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F. W. THIONG'O, A. LUOBA and J. H. OUMA

ABSTRACT

Objective: **To determine the extent of intestinal schistosomiasis, ascariasis, trichuriasis and hookworm infections among school children of Usigu and Bondo divisions of Bondo District.**
Design: A cross sectional study.
Setting: **Fifty out of 130 primary schools in Usigu and Bondo divisions, Bondo District.**
Subjects: **Randomly selected school children (n= 3158) aged five to 20 years, were examined for intestinal helminths and schistosomiasis using Kato thick smear technique.**
Results: **The overall prevalence and geometric mean egg counts per gram/faeces for *Schistosoma mansoni* were 31.6% and 3.1; hookworm 36.8% and 4.1; *Trichuris trichiura* 21.8% and 1.5, and *Ascaris lumbricoides* 16.5% and 2.5. More girls (34.9%) than boys (28.6%) were infected with *S. mansoni* whereas more boys (39.0%) than girls (34.5%) were infected with hookworm. The prevalence of *S. mansoni* and hookworm infections increased with age but *Ascaris* and *Trichuris* infections decreased with age without any sex differences. Children under ten years of age tended to be more heavily infected with ascariasis, trichuriasis and hookworm than the older ones, while the intensity of *S. mansoni* increased gradually with age. There were positive relationships between different infections except for a significant negative correlation between *Schistosoma mansoni* and hookworm infections. Only four cases out of 789 had *S. haematobium infection.***
Conclusion. Schistosoma mansoni **and geohelminths were endemic in Bondo District, where two thirds of the school children suffered from these parasites. Polyparasitism was also common. There was a little overlap in the distribution of *Schistosoma mansoni* and hookworm, whereas ascariasis and trichuriasis were fairly distributed in the district.**

INTRODUCTION

Intestinal helminthiasis and human schistosomiasis are among the most common infections in developing countries. Their impact on public health has been grossly underestimated and although these parasitic infections cause considerable morbidity, mortality is very low(1). Intestinal helminth infections are known to cause protein energy malnutrition and iron deficiency anaemia. This affects 500 million children and nearly a billion adults(1,2). Intestinal schistosomiasis debilitates and may cause hepatic disease in nearly 200 million people worldwide among the 600 million at risk of infection(3,4).

In order to improve the health of school age children, WHO recommends routine check up for intestinal helminth infections, followed by repeated chemotherapy. This is beneficial not only to curb re-infection but also assures that the levels of infection are below those associated with morbidity. This study was undertaken to determine the extent of intestinal schistosomiasis, ascariasis, trichuriasis and hookworm infections among school children of Usigu and Bondo divisions of Bondo District. These findings provided base line data for further studies on the effect of anthelmintic drugs and micronutrient supplementation on re-infection.

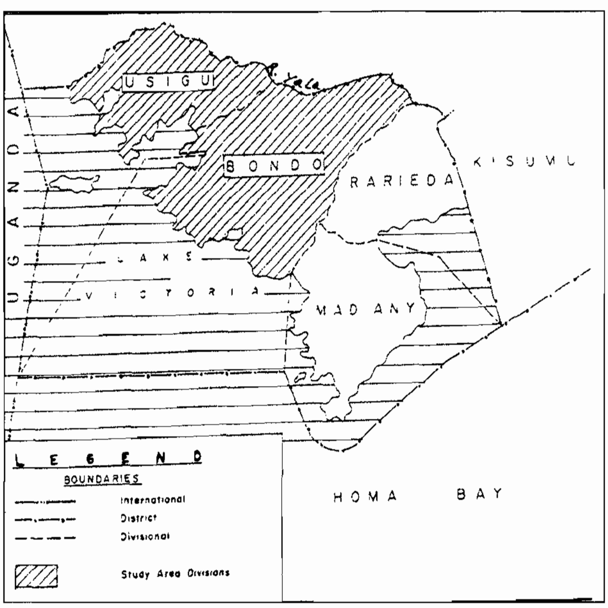
MATERIALS AND METHODS

Study area and population: Usigu and Bondo divisions which border the Winam Gulf of Lake Victoria at the southwestern corner of Bondo District were selected for the study (Figure 1). These are newly created divisions (formerly Bondo) and are rated as the least developed and economically poor in the district(6). Most of the terrain lies below 1500 m above sea level with several scattered hills locally known as Got. There is one permanent river, Yala, passing through the northern part of Usigu, but several seasonal streams traverse the two divisions. This area has a typical tropical climate with conventional annual rainfall of 800-1800 mm and fluctuating temperatures between 15-30°C with high relative humidity.

The inhabitants are predominantly Luo, a nilotic ethnic group that lives in characteristically dispersed homesteads. Although there has been recent migrations from other parts of the district to this area, the population is, however, relatively homogenous as regards cultural and socio-economic status(5). They depend on subsistence farming by growing mainly cassava and sorghum, although much of the land remains underutilised. They keep zebu cattle for milk and other social family needs(5). Fishing is the main income generating activity. The community relies on the lake as a source of water. The shores are also good breeding sites for intermediate hosts for human schistosomiasis(4).

Figure 1

A sketch map showing study area divisions in Bondo district



Primary school children aged five to twenty years were randomly selected from 50 out of the 130 schools. This age group is likely to be having the highest burden of the intestinal helminth infections and is one of the most accessible and suitable targets for control measures(1,3). Stool specimens were collected from the children and examined parasitologically for *Schistosoma mansoni* and other geohelminths. Duplicate Kato smears(6) were prepared from stool samples collected from all children and immediately examined for hookworm eggs. On the day following the examination, eggs of *S. mansoni, Ascaris* and *Trichuris* were counted and expressed as number of eggs/g (epg) of faeces. Urine samples were taken from 789 pupils (25% of the study population), processed and examined for eggs of *S. haematobium,* using urine filtration method(6), and expressed as number of eggs/10 ml of urine.

Data analysis: All the data were entered on SPSSPC spread sheet for statistical analysis by conventional techniques on raw data or data normalised by transformation to log 10 (x+1). Chi squared, T-test and one way analysis of variance were used to find out if there were differences in prevalence and intensity of these infections between localities, sexes and age groups.

RESULTS

A total of 3,158 pupils were randomly selected (10% of entire school population). Five hundred and forty three (17.3%) of the children were aged between five and nine years, 2292 (72.3%) were aged 10-14 years and 323 (10.4%) were aged above 14 years. The ratio of boys to girls was 1.1. Generally, girls were significantly younger than boys (mean ± SD: 11.8 ± 2.3 versus 11.9 ± 2.4, $p<0.05$).

The prevalence and intensity of the four common intestinal parasitic infections by location, sex and age are shown in Tables 1-3. Schools located at a radius of less than five kilometres from the lake had significantly higher mean prevalence of *S. mansoni (55.8%)* than those further interior (16.8%), $\chi=524.9$; $p<0.001$. The overall prevalence of *S. mansoni* was 31.6%, ranging from 2% to 90.8% in different schools. Fourteen out of nineteen schools (73.7%) situated within five kilometres from the lake shore, recorded more than 40% (data not shown). Hookworm infection was found in 36.8% of the children, ranging from 14.6% to 80.0% in different schools. A significantly higher prevalence occurred in schools located further inland than close to the lake ($\chi= 99.5$, $p<0.001$). Nineteen out of 31 (61.3%) schools with over 40% infected with hookworm were situated more than five kilometres away from the lake (data not shown). *Ascaris* infected was seen in 16.5% of the pupils, ranging from 5% to 54.1% and only one school had over 40%. *Trichuris* infection was found in 21.8% of the pupils and ranged from 0 to 59.2%. Only two schools recorded over 40%.

Table 1

The mean prevalence of helminth infections of 50 schools according to their proximity to the Lake Victoria

Parasite species	Schools >5 kms from the Lake shore (n=31) %	Schools <5 kms from the Lake shores (n=19) %	χ- value*	Significance level**
S. mansoni	16.8	55.8	524.9	P<0.001
Hookworm	44.5	26.8	99.5	P<0.001
Ascaris	17.5	13.4	9.4	P<0.01
Trichuris	19.8	23.3	5.54	P<0.05

*Chi-squared value with 1 degree of freedom; **Significance level is indicated by the P-values

Table 2

The prevalence and intensity of helminth infections by sex

Parasite species	Prevalence % Boys	Girls	P-value	Overall	Geometric mean egg counts per gram (GM) Boys	Girls	P-value	Overall
S. mansoni	28.6	34.9	P<0.001	31.6	2.6	3.8	P<0.001	3.1
Hookworm	39.0	34.5	P<0.01	36.8	4.6	3.8	P<0.05	4.1
Ascaris	16.9	16.1	P>0.05	16.5	2.6	2.5	P>0.05	2.5
Trichuris	21.2	22.5	P>0.05	21.8	1.4	1.6	P>0.05	1.5

Table 3

The prevalence and intensity of helminth infections by age groups

	Age groups in years						
	5-9		10-14		Above 15		Significance level*
Parasite species	GM	%	GM	%	GM	%	
S. mansoni	13.8	1.8	35.7	5.0	31.6	4.1	P<0.001; <0.001
Hookworm	37.9	5.4	35.6	5.0	44.0	6.4	P>0.05; <0.05
Ascaris	24.3	7.5	15.5	3.2	11.5	2.3	P<0.001; <0.001
Trichuris	26.7	3.2	21.2	2.4	18.6	2.2	P<0.001; <0.01

*Significance level for prevalence and geometric mean (GM), respectively

Table 4

Frequency of multiple infections by age groups and sex

	Number of parasites									
	0		1		2		3		4	
Age group	No.	%	No.	%	No.	%	No.	%	No.	%
5-9	190	35	205	37.8	99	18.2	41	7.6	8	1.5
10-14	732	31.9	882	38.5	475	20.7	169	7.4	34	1.5
Above 15	95	29.4	132	40.9	80	24.8	15	4.6	1	0.3
Boys	530	16.8	648	20.5	318	10.1	113	3.6	27	0.9
Girls	487	15.4	571	18.1	336	10.6	112	3.5	16	0.5
Total	1017	32.2	1219	38.6	654	20.7	225	7.1	43	1.4

The prevalence of *S. mansoni* and hookworm tended to rise with age (p<0.001, p<0.05 respectively) and more girls than boys (p<0.001) were infected with *S. mansoni* while more boys than girls were infected with hookworm (p<0.01).

There were significant differences in the intensity of *S. mansoni* between sexes (p<0.001) and among the age groups (p<0.001), while in hookworm a significant difference occurred between sexes (p<0.05) but not in age groups (p>0.05). The prevalence and intensity for *Ascaris* and *Trichuris* decreased linearly with age (p<0.001; p<0.01, respectively) and without marked sex differences (p>0.05). Children below ten years of age tended to have higher intensity of *Ascaris, Trichuris* and hookworm infections than the older age groups (Table 3), while that of *S. mansoni* followed the usual curve (above 10 years). The frequency and percentage of multiple infections by sex and age groups are shown in Table 4. Only 32.2% of the study population were found uninfected with either of the four studied parasites.

S. mansoni and hookworm (0.3243) had a significant negative association (p<0.001) whereas *Ascaris* and *Trichuris* (0.1476), *Ascaris* and hookworm (0.1186) and *S. mansoni and Trichuris* (0.1088) were positively associated at 0.1% level. Since only four cases out of 789 had *S. haematobium,* no further analysis on this parasite was done.

DISCUSSION

This study showed that intestinal schistosomiasis, ascariasis, trichuriasis and hookworm infections are endemic in the Bondo and Usigu divisions, where at least 68% of the children harboured one or more of the four infections. Urinary schistosomiasis (0.5 %) was, however, confined to a small focus at Got Kachieng in southeast Bondo. The prevalence of *S. mansoni* was notably higher in schools situated close to the Lake Victoria shores, where the prevalence of hookworm was remarkably low. The reason for this is unclear although the observation is consistent with those from other areas(7,8). However, a number of cross reactive immune responses against *S. mansoni* antigens have been observed in patients infected with hookworms and the reverse is also true(9,10). Thus, the presence of one of these infections may confer protective immunity against the other. In addition, a study in Mali(11) reported fewer mixed infections of schistosomes and hookworms than expected and this was attributed to regional differences in transmission factors and climate.

Previous studies carried out in the same region(4,12) have also shown that *S. mansoni* infections decreased markedly from the shores. Further more, the prevalence of intestinal schistosomiasis in different localities along the shores of Lake Victoria rarely exceeded 50%(4). In the present study, eleven out of 19 (57.9%) schools situated less the 5 km away from the shores had a prevalence above 50%. Various stool concentration techniques have been previously used by a number of investigators(6,12,15) and have ended up in reporting varying prevalence for the same parasitic infections. The Kato-Katz technique used in this study has been shown repeatedly to be superior in the diagnosis of *S. mansoni, Ascaris* and *Trichuris* and to some extent hookworm, if examined within 30 minutes after preparations(14). It also allowed us to determine the intensity of infection in a relatively invariable, reliable and consistent form(3,6,16). In our view, we were able to cover a relatively large population.

Among the helminth positive children, 38.6%, 20.7% and 8.5%, had single, double and multiple species infections, respectively. The occurrence of poly-parasitism is not a rare phenomenon in rural children, who may harbour as many parasites as nine, at one point in time(16). Recent studies on helminths, nutrition and growth, showed that the health and well being of the school-age children are dis-proportionately and negatively affected by such infections(1,12). Because of the epidemiology of helminth infections and their behavioural patterns, children also, are probably responsible for the majority of infections and their transmission(13,16). This is of significance to the control strategies based on the use of antihelminthic targetted at school aged children.

The study also revealed that mixed infections with intestinal helminths and schistosomiasis were common among these children. In case of control measures, broad-spectrum antihelminthics are of great potential value in reducing the total burden of intestinal helminth infections within a community. Currently, safe and highly effective single dose drugs such as albendazole, mebendazole and praziquantel are available and integrated intervention is justifiable.

It is concluded that although slightly more than two thirds of the school age children in the two divisions suffered from one or more helminth infections at one point in time, the majority had light infections. Essentially, those few heavily infected children are responsible for continued transmission(12,13,16). However, nearly one third of these children were infected with mixed infections of intestinal schistosomiasis, hookworm, *Ascaris* and *Trichuris* whose combined effects are known to be disastrous to the children's health in terms of morbidity(12,15,17). Thus, concentrating on treating this age group would reduce infection and morbidity, and is likely to effectively influence transmission(17).

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