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PREVALENCE AND INTENSITY OF SOIL-TRANSMITTED HELMINTHES (STHs) AND SCHISTOSOMES IN PRIMARY SCHOOLS IN BO DISTRICT, SOUTHETN SIERRA LEONE

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ABSTRACT
Soil–transmitted helminths group various nematodes together that infect humans and share a common source of infection-soil contaminated by faecal matters. It is also true that multi-parasitism is common among deprived populations, especially those living in developing countries. This paper reports study that investigated magnitude of the prevalence and intensity of soil –transmitted helminthes (STHs) and Schistosomeses in primary schools in Bo District in Sierra Leone. The study was conducted in two primary Schools- ABC and DEC Primary Schools in Lewabu and Korwama Communities in the Eastern part of Bo District. Purposive and simple random sampling techniques were used in selecting the schools and the participants for the study. A laboratory test was carried on stools and urines of pupils aged 9- 14 years in classes IV, V and VI. It was found that 141 (94.0%) of the 150 pupils tested hosted either one or two different types of parasites. There was also high infection intensity and prevalence in both schools. The parasite infection was prevalence for *Schistosoma haematobium*, (37.0%), and *Schistosoma mansoni*, (33.8%),). There was no significant difference in the prevalence of Hookworm (21.3%) and Ascaris (17.7%). The prevalence was for Hookworm (11.3%) and Ascaris (9.2%) in Korwama, and (9.9%) and (8.5%) for Lewabu. It is concluded that STH infections is prevalent in school children in Korwama and Lewabu communities. The very high prevalence and high intensity of parasitic worm infections observed in both communities raise serious concern about the resulting morbidity in school children in these communities It was recommended that Bo City Council, Ministry of Education, and Health identify the factors of prevalence of STHs parasites. Also, a school–based STH control programme should be launched in the localities combined administration of Praziquantel and mebendazole tablets to all infected pupils in the schools.

KEY WORD: Soil Transmitted Helminthes, Intestinal Parasites, Prevalence, Intensity.

INTRODUCTION

Schistosomiasis and soil-transmitted Helminthiasis (STH) (geohelminths) infections are among the most prevalence of chronic human infections with estimated 2 billion individuals infected worldwide (Stothard, 2009). These infections are more prevalence in tropical and subtropical regions of the developing world where adequate water supply and sanitation are lacking (WHO, 2002). The most common STHs are round worm (*Ascaris lumbricoides*), whipworm (*Trichuris trihiura*), and the anthropophilic hookworms (*Nncylostoma duobenale*). STH infections rarely cause death. Instead, the burden of disease is related less to mortality than to the chronic and insidious effects on the host' health and nutrition al status (Stephenson *et al*., 2000). The greatest STH infections occur in Sub-Sharan Africa where 89.9 million of school-age children are infected (Brooker *et al*., 2006). Chronic and intense STH infections can contribute to malnutrition and iron deficiency anemia, and can adversely affect physical and mental growth in childhood (Hotez *et al*., 2004). Because of their underlying poor iron status, children, women of reproductive age, and pregnant women are frequently the ones most susceptible to developing hookworm anemia (Brooker *et al*., 2004). Iron mental –fetal consequences, during pregnancy has been linked to adverse martanal fetal consequences, including prematurity, low-birth-weight, and impaired lactation (WHO 2002). The manifestations of severe disease include fatal intestinal obstruction or pulmonary allergic reactions in the case of ascariasis, severe anaemia in hookworm infections and chronic dysentery and rectal prolapsed in trichuriasis (Crompton& Nesheim, 2002). The most tricking epidemiological features of human helminth infections are aggregated distribution of in human communities, predisposition on individuals to heavy (or light) infections , rapid re-infestation following chemotherapy, and age-intensity profiles that are typically convex (with the exception of hookworm (Hotez *et al*., 2005). However, there is a potential for public health-related control because most STH species do not multiply within the human host (Maizels *et al*., 1993). Each adult worm originates from egg or lava in the environment. It follows that prevention feacal pollution, as a public health measure, can control and possibly even eradicate STH infection, thus obviating the need for chemotherapy (Hotez *et al*., 2005). Environmental conditions govern the potential distribution of a range of parasites with free-living or vector –dependent stages. The main determinants are the climate (temperature and precipitation), the geographical conditions including soil- type, slope, wetness and water

bodies, and the vegetation. Most of these factors are interrelated acting upon each other in multiple ways and complex causal webs (Patz, 200). Humans are subject to the local conditions and adapt to the prevailing environment, most notably in traditional and rural societies. But they also act upon the environment, thereby influencing the local endemicity of parasites. Human helminth infections are common in Sierra Leone, particularly in the soil–transmitted helminths, namely *Ascaris lumbricoides*, *Trichuris trichiura* and the hookworms (namely *Nectator americanus*)(Koroma *et al*., 1999). In school age populations of developing countries including Sierra Leone, intestinal helminth infections rank first among the causes of communicable and non-communicable diseases (WHO, 2002). Hygiene and play habits of among the male children especially make them vulnerable to Schistosomiasis and SHT infections. It is estimated that 400 million schools –aged children who are infected are often physically and intellectually compromised by anemia, leading to attention deficits, learning disabilities, school absenteeism and higher dropouts (WHO, 2001). The development of effective parasite control is possible by regular chemotherapy, using anti-helminthics to school children delivered through school system which can be the main intervention strategy (Awasthi *et al*., 2003; Hotez *et al*., 2005). Unfortunately, there is no recent school based study which provides information on the epidemiology of the parasitic infection in STH among school children from rural communities in Sierra Leone. Schistosomiasis is strongly associated with social, cultural, behavioral and economic factors and lifestyles that interact in a complex way with ecological and environmental factors at the local scale (Huang & Manderson, 2005). The main interrelating factors are migration and urbanization, socio-economic status, lifestyles, quality of sanitation and water supply, proximity to transmission sites, water contact behaviour and agricultural practices. Hookworm infections occur rather in rural than urban areas and are often linked to occupational exposure. Agricultural activities are an important contextual factor for hookworm infection, which is very common among farmers and vegetable growers (Brooker *et al*., 2004; Hotez *et al*., 2003). Peri-urban and urban zones with intensive agriculture are high-risk areas for hookworms in particular and soil-transmitted helminths more generally. Risk factors are the use of fertilizers based on human faeces and untreated wastewater, daily contact with agricultural soils, outdoor defecation, and a high population pressure combined with poor sanitation in temporary settlements of migrants (van der Hoek *et al*., 2003).

The present study, therefore, attempts to address this earth of information and describe the prevalence, characteristics and control of STH intestinal parasitic infections among school children from two rural communities in the Bo city, southern Sierra Leone. It is hoped that result of this study will be attractive to Ministry of Health and Sanitation, Ministry of Education, WHO, and FAO who are involved in Child development in Sierra Leone. It is also hoped that other countries in the Sub-Sahara will use it for planning strategies for controlling this mayhem in the continent.

MATERIALS AND METHODS

Research Design

The design of this study was a longitudinal study based on the repeated cross-sectional survey and carried out among primary school children.

Study Area

The research was conducted in two communities (Korwama and Lewabu) in the western part of Bo City in the Southern Region of Sierra Leone. These two communities were selected because of their strategic locations in the city and the socio-economic activities of their inhabitants. Living conditions in Korwama and Lewabu are particularly very poor in most homes where people are gathered in overcrowded mud-block houses completely devoid of basic sanitation and pipe borne water supply. There are only three secondary schools in these communities – one in Korwama and two in Lewabu. Most of the youths of these communities depend on sand mining, living the pits open in the swamps bordering the two communities. Korwama and Lewabu are typically dependent on water from swamps and wells for their various daily activities, including cooking, bathing, and washing clothes. Fishing is not a common occupation of occupants of these communities but young boys and children between ages 8 and 15 years are normally seen fishing in the streams and waters in the pits, while adult males and females with their girls use these swamps for agricultural activities during the dries. In this farming activities, the farmers use night-soil materials got from empting toilets, reserved in pits near these swamps as fertilizers on their crops. These farmers mixed this organic material either with their bare hands or feet.

Study Subject

Primary School pupils in Bo were the subject of the study. Out of the three primary schools, two (Sierra Leone Muslim Brotherhood (SLMP) School and American Calvary Baptist Church (ACBC) School) were selected-one, SLMB, randomly selected from Lewabu and the other, ACBC, purposively selected from Korwama communities. Within each school, in according with WHO rapid assessment protocols (Bookes *et al*., 2005; 2009) appropriately 170 (75 boys and 95 girls) were randomly selected by the headmasters of the two primary schools from classes IV, V and VI. These corresponded roughly to ages 9-14 years.

Informed Consent and Ethical Consideration

Before the field work itself, ethical approval was granted by the authorities in the Southern Region Branch of the Ministry of Health and Sanitation, and the Ministry of Education. The community leaders and Headmasters were asked for informed consent on behalf of the pupils to participate in the surveys and sample collection. Information meetings were held with the parents, children and community leaders in each school to explain the purpose of the study, the procedures involved, the benefit and risks of taking part in the study. The benefits were that school children received free laboratory investigation and free treatment for Schistosomiasis and STH. The risks of taking part in the study were mainly due to mild and transient advert drug reactions. Oral consent was sought from parents whose children were sampled for the study.

Stool and Urine Collection

The field work was carried out in May to October, 2015. First, the Head Masters / Head Mistresses of the selected schools were contacted by a senior member of the research team. During this visit, the researchers were able to fix a date and time for the data collection. Data collection was done by the researchers themselves, assisted by two experienced laboratory technicians from Njala University Hospital. In an attempt to ensure co-operation of the sample respondents in the various schools, first, the school authorities and pupils, local authorities- Chiefs, Elders, parents, and other stakeholders were approached and the researchers' mission explained. Children were given brief information on disease (causes, manifestation, consequences, and diagnosis). After simple random selection, each child was given a unique reference number. For each child, data on age and sex were collected from the school, while that for height (by standard measuring tape) and weight (UNICEF Scales). Stool and urine samples were collected from each child in labelled 50ml screwed vats and transported to the Njala University Hospital laboratory. A few drops of formaldehyde were added to sufficiently cover the stool in the stool in the specimen bottle to avoid decade and to fix eggs and larva in the faeces. Examination of stool was in two stages - the Kato Katz technique (WHO, 2003), and microscopic examination prepared slides. A small mound of faeces was scooped from the specimen bottle with a spatula and then placed on a piece of scrap paper. A sieve was placed on top of the faeces with the spatula until sufficient stool was collected to fill a 50mg template placed on a clean microscopic slide. A piece of Cellophane paper dipped in malachite green is placed on the faeces and spatula was used to evenly spread the faeces on the slide. The prepared slides were observed under x10 magnification of a light compound microscope with a movable stage. The examination of slides was done systematically. Identification of ova was made with the use of bench aids for diagnosis of intestinal within 30-60minutes after preparations. The eggs of *Schistosoma mansoni*, *A. lumbricoides*, hookworm and *T. trichiura* were recorded separately.

Urine from each child was collected between 12.0 Midday and 2.0 PM. The urine examination was done in two stages–centrifugation and slide examination. During centrifugation, each urine tube was transferred into a centrifuge tube and then placed into the rotor of the centrifuge. A total of four tubes were placed at a time. The samples were then spun for five minutes at a speed of two thousand revolutions per minute (2000rpm). After spinning, the samples were decanted and deposited on a clean microscopic slide. The slides were observed in a light compound microscope using 10x10 objective lenses. The ova Schistosoma seen were then counted and recorded.

Treatment

At the end of the epidemiological survey, participants found infected with *S. mansoni*were treated with praziquantel single oral dose of 40 mg/kg. Individuals infected with other intestinal parasitic infections were treated with a single dose of albendazole (400 mg). To analyze the efficacy of treatment, stool samples from positive cases were tested after four months post-treatment. Treatment of infected children was administered by the nurses under supervision of District Medical Officer and Njala University.

Data Analysis

The prevalence (**P_r**) was expressed as the percentage (%) of infected schoolchildren (Children found to be positive) **(C_i)** among the total number of children examined (**C_{te}**). [$P_r = C_i / C_{te} \times 100$] (Margolis *et al*., 1982). The intensity of *S. mansoni* and STH was expressed as the number of eggs per gram (epg) of faeces and it is recorded as number of eggs observed as arithmetic means intensity of all examined individuals. The intensity of *S. haematobium* was expressed as the number of eggs observed in 10ml (eggs/10ml) of urine collected from each schoolchild and is reported as arithmetic mean intensity of all examined individuals. The parasite load was defined as the mean number of eggs of each parasite species per gram of stool of each child. The level of statistical significance was set at 5% ($P< 0.05$).

RESULTS

Over half (59.0%) of the school children that participated in the research were girls (28 from Korwama and 31 from Lewabu) and the rest (41.0%) were boys (22 from Korwama and 19 from Lewabu, Table 1.

TABLE 1(a): Number of School Children examined by age and sex in the two communities

	ABC School Korwama		SLMB School Lewabu		Total (Two Schools Combined)		
	Male (N=30)	Female (N=45)	Male	Female	Male	Female	Total
Age	No.(%)	No.(%)	No.(%)	No.(%)	No.(%)	No.(%)	No.(%)
9	4(13.3)	4(8.9)	6(18.8)	5(11.6)	12(18.8)	9(10.2)	21(14.0)
10	3(10.0)	3(6.7)	5(15.6)	6(14.0)	8(12.5)	9(10.2)	17(11.3)
11	6(20.0)	9(20.0)	3(9.4)	10(23.3)	9(14.0)	19(21.6)	28(18.7)
12	5(16.7)	8(17.8)	5(15.6)	6(14.0)	10(15.6)	14(16.0)	24(16.0)
13	7(23.3)	7(15.5)	4(12.5)	5(11.6)	11(17.2)	12(13.6)	21(14.0
14	3(10.0)	8(17.8)	7(21.9)	7(16.3)	10(15.6)	15(17.0)	25(16.7)
15	2(6.7)	6(13.3)	2(6.2)	4(9.2)	4(6.3)	10(11.4)	14(9.3)
Total	30(100.0)	45(100.0)	32(100.0)	43(100.0)	64(42.7)	86(57.3)	150(100.0)

On the basis of age, over one –fifth of the children (22.0%) were 9 years old. The number of males (12.0%) is higher than females (10.0%). Exactly one fifth of the children (29.0%) were 11 years of age, of these, females (14.0%) outweighed the males (4.0%). Slightly below one-fifth of the participants (18.0%) were 10 years old; the

number of females (14.0%) is higher than that of males (4.0%). Over one –tenth of the children (15.0%) were 12years old; the number of females (9.0%) was greater than that of the males (6.0%); and 14.0%) were 13 years old, and those that were females (9.0% outweighed the males (5.0%). Slightly above one-tenth (11.0%) of the participants were 14 years old.

There were more males (8.0%) than females (3.0%). The mean age was 11.1 years with a range of 9-14 years and standard deviations of 1.7 years. The mean age for boys in ACBC Primary School in Korwama was 11.8 and 11.0 years for girls, while it was 10.7 years for boys and 11.0years for girls in Lewabu (Table 2). Over three-fourths (78.0%) of the participants harbored at least one of the two species of helminthes and Schistosomiasis, while slightly above one- fifth of them (22.0%) were not infected by any of the four parasite species. On the basis of school or community, Less than three-fourths of children (84.0%) out of 50 children from Korwama were infected and less than one-fifth of them (16.0%) were not positive, while over four-fifths of children (72.0%) from Lewabu were infected by either one, two or three of the parasite species. Over one fourth of them (28.0%) were free from the parasites infections. Over half of the girls (58.0 %) were infected by one, two, or three of the parasites.

TABLE 1b: Sex and Age Sample School children Distribution by School

Male					Female			
Age:	Range	Mean	Mode	S. Dev	Range	Mean	Mode	S. Dev.
ACBC	9-14 yrs	11.8 yrs	9 yrs	1.32 yrs	9 -14	10.3 yrs	11yrs	1.2yrs
SLMB	9-14 yrs	11.0 yrs	11 yrs	1.14 yrs	9 -14	11.0 yrs	10 yrs	1.2 yrs
Overall	9-14 yrs	11.1yrs	9yrs	1.2 yrs	9-14	10.2 yrs	11 yrs	1.2 yrs

The parasite infection was prevalence for *Schistosoma haematobium*, (37.0%), with Lewabu (19.9%) higher than Korwama (19.0%) and *Schistosoma mansoni*, (33.8%); Lewabu (12.8%) higher than Korwama (10.6%). There was no significant difference in the prevalence of Hookworm (21.3%) and Ascaris (17.7%). The prevalence was for Hookworm (11.3%) and Ascaris (9.2%) in Korwama, and (9.9%) and (8.5%) for Lewabu respectively. There is no statistically significant difference in Schistosoma *mansoni*, *Schistosoma haematobium*, and Ascaris between schools. There was, however, a statistically significant difference in Hookworm prevalence between schools (P<0.05) (Table3).

TABLE 2: Prevalence of infection

	Children	Children	Prevalence of Parasite Species in Korwama and Lewabu Communities				
Community	Examined	Infected	*S. mansoni*	*S. Haem*	Ascaris	Hookworm	Others
Korwama	7 5	69(48.9%)	15(10.6%)	25(17.7%)	13(9.2%)	16(11.3%)	0(0.0)
Lewabu	75	72(51.1%)	18(12.8%)	28(19.9%)	12(8.5%)	14(9.9%)	0(0.0)
Total	150	141(100.0%)	33(23.4%)	53(37.6%)	25(17.7%)	30(21.3%)	0(0.0%)

TABLE 3: Parasite infection by ages and schools in the two communities

	ACBC Primary School, Korwama												SLMB Primary School, Lewabu											
Age	S. mansoni			S. haem			Ascaris			H/worm			S. mansoni			S. haem			Ascaris			H/worm		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
9	2	3	5	1	2	3	2	4	6	0	1	1	5	0	5	7	5	12	2	2	4	1	1	2
10	1	2	3	0	1	1	1	3	4	2	2	4	2	2	4	1	5	6	1	2	3	0	2	2
11	1	1	2	1	7	8	3	1	4	0	3	3	0	4	4	0	4	4	0	1	1	2	1	3
12	2	1	3	2	2	4	0	2	2	0	1	1	0	1	1	2	1	3	1	0	1	0	1	1
13	1	1	2	1	2	3	1	1	2	2	1	3	0	1	1	2	1	3	1	1	2	1	2	3
14	3	2	5	3	0	3	0	0	0	1	1	2	1	2	3	1	0	1	1	3	4	1	1	2
Total	10	10	20	8	14	22	7	11	18	5	10	15	8	10	18	13	16	29	6	9	15	5	8	13

M =Male F =Female T =Total

The Intensity of Helminthes in Primary School Children in Korwama and Lewabu

The intensity of helminthes in primary school children, ACBC Primary School were *Schistosoma mansoni* (559.2) *Schistosoma haematobium* (24.9), Ascaris (644.3) and Hookworm (396); while in children in SLMB Primary School, Lewabu, were *Schistosoma mansoni* (393), *Schistosoma haematobium* (42.3), Ascaris (284.1) and Hookworm (192.5) respectively (Table 4). A significant difference in intensity was observed for all the four helminthes *Schistosoma mansoni*, (P<0.05), *Schistosoma haematobium* (P<0.05); and Ascaris (P<0.005) and Hookworm (P<0.005) between school (Table5).

TABLE 4. The intensity of helminthes in primary school children in Bo city

School	Helminthes Species				
	S. mansoni	*S. haematobium*	Ascaris	Hookworm	Others
ACBC	559.2	24.9	644.3	396	0
SLMB	393	42.3	284.1	192.5	0
TOTAL	476.1	33.6	464.2	294.2	0

TABLE 5: Prevalence and Intensity of helminthes in Lewabu and Korwama School Children by Sex

Helminthes Species	Age (Years)						Male	Female	Total
	9	10	11	12	13	14			
S. mansoni							13(13.0)	13(13.0)	26(26.0)
S. haematobium							15(15.0)	32(32.0)	47(47.0)
Ascaris							10(10.0)	4(4.0)	15(16.0)
Hookworm							5(5.0)	10(10.0)	15(15.0)
Others							0(0.0)	0(0.0)	0(0.0)

DISCUSSION

The study aimed to identify the prevalence and intensity of intestinal parasitic infections among school children in Lewabu and Korwama sections in Bo City in Sierra Leone. Up till the time of the research no systematic study on intestinal parasitic infection on school based control has been done in this part of the country and, therefore, the study focused on the epidemiology of intersectional parasites as well as targeted school based treatment in reducing the prevalence and intensity of the parasites. So majority of the participants (94%) examined had positive stool and urine infection specimens, most had a single parasitic infection. Our study population harbored up to four different parasites concurrently and among those submitted at least two stools, samples; we found none who was free of an infection. The infection intensities were predominantly light in Ascaris and Hookworm but high in *S. Haematobium* and Masoni. Two soil transmitted helminthes, and two schistosomeses intestinal parasites were identified in this study. This is similar to Escobedo *et al.* (2008) and Abolfath *et al.* (2008) findings in Western India. There was high prevalence of two major intestinal Schistosomeses-Schistosoma *mansoni* and Schistosoma *haematobium* in the study area. Similar cases have been reported in Cameroon, Ghana, Mali, Cote D'voire and Nigeria (Steinman, 2008). The study also found that older children (9-13 years) were most infected, particularly with *Schistosoma mansoni*, Schistosoma *haematobium* and hookworm. This would be due the location of the two communities, almost surrounded by swamps with stagnant waters and uncovered pits. The older children are most times seen bathing in, fishing or otherwise fetching water from these swamps. In the school and at homes, these children play ball bare footed. Likewise, the older girls play "accra". Stone -ball and hide-and-seek with no shoes on. During the dries, more children, especially the girls are down the swamp helping their farmer parents increasing their vulnerability to the parasites. The low prevalence of Ascaris in children in the two communities confirms the findings in Sierra Leone of Wilson *et al.* (1991); Raso *et al.* (2005), and (Asaolu *et al.*, 2002). Dog ownership is a very significant factor for Ascaris infection in children. There are few people who own dogs in these communities, and so these were not promiscuous defecation of by human (Ukpai and Ugwu, 2003). Children whose fathers use night soils (human faeces and urine) as fertilizers for crops may be at more risks of STH infection than children whose fathers are businessmen and professionals (Van der Werf, 2003). In this study, the use of human faeces as fertilizer is not common.

CONCLUSION

It is concluded that STH infections is prevalent in school children in Korwama and Lewabu communities. The very high prevalence and high intensity of parasitic worm infections observed in both communities raise serious concern about the resulting morbidity in school children in these communities Therefore; it is likely that school children in Korwama and Lewabu communities are subject to significant nutrition, education, development, and productivity constraints as a consequence of their heavy infections and poor health.

RECOMMENDATIONS

Prevalence of Schistosomiasis was high and there was still lack of understanding concerning Schistosomiasis in many of the school children from Korwama and Lewabu communities. Thus, combined efforts from the Bo City Council, community, education, and health sectors are urgently needed to identify the factors which led prevalence of these parasites, and to come up with participatory approaches which will involve stakeholders. All school going children should be incorporated into deworming programmes in all rural communities in the southern region and to explore innovative way of delivering cost- effective deworming treatments to those high- risk age groups. A school–based control programme should be launched in the localities, with emphasis on multiple species strategy by combining control of Schistosomes and STH infections, using two drugs: Praziquantel and mebendazole. This multispecies control approach is recognized as most cost-effective and future work will evaluate its impact on the transmission levels in these endemic communities.

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