Original article

Schistosomiasis mansoni and geo-helminthiasis in school children in the Dembia plains, Northwest Ethiopia

Leykun Jemaneh

Abstract: A cross sectional survey was conducted in twelve elementary schools in the Dembia Plains, Northwest Ethiopia, in 1995. Faecal specimens of 1282 pupils were examined for schistosoma mansoni and the major soil-transmitted helminths (*Ascaris lumbricoides, Trichuris trichiura*, the hookworms) by the Kato thick smear technique. Infection due to *A. lumbricoides* was registered in all schools and was the most prevalent (41.3%, range:4.4%-70.8%)followed by *Schistosoma mansoni* (35.8%, range:19.5%-62.2%),the hookworms (22.8%, range:2.5%-35.1%), and *Trichuris trichiura* infection (16.5%, range:9.2%-31.6%). Double, triple and quadruple infections were encountered in 693 (54.0%), 90 (7.1%) and 4 (0.3%) specimens, respectively. Most of the double infections were a combination of *S. mansoni* and *A. lumbricoides (20.3%)*. The highest prevalence for a single infection was recorded for *A. lumbricoides* (139=10.9%). Infection was found in all ages and appeared to increase with age in schistosomiasis and ascariasis cases only. There was no significant difference in infection rates between the sexes. The intensity of infection was generally higher for *A. lumbricoides* and *S. mansoni*. The rate of heavy infection was high for *A. lumbricoides* (32.4%) and 23.7% of the infected children harboured moderate *S. mansoni* infection. Neither age nor sex was related to egg output except for *S. mansoni* which showed a marked age-related difference (F=3.13, p<0.005). The relationships between prevalence and intensity of infection gave a positive linear relationship for *S. mansoni* (r=0.84) and *A. lumbricoides* (r=0.93). The high infection rate observed in this study signifies the need for timely control measures in the area. [*Ethiop. J. Health Dev.* 1998;12(3):237-244]

Introduction

Intestinal helminthic infections are ubiquitous in the developing world, especially in poor communities of the tropical areas with low level of sanitary conditions. The prevalence rates for the most common of these helminths in the last few decades have not changed much despite the availability of cheap and effective drugs for their control (1). Estimates indicate that at least 3000 million people are infected worldwide and hundreds of thousands of deaths occur each year as a result of infection by the helminths (2). Furthermore, helminth infections, particularly in younger age groups, have marked effects on nutrition (3), growth and development, and learning ability(4).

Surveys on human parasitoses in Ethiopia (5-10) and in the areas of the present study in particular (11) have elucidated the type of helminth parasites, their prevalence, and distribution. However, when considering the diverse geographic nature of the country, it is highly likely to expect variations in distribution and prevalence of these helminths. Helminth control strategies require adequate awareness of the epidemiology on a large scale and the changes in time.

From the Department of Microbiology and Parasitology, Faculty of Medicine, Addis Ababa University, P.O.BOX 9086, Addis Ababa, Ethiopia

Accordingly, the present study is aimed at providing epidemiological information on *Schistosoma mansoni* and other major geohelminths of man (*Ascaris lumbricoides, Trichuris trichiura*, the hookworms) among schoolchildren in the Dembia plains in Northwest Ethiopia. It is anticipated that the data generated in this study will provide information for future health promotion scheme in the area.

Methods

The study area and population: The study was conducted in the Dembia Plains, Northwest Ethiopia, in 1995. Dembia, with an area of 1294 sq km, is situated in the north end of Lake Tana and forms the plains that make the upper drainage basin of the Abay River. The population is estimated at 218 000. The inhabitants are mainly engaged in farming and trading. The plains have an altitude ranging from about 1850m to about 2000m above sea level. There are rivers and streams traversing the Plains and often serving as sources of water for the population. Defecation is mainly in open fields and in ditches.

Children attending twelve of the forty elementary schools in the Plains were selected using systematic sampling to constitute the sample population. Their ages and sexes were registered.

Stool examination: Faecal specimens were collected from the school children. For each child, double slides were prepared using the Kato-Katz cellophane faecal thick smear technique (50 mg template)(12)and examined for helminth ova. Detection for hookworm ova was made soon after the slide preparations following which the slides were kept for at least one hour before examination for *Schistosoma mansoni, Ascaris lumbricoides* and *Trichuris trichiura* eggs. The number of eggs of each species on both slides was recorded. The mean was taken when eggs were found on the two Kato slides.

Ethical aspects: Children positive for *Schistosoma mansoni* were treated with a single dose of praziquantel at 40 mg/kg body weight. Those positive for the other helminths were informed of the parasites they were infected with and advised to get treatment. The parasitological results were also handed over to the teachers who were asked to make follow- up on the treatment of the children.

Data analysis: For each helminth parasite, the number of eggs counted was converted into the number of eggs per gram of faeces (EPG) by multiplying by a factor of 20 in order to analyze intensity of infection. In addition to descriptive statistics, the Chi-square test, analysis of variance, and regression analysis were employed to compare the prevalence and intensity of infection.

Results

A total of 1282 children were examined. Of these 508 and 774 were males and females, respectively. The overall prevalence rates for *S. mansoni, A. lumbricoides* , the hookworms and *T. trichiura* were 35.0%, 41.3%, 22.8%, and 16.5%, respectively (Table 1). Schistosoma mansoni infection was encountered in 10 of the twelve schools with the prevalence ranging from 19.5% in Gendewa to 62.2% in Chuait. On the other hand infection due to *A. lumbricoides* was found in all schools with prevalence rates from as low as 4.4% in Gendewa elementary school to as high as 70.8% in Gorgora with more than 80% of the schools having infection rates greater than 20%. Likewise hookworm infection prevalence was encountered in all schools and was high in Meskerem Hulet (35.1%), Gendewa (33.6%) and Chuait (32.8). Infection due to *T. trichiura* was registered in all schools except in Chuait Elementary School. It ranged from 9.2% in Sekelt to 31.6% in Koladeba.

Analysis of age specific prevalences due to each of the four parasites in the student population under consideration showed the presence of infection in all ages with *S. mansoni* and *A. lumbricoides* having higher infection rates above the ages of 12 and 10 years, respectively. The intensity of infection showed a similar pattern for *S. mansoni* only. There was no marked difference in prevalence or intensity of infection among the ages in *T. trichiura* and hookworm infections.

Overall analysis of the prevalence by sex showed no significant difference in infection rates (Tables 2). However males were affected more by *Schistosoma mansoni* in

Table 1: **Prevalence (%) of intestinal helminth infections and average egg counts per gram of faeces (EPG) in twelve elementary school children in Dembia, Northwest Ethiopia, 1995.**

School	No Examined	Positive for											
		S. mansoni			A. lumbricoides			T. trichiura			Hookworms		
		#	%	EPG	#	%	EPG	#	%	EPG	#	%	EPG

Girarge	117	23	19.7	179	21	17.9	146	26	22.2	151	12	10.3	28
Zengaj	112	23	29.5	224	45	40.2	326	30	26.8	183	30		194
												26.8	
Gendewa	113	22	19..5	134	5	4.4	40	14	12.4	84	38	33.6	07
Sekelt	120	8	40.0	182	42	35.0	646	11	9.2	43	26	21.7	102
Guramba	94	0	0.0	0	28	29.8	245	9	9.6	56	26	27.7	28
Meskerem Hulet	74	0	0.0	0	19	25.7	255	8	10.8	81	26	35.1	124
Salije	118	44	37.3	194	63	53.4	1482	22	18.6	176	3	2.5	13
Chuahit	119	74	62.2	342	58	48.7	1213	0	0.0	0	39	32.8	129
Sufankara	115	50	43.5	172	64	55.7	1256	11	9.6	52	35	30.4	267
Achera	63	38	60.3	357	37	58.7	1475	12	19.0	388	11	17.5	119
Koladeba	117	59	50.4	232	63	53.8	1252	37	31.6	179	13	11.1	89
Gorgora	120	68	56.7	360	85	70.8	1691	32	26.7	157	33	27.5	259
Total	1282	49	35.0	202	530	41.3	845	212	16.5	121	292	22.8	28

Achera and Sufankara, by *A. lumbricoides* in Guramba, Meskerem Hulet and Sufankara, by trichuriasis in Zengaj and Salije and by the hookworms in Chuahit. On the other hand infections due to *S. mansoni* and *A. lumbricoides* appears to be higher in females in Girarge and Koladeba, respectively. With the hookworms, more females are affected in Gendewa, Guramba and Meskerem Hulet.

Multiparasitism was frequently seen in the area. Double, triple, and quadruple infections were encountered, in 693 (54.0%), 90 (7.1%) and 4 (0.3%) stool specimens (Table 3) respectively. Most of the double infections were a combination of *S. mansoni* and *A. lumbricoides* (20.3%) and *A. lumbricoides* and/or *S. mansoni* and the hookworms

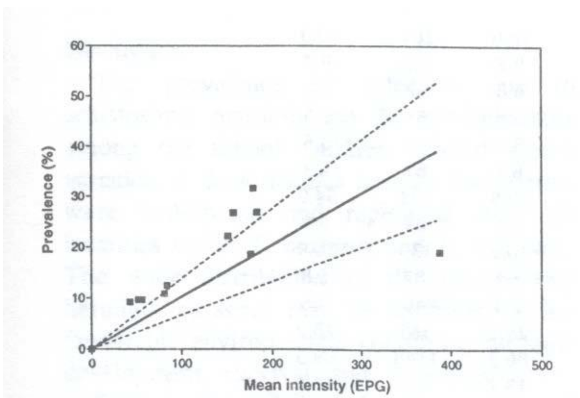

Figure 1: **Regression line (with 95% CI) for the relationship between prevalence and mean intensity of S. mansoni infection in school children in Dembia in 1995. Each point represents an elementary school**

(9.7% and 7.6%, respectively). The highest prevalence for a single infection was recorded for *A. lumbricoides (139*=10.9%). Although no difference in polyparasitism among the sexes was observed males appeared to harbour most of the double infections.

The average EPG due to *S. mansoni* was highest in Gorgora, Achera and Chuait (Table 1). With *T. trichiura* and the hookworms, it tended to be higher in Achera and Gendewa, respectively. Higher mean EPG for *A. lumbricoides* was obtained in six of the twelve elementary schools investigated. There was no significant difference in average egg counts between the age groups for *A. lumbricoides, T. trichiura* , and hookworm infections.

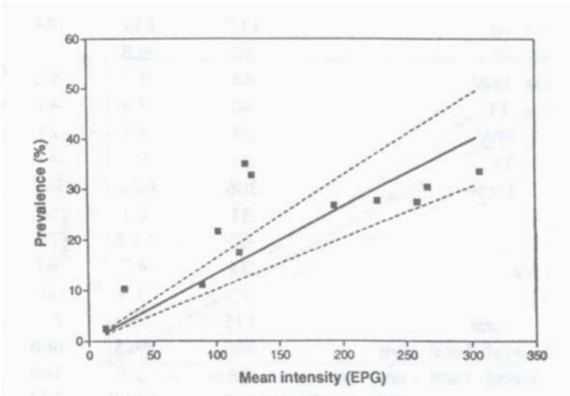

Figure 2: **Regression line (with 95% CI) for the relationship between prevalence and mean intensity of A. lumbricoides infection in school children in Dembia in 1995. Each point represents an elementary school**

Table 2: **Prevalence (%) of intestinal helminth infection, by sex, in elementary school children in Dembia, 1995.**

School	% positive for									
	No examined		S. mansoni		A. lumbricoides		T. trichiura		Hookworms	
	M	F	M	F	M	F	M	F	M	F
Girarge	29	88	13.8	21.6	17.2	18.2	20.7	22.7	10.3	10.2
Zengaj	50	62	32.0	27.4	38.0	41.9	42.0	14.5	30.0	24.2
Gendewa	35	78	17.1	20.5	5.7	3.8	11.4	12.8	25.7	37.2
Sekelt	41	79	39.0	40.5	39.0	32.9	4.9	11.4	19.5	22.8
Guramba	29	65	0.0	0.0	37.9	26.2	10.3	9.2	20.7	30.8
Meskerem Hulet	27	47	0.0	0.0	33.3	21.3	11.1	10.6	25.9	40.4
Salije	62	56	37.1	37.5	54.8	51.8	25.8	10.7	3.2	1.8
Chuahit	60	59	63.3	61.0	46.7	50.8	0.0	0.0	38.3	27.1
Sufankara	24	91	54.2	40.7	66.7	52.7	8.3	9.9	33.3	29.7
Achera	32	31	71.9	48.4	59.4	58.1	18.8	19.4	15.6	19.4
Koladeba	55	62	50.9	50.0	49.1	58.1	30.9	32.4	14.5	8.1
Gorgora	64	56	56.3	57.1	71.9	69.6	28.1	25.0	26.6	28.6
Total	508	774	40.0	33.0	45.7	38.5	19.3	14.7	21.9	23.4
			(203)	(256)	(232)	(298)	(98)	114)	(111)	(181)

However, the difference in average EPG between the age groups was significant for schistosomiasis mansoni infection ($F=3.13$, $p<0.005$). There was no significant difference observed in the intensity of infection by the helminths among the sexes.

The rate of heavy infection was low for *S. mansoni* (6.9%), *T. trichiura* (5.1%) and the hookworms (6.9%) whereas it was high for *A. lumbricoides* (32.4%) (Table 4). On the other hand 23.7%, 8.1%, 9.8%, and 13.2% of the infected children harboured moderate infection

Table 3: **Multiparasitism due to intestinal helminthic infections in elementary school children in Dembia, 1995.**

Multiplicity of infection	Males		Females		Both sexes	
	No.	%	No.	%	No.	%
SM, AL, TT, HW	2	0.4	2	0.2	4	0.3
SM, AL, HW	18	3.5	24	3.1	42	3.3
SM, AL, TT	7	1.4	16	2.1	23	1.8
SM, TT, HW	6	1.2	4	0.5	10	0.8
AL, TT, HW	6	1.2	9	1.2	15	1.2
Total	37	7.3	53	6.9	90	7.1
SM, AL	117	23.0	144	18.6	261	20.3
AL, HW	50	9.8	75	9.7	125	9.7
SM, HW	44	8.7	53	6.8	97	7.6
SM, TT	40	7.9	43	5.5	83	6.5
TT, HW	21	4.1	25	3.2	46	3.6
AL, TT	34	6.7	47	6.1	81	6.3
Total	306	60.2	387	49.9	693	54.0
SM	31	6.1	58	7.5	89	6.9
AL	60	11.8	79	10.2	139	10.9
HW	24	4.7	63	8.1	87	6.8

TT	20	3.9	26	3.3	46	3.6
Total	135	26.5	226	29.1	361	28.2
Overall Total +ve	480	94.5	668	86.3	1148	89.5
Overall Total - ve	28	5.5	106	13.7	134	10.5
Examined	508	100.0	774	100.0	1282	100.0

SM= *S. mansoni* AL= *A. lumbricoides* TT= *T. trichiura* HW= *Hookworms*

Table 4: **Categorization of infection of *S. mansoni, A. lumbricoides, T. trichiura*, and the hookworms in school children in Dembia 1995.**

Infection category*	s. mansoni A.		lumbricoides		T. trichiura		Hookworm	
	#	%						
Negative	823	64.2	752	58.7	1070	83.5	990	77.2
Low	67	5.2	11	0.9	21	1.6	34	2.7
Moderate	304	23.7	104	8.1	126	1.9	169	13.2
Heavy	88	6.9	415	32.4	65	5.1	5.1	6.9
Total	1282	100	1282	100	1282	100	1282	100

(Low=<200 EPG Mod=201-800 EPG
Heavy->800

for *S. mansoni, A. lumbricoides, T. trichiura* and the hookworms, respectively.

The relationships between prevalence and mean intensity for *S. mansoni, A. lumbricoides, T. trichiura*, and the hookworms are shown in Figures 1-4. Prevalence and mean intensity had a positive linear relationship for *S. mansoni* (r=0.84), and *A. lumbricoides* (r=0.93).

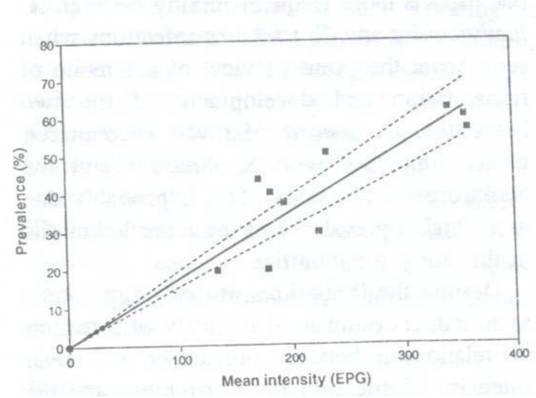

Figure 3: **Regression line (with 95% CI) for the relationship between prevalence and mean intensity of T. trichiura infection in school children in Dembia in 1995. Each point represents in elementary school**

Discussion

The prevalence of infection due to schistosoma mansoni and the geo-helminths among the school children studied shows variation. *A. lumbricoides* and the hookworms were widespread and registered from all localities unlike *S. mansoni* and *T. trichiura*. The wide distribution of the former two helminth parasites may be attributed to the favourable environmental conditions for their development, survival, and transmission.

Similar varying findings have been reported from school children in other districts in Gondar Region. In my study of intestinal helminth infections in school children of five schools in Adarkay District, I (10)reported prevalence rates of 54.3%, 43.0%, 23.3%, and 11.8% for *S. mansoni, A. lumbricoides*, the hookworms and *T. trichiura*, respectively, and except for *T. trichiura*, infection by the other helminths was registered in all localities surveyed. From another study conducted in school children of similar ages of eleven elementary schools in Lay Armacho District (13), prevalence rates ranging from 2.7%-72.3% for *S. mansoni*, 9.1%-49.4% for *A. lumbricoides*, 2.5%28.3% for *T. trichiura*, and 17.9%-53.4% for the hookworms was reported. *A. lumbricoides and T. trichiura* were found in virtually all of the schools surveyed as compared to the hookworms and *S. mansoni* which were registered in less than half of the schools. Moreover, for *A. lumbricoides, T. trichiura, S. mansoni* and hookworm rates of 34.4%, 5.7%, 5.2% and 3.6%, respectively, have also been reported from residents of the Gebaba village in the Dembia Plains (11). Elsewhere, in their study of intestinal parasitism among student populations, Tilahun *et al*(14) have recorded prevalence rates of 22.2%, 19.5%, 15.4%, and 14.7% for *A. lumbricoides, T. trichiura, S. mansoni*, and the hookworms, respectively. Similar occurrences of high *A. lumbricoides* and low *T. trichiura* rates have also been reported from the Fincha Plantation area (15).

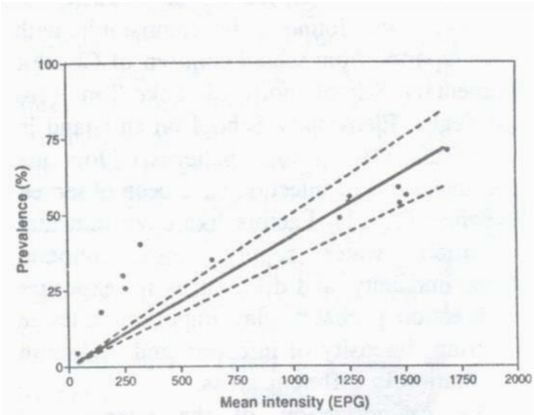

Figure 4: **Regression line (with 95% CI) for the relationship between prevalence and mean intensity of hookworm infection in school children in Dembia in 1995. Each point represents an elementary school.**

No marked difference was obtained in infection rates and egg counts among the ages of school children under consideration for *T. trichiura* and hookworm infections which denotes a similar exposure risk to infection by these helminths. On the other hand age-specific infection rates tended to increase with increasing age for *S. mansoni* and *A. lumbricoides* infections. Similar findings have been reported from school children in Fincha Valley, Western Ethiopia, for *S. mansoni* (16)and in Wonji Sugar Estate for *A. lumbricoides* (14)infections.

The intensity of infection has been assessed using faecal egg counts obtained by the Kato-Katz stool examination technique and has been expressed as the mean egg output of infected and uninfected persons. The method is vulnerable to sampling errors due to a variety of parasite and host factors (17). However, it is still widely used as an indirect measure of intensity of intestinal helminth infections particularly for samples collected from communities. Using the same method, studies on the intensity of infection have been carried out in school children of Adarkay (10) and Lay Armacho Districts (13) in North Gondar area. The reported EPGs for the helminths in these two studies were much higher than that of the present study and this was probably due to the fact that the eggs per gramme of faeces in the former studies were expressed as the average egg output of the infected children only. On the other hand, the intensity of infection was found to be comparable with those reported from school children of Chuahit Elementary School, north of Lake Tana (18) and Zeghie Elementary School on an island in Lake Tana (19). Similar patterns of low and high intensities of infection have been observed elsewhere (20,21). Factors like environmental sanitation, water supply, socio-economic status, immunity, and differences in exposure to infection probably play important roles in affecting intensity of infection and helminth distribution in different areas.

The categorization of the intensity of infection due to *S. mansoni, A. lumbricoides, T. trichiura*, and the hookworms showed the infection to be heavy for *A. lumbricoides* and fairly heavy and moderate for the other helminths. The majority of the sampled children were negative or few egg excreters. Similar findings have been reported from a study conducted in the Fincha Sugar Plantation area in Western Ethiopia (15). This suggests a high degree of aggregation of eggs in the infected population and has implication in the contamination of the environment and the control of these helminths.

Multiple helminth infection is a common phenomenon in areas where different types of parasites are encountered. The most common combinations in many areas involve infections by *A. lumbricoides and T. trichiura, A. lumbricoides* and the hookworms, and S. mansoni and hookworms (10,13). Although one expects more frequent mixing between *A. lumbricoides* and *T. trichiura* infections when seen from the point of view of the mode of transmission and development of the two helminths, *A. lumbricoides* was encountered more commonly with *S. mansoni* and the hookworms in this study. This is probably due to the higher prevalence of the three helminths in the study communities.

Despite the limitations of using egg counts as an indirect estimate of intensity of infection the relationship between prevalence and mean intensity of infection for *T. trichiura* and the hookworms shows a non-linear pattern. Similar positive non-linear relationship between the prevalence of infection and mean intensity, as measured by faecal egg counts, has been demonstrated by Guyatt et al (22). However, the positive linear relationship exhibited between the prevalence and mean intensity of infection for *A. lumbricoides* and *S. mansoni* in this study is quite different from that of Guyatt et al (22) who have reported a consistent non-linear pattern. This discrepancy requires further investigation.

The high prevalence rate of intestinal helminth infection encountered among school children of the study area raises a serious concern. These parasites are well known to be associated with lowered work capacity and productivity both in children and adults and increased susceptibility to other infections (1,23). Helminths also impair the mental and physical development of children (24). Hookworm infection and schistosomiasis cause anemia both in adults and children (25). All these indicate the need for timely control measures. The majority of wormy individuals are not only infected with one species of worm but they also tend to harbour the heaviest burdens. Intervention measures such as periodic deworming and health education and targeted at these individuals and particularly at the school aged child with long term improvements of sanitation should be exercised.

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