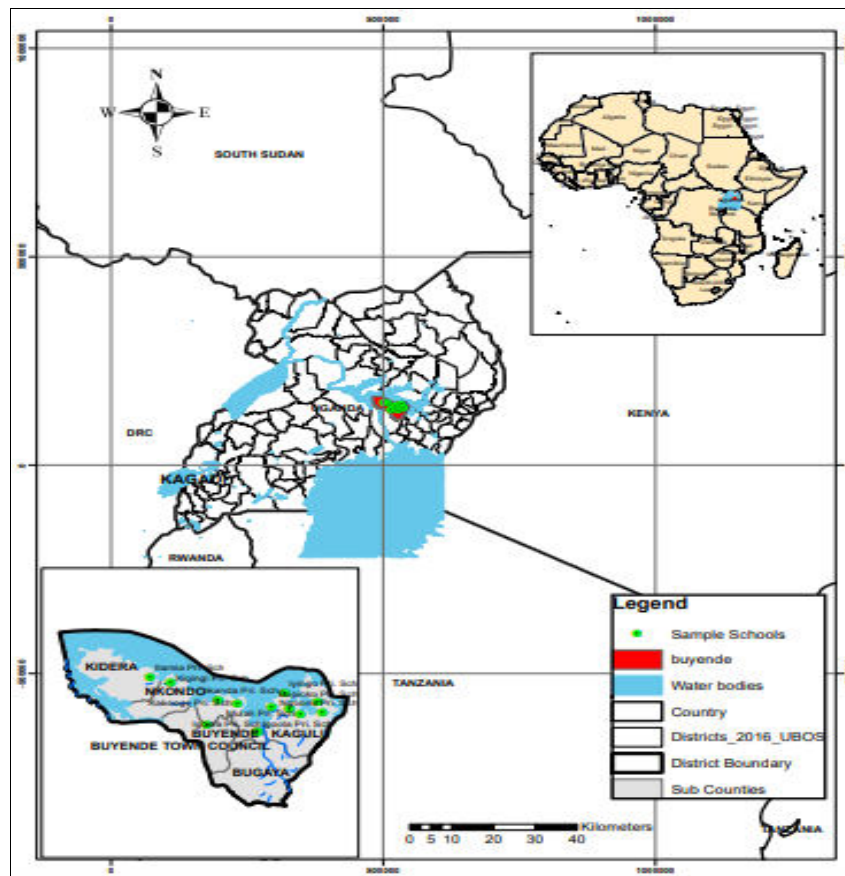


Fig 1: Location of the selected primary schools in Buyende district

Field and Laboratory procedures

Primary data based on examination of faecal samples and administration of an interview guide were meant to obtain information on socio-demographic, behavioral practices, individual, community, institutional factors influencing the prevalence of *Schistosoma mansoni* and STHs in Buyende district by 2011. Interview responses were verified by observations of the surrounding environment using a checklist.

A total of 400 children, boys and girls, aged 10 to 14 from eight primary schools were enrolled in the study. Each child was assigned with disposable plastic stool container bearing school's three-digit prefix code as identifier, name, village, and date of collection to scoop about 100 mg of faeces. Approximately 50 mg of stool were processed using Kato-Katz technique^[9] to obtain appropriately transparent smear based on a 41.7 mg template. Precautionary measures outlined^[10] to ensure quality control of faecal results, including multiple reading of the prepared slides and preservation of the remaining stool for further verification

were adopted. All identified helminth eggs were counted using tally-counters while being viewed under magnification of x40.

Statistical analysis

Frequency distributions with their means and standard deviations were used to compare normality. Knowledge level and the factors associated with the prevalence of the parasites was determined using a scale of index score ranging from 0 to 3, i.e. no to high knowledge^[11]. Descriptive statistics were used to analyze the risk factors associated with the parasites using SPSS version 20.0 and STATA version 13.0. The prevalence of the different parasites was obtained as a percentage of the total examined samples. Logistic regression for the multivariate analysis was done to identify factors independently associated with the parasites. Unadjusted and adjusted odds ratios and their respective 95% confidence intervals (CIs), as well as p-values, were reported. Cross tabulation with chi-square test was done to compare the frequencies of STHs

and *Schistosoma mansoni* infestations among the different socio-demographic categories. Multivariate logistics regression (table 4.2) was performed to determine the association between the independent variables. Variables that showed p-value ≤ 0.05 were considered significant.

Results

Out of the 400 children, 120 (30%) were found infected with at least one of the four parasite species (Table 4.1). *Schistosoma mansoni* was found co-infested with hookworm 61 (7.7%) and with *Trichuris trichiura* 22 (2.8%). Dual and triple species infestations were recorded in 93 (23%) and 7 (1.757%) children, respectively. None of the children were infected with all the four helminths species. In ascending order, mono-infestations were reported; hookworm (14.3%), *S. mansoni* (10.8%), *T. trichiura* (4.3%), *E. vermicularis* (0.8%).

Schistosoma mansoni had the highest prevalence in Kidera (68.5%) followed by Nkondo (57.7%) while STHs generally recorded low prevalence in all sub-counties. There was a decrease in the prevalence of *S. mansoni* from 32% in 2011 to 16% in 2018. Apart from the hookworm that scored 6.7% the rest of the STH were negligible.

There was a significant association of *Schistosoma mansoni* and STHs co-infestation with the study participants who resided in houses made of inferior building materials such as mud and grass-thatched roofs (UOR = 0.078, 95% CI: 0.047-0.128) than those staying in permanent houses (UOR = 0.003, 95% CI: 90.003 - 0.157) (Table 4.2). Co-infection of *S. mansoni* with at least one STH was 20 (5%) of the total respondents examined while 375 (93.8%) were not co-infested (Table 4.2).

Discussion

The prevalence of *Schistosoma mansoni* must be considered high, given the fact that it exceeds the 10% recommended value for mass drug administration [12]. Proximity to the lake coupled with inadequate environmental sanitation and irregular MDA programme could explain this augmented prevalence. Proximity to the lake influences direct egg-inputs through the numerous contamination-related activities such as washing in private or communal areas of the shoreline location, which also vary by age, gender and cultural practices. Furthermore, indirect inputs of eggs from other sources such as those from overflowing latrines or that washed-in by rain, should not be ignored [13]. Environmental insanitation characterized by unusual contamination-related activities including the purposeful spreading of human or animal faecal material by fisherfolk as fish attractants is potential risk factors to the infestations of *Schistosoma mansoni* and soil-transmitted helminth parasites. Irregular MDA performed by the village health teams (VHTs) that are not well facilitated other than the monthly payment of fewer than two dollars lead to intermittent schedules in administering drugs. This has, in turn, encouraged re-infestation and poor drug adherence as well as cases of possible resistance. In addition, treatment with praziquantel against intestinal schistosomiasis due to *S. mansoni* was observed mainly being administered to fishermen without albendazole as one regimen, violating the recommendation by WHO. This results in poor treatment outcomes which sustain both infestation and transmission in the community. As mentioned by one of the key informants, institutional factors associated with infections of *S. mansoni* and STHs

especially against their control included insufficient power in mobilizing the funds, inadequate monitoring and evaluation mechanisms as well as the inefficient diagnostic tools. These were reported to have led to failure to extend regular deworming coverage [14] resulting in inefficiencies in implementing and sustaining of the control programme. These scenarios were more prominent in Kidera and Nkondo than other sub-counties hence increased prevalence of *S. mansoni*. The predominance of education of the caretaker and house-building material as risk factors isolated by the analyses ($p < 0.05$) as shown in tables 2 has been recorded elsewhere in Malaysia, Tanzania, Nepal, Cote d'Ivoire [15]. Education furnishes necessary information about a parasite and ultimately prompt one to participate in the control [16]. Building material reflects the socio-economic status that in turn influences behavioral patterns such as personal hygiene and environmental sanitation practices both of which are associated with parasites' epidemiology. The current study being conducted in a fishing community, the majority of occupations were fishing and peasantry. As reported by one of the critical informants "children join their caretakers in the same occupations during school holidays."

Elsewhere infection is more common among boys than girls, [17] given that boys are more expeditious in their play habits and knowledgeable than girls [18]. However, on the contrary, the current study revealed girls more infested than boys, agreeing with findings of [19]. Girls perform various home chores, including bathing of children, cleaning of tuber-based foods and water collection that expose them to the prevailing infective cercariae than boys. Even during swimming girls tend to restrict themselves in the shallow waters containing more pulmonate snails and their cercariae than boys that tend to extend into deeper water parts where the snails and their cercariae are fewer [20].

Conclusions

The prevalence of co-infestation of *Schistosoma mansoni* and STHs was 5%, most of which was *S. mansoni* with hookworms. In comparison, a mono infestation of *Schistosoma mansoni* was 32.32% in 2011, which decreased to 15.86% in 2018. This is critical because according to WHO (2002) both prevalence in the two years are considered high since they exceed the 10% recommended value for mass drug administration of all the primary schools in the endemic communities. However, despite the existing challenges, it is evident that MDA has reduced the burden of *Schistosoma mansoni* and STHs in the district.

The most important risk factors associated with *Schistosoma mansoni* and STHs infections included low-cost house building material indicative of miserable socio-economic status and low education level of the caretakers. These factors have been noted elsewhere as critical in the control of parasitic diseases [21, 22].

The global distribution of *Schistosoma mansoni* in all the sub-counties of Buyende district puts the activity of rice-growing in perspective as equally important in the epidemiology of the disease. This is aggravated by the limited level of knowledge about the diseases by the local council leaders.

What is already known on this topic?

The two infections are so prevalence among the primary school age group. It is known that schistosomiasis increase

rates of absenteeism leading to low productivity and increased school drop outs. From this study, it verifies that the two infections are related to poverty, thus classified as neglected tropical diseases (NTDs).

What this study adds

Increased timely sensitisation to improve knowledge of care takers will increase vigilance and heeding control and prevention measures.

This will result to reduced school absenteeism and drop outs

leading to improved productivity.

The results on infections related to poverty, the study further reveals that co-infection was higher to poorer households and in which the care takers had never been to school. This will prompt appropriate resource allocation in effort to improve the socio-economic status of such fishing communities. Furthermore in the national programs to educate all irrespective of age, will give priority to such homesteads.

Table 1: Prevalence of *Schistosoma mansoni* and STH parasites among the 10 to 14 year-old school-going children per sub-county in 2011 and 2018

Sub-county	Prevalence in 2011					Prevalence in 2018						Co-infestation of <i>S. mansoni</i> with STH (%) Co-infestation (%) ⁵
	<i>S.mansoni</i>	<i>T. trichiura</i>	<i>A.lumbricoides</i>	<i>H.nana</i>	<i>E.vermicularis</i>	<i>S.mansoni</i>	<i>T.trichiura</i>	Hookworm	<i>A.lumbricoides</i>	<i>H.nana</i>	<i>E.vermicularis</i>	
Bugaya	1.8	0	0	0	0	1	0	6	0	0	0	5
Buyende	20	3	0	0	0	9.3	0.4	10	0	0	0	
Kagulu	13.6	0	0	0	0.03	9	1	9	0	0	0	
Nkondo	57.7	0.5	0	0	0	25	0	4	0	0	0	
Kidera	68.5	2.7	0.8	0.4	0.8	35	0.5	4.6	0	0	0	
Total	32.32	1.25	.16	.008	.166	15.86	.38	6.72	0	0	0	

Recommendations

The district health management unit should come up with a package to sensitise the communities by acquiring training manual from the government and incorporate them into public health care system which should also be made available to all that are in need of them to increase knowledge on the schistosomiasis and STHs. This will avert the 59.5% caretakers and the local council leaders that were not knowledgeable of the infestation dynamics of both schistosomiasis and soil-transmitted helminths for improved public health. The government should lobby for more funds by partnering with donor agencies such as World Vision and UNICEF in an effort to broaden the health education to many endemic areas and frequency of treatment, especially in heavy infestations.

The low socio-economic status can be improved by the government initiating self-help projects to the communities to allow better house-hold income. Given the limitation of the Kato-Katz method, triangulation of diagnostic methods should be encouraged to achieve the accurate representation of parasitic infestations in the district.

Contributors

Covia Atuheire collected and analyzed the data, John Kisakye and Innocent Rwego mentored and supervised the whole research and the write-up.

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