

INTESTINAL HELMINTH INFECTIONS IN SCHOOLCHILDREN IN GONDER TOWN AND SURROUNDING AREAS, NORTHWEST ETHIOPIA

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ABSTRACT: A parasitological survey was conducted in four urban elementary schools in Gonder town and in four rural schools from the surrounding areas. A total of 878 stool specimens supplied by children were examined for *Ascaris lumbricoides*, *Trichuris trichiura*, the hookworms and *Schistosoma mansoni* by the Kato thick smear technique. Infection due to *A. lumbricoides* was the most prevalent (35.6%) followed by infection by *S. mansoni* (17.3%) and *T. trichiura* (8.5%). The least prevalent was infection due to hookworms (3.3%). Females were infected more than males by *A. lumbricoides* and *T. trichiura*. Infection was not age-related except for *S. mansoni* which showed higher rates in the 12–16 age groups. Higher number of children of both sexes were infected in the rural areas by *S. mansoni*, *A. lumbricoides* and *T. trichiura* than in the urban. Of those infected, 69.8% and 30.2% had single and double infections, respectively. The common combination of double infections was with *S. mansoni* and *A. lumbricoides* and *A. lumbricoides* and *T. trichiura*. The prevalence of heavy and moderate infections classified by eggs per gram of faeces was very low and showed over dispersion.

Key words/phrases: Gonder, intestinal helminth infections, parasitological survey, school children

INTRODUCTION

Parasitic diseases, particularly, soil transmitted intestinal helminth infections and schistosomiasis, are common in the developing world, especially in the tropical areas. Their abundance and distribution is governed, among others, by factors related to geography, climate and socioeconomics. These helminths have

detrimental effects on nutrition (WHO, 1990), growth and development and learning ability particularly in young children (WHO, 1987).

In Ethiopia, a number of surveys on human intestinal helminth parasites have been carried out (McConnell and Armstrong, 1976; Kloos *et al.*, 1980; Shibru Tedla and Leykun Jemaneh, 1985; Zein Ahmed Zein and Mekonnen Assefa, 1985; Shibru Tedla, 1986; Hailu Birrie *et al.*, 1994; Leykun Jemaneh, 1997; 1999) whereby the species, prevalence and distribution have been well documented for most parts of the country. However, when one considers the varied climatic conditions and the topography of Ethiopia it becomes apparent that there will be regional and local differences in the distribution and prevalence of these helminths. The aim of this study was to determine the prevalence and intensity of intestinal helminth infections (*Ascaris lumbricoides*, *Trichuris trichiura*, *Schistosoma mansoni* and the hookworms) and the relative frequencies of multiparasitism according to the types of combinations in elementary school children from urban and rural areas.

MATERIALS AND METHODS

The study was undertaken in 1995 in eight randomly selected elementary schools, four urban (Atse Bekafa, Azezo, Kebele 16, Meseret) from Gonder town and four rural (Deb Abo, Deguma, Maksegnt, Teda), from the surrounding areas (Table 1). Accessibility by vehicle was a factor in the selection of the rural schools. The area has about one hundred fifty thousand inhabitants. The altitude ranges from about 1500 m to about 2700 m above sea level. The topography shows hills and plain land with rivers and streams. Defecation is mainly in open fields and in ditches in the rural areas and in pit latrines in the urban areas.

The study population constituted children attending classes in these eight elementary schools. A total of 878 pupils (456 urban, 422 rural) were selected from the registry of children, using systematic sampling with a random start, to constitute the sample population. Their ages and sexes were recorded.

Table 1. Prevalence of intestinal helminth infections in children attending schools in Gonder town and surrounding areas in 1995.

School	Examined			% Positive for												
				<i>S. mansoni</i>			<i>A. lumbricoides</i>			<i>T. Trichiura</i>			Hookworms			
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	
Gonder town (Urban)																
Atse Bekafa	67	52	119	0.0	0.0	0.0	0.0	0.0	0.0	1.5	11.5	5.9	6.0	1.9	4.2	
Azezo	67	50	117	34.3	28.0	31.6	37.3	52.0	43.6	0.0	0.0	0.0	0.0	2.0	0.9	
Kebele 16	60	60	120	0.0	0.0	0.0	25.0	30.0	27.5	15.0	10.0	12.5	8.3	10.0	9.2	
Meseret	44	56	100	0.0	1.8	1.0	22.7	10.7	16.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total	238	218	456	9.7	6.9	8.3	21.0	22.9	21.9	4.2	5.5	4.8	3.8	3.7	3.7	
Surrounding areas (Rural)																
Deb Abo	34	81	115	0.0	0.0	0.0	41.2	61.7	55.7	35.3	35.8	35.7	0.0	0.0	0.0	
Deguma	40	30	70	0.0	0.0	0.0	32.5	43.3	37.1	10.0	23.3	15.7	20.0	13.3	17.1	
Maksegt	70	50	120	48.6	62.0	54.2	55.7	66.0	60.0	1.4	0.0	0.8	0.0	0.0	0.0	
Teda	57	60	117	42.1	41.7	41.9	40.4	46.7	43.6	0.0	0.0	0.0	0.0	0.0	0.0	
Total	201	221	422	28.9	25.3	27.0	44.3	56.1	50.5	8.5	16.3	12.6	4.0	1.8	2.8	
Over-all Total	439	439	878	18.5	16.2	17.3	31.7	39.6	35.6	6.2	10.9	8.5	3.9	2.7	3.3	

Faecal specimens were collected from all 878 (439 males, 439 females) children and examined for helminth ova on double Kato-Katz slides prepared using the standard Kato-Katz cellophane faecal thick smear technique (50 mg template) (WHO, 1992). Examination for hookworm ova was carried out immediately after the slide preparations following which the slides were kept for at least for one hour prior to examination for *Ascaris*, *Trichuris* and *Schistosoma* eggs. Positivity for the helminths was established on finding the characteristic eggs on any one of the Kato slides. The number of eggs of each species was recorded and converted into number of eggs per gram of faeces (EPG). The average number was taken when eggs were found on two Kato slides.

Individuals positive for *S. mansoni* were treated on the spot with a single dose of praziquantel at 40 mg kg⁻¹ body weight. Those positive for the other helminths were notified of the type they had and advised to get treatment from the nearest health institution. Their names along with the parasitological results were also passed to their teachers who were asked to follow their treatment.

For each helminth parasite the EPG was used to categorize intensity of infection. The intensity of infection was classified as low (< 200 EPG), moderate (201–800 EPG) and heavy (> 800 EPG). In addition to descriptive statistics the Chi-square test was used to analyze the prevalence and intensity of infection.

RESULTS

Table 1 shows the prevalence of intestinal helminth infections in children attending urban and rural schools.

Over all, *A. lumbricoides* was present in 35.6% (range:16.0 – 60.0%) of the school children examined followed by infection due to *Schistosoma mansoni* (17.3%, range:1.0–54.2%) and *T. trichiura* (8.5%, range:0.8–35.7%). The least prevalent was infection by hookworms (3.3%).

There was no sex related difference in *S. mansoni* and hookworm infections. On the other hand there was significant difference in prevalence between the sexes

such that females were affected more by *A. lumbricoides* ($p < 0.01$, $\chi^2=6.1$) and *T. trichiura* ($p < 0.01$, $\chi^2=6.4$) than males.

When compared by urban and rural setting, significantly higher number of children, both males and females, were infected in the rural areas by *S. mansoni* ($p < 0.001$, $\chi^2=53.4$), *A. lumbricoides* ($p < 0.001$, $\chi^2=77.8$) and *T. trichiura* ($p < 0.001$, $\chi^2=16.8$). There was no difference in prevalence by hookworms.

Age specific analysis of prevalence showed the presence of infection due to *S. mansoni* and *A. lumbricoides* in all ages under consideration as compared to *T. trichiura* and hookworm infections (Fig. 1). Infection by *S. mansoni* was significantly higher in the 12–16 age groups ($p < 0.001$, $\chi^2=44.6$). Infection was not age-related in the other helminths.

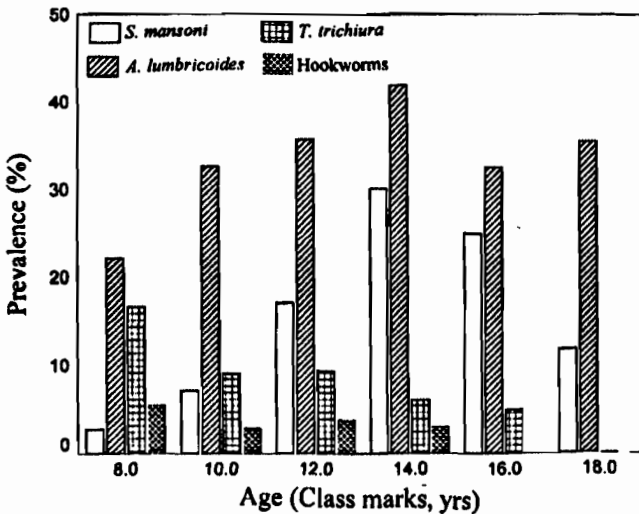


Fig. 1. Age-specific prevalence of intestinal helminth infections in children attending schools in Gonder town and surrounding areas, Northwest Ethiopia, in 1995.

Table 2 shows the proportion of schoolchildren with multiple infections of *S. mansoni*, *A. lumbricoides*, *T. trichiura* and hookworms. Of 878 stool samples examined, 437 (49.7%) were found positive for various helminth infections and over one-third of the samples (15.0%) had two types of infections. Of those

infected, 69.8% and 30.2% had single and double infections, respectively. The most common combination of infections was with *S. mansoni* and *A. lumbricoides* which was recorded in 10.0% of children examined. Combined infections accounted for 20.1% of those infected. Combination of *A. lumbricoides* and *T. trichiura* was encountered in 4.1% of the total sampled population and in 8.2% of the infected children. There were no triple or quadruple infections. Multiplicity of infection was not related to sex or age.

Table 2. Proportion of schoolchildren with multiple infections and helminth combinations of *S. mansoni*, *A. lumbricoides*, *T. trichiura* and the hookworms in Gonder town and the surrounding areas in 1995.

	Total children examined (%) (n=878)	Infected children (%) (n=437)
Number of infections		
1	34.7	69.8
2	15.0	30.2
Total positive	49.7	100.0
Total negative	50.3	0.0
Helminth combinations		
<i>S. mansoni</i> and <i>A. lumbricoides</i>	10.0	20.1
<i>A. lumbricoides</i> and hookworms	0.7	1.4
<i>T. trichiura</i> and hookworms	0.2	0.4
<i>A. lumbricoides</i> and <i>T. trichiura</i>	4.1	8.2

As shown in Figure 2 the prevalence of heavy and moderate infections was very low signifying the fact that the frequency distribution of egg counts was over dispersed.

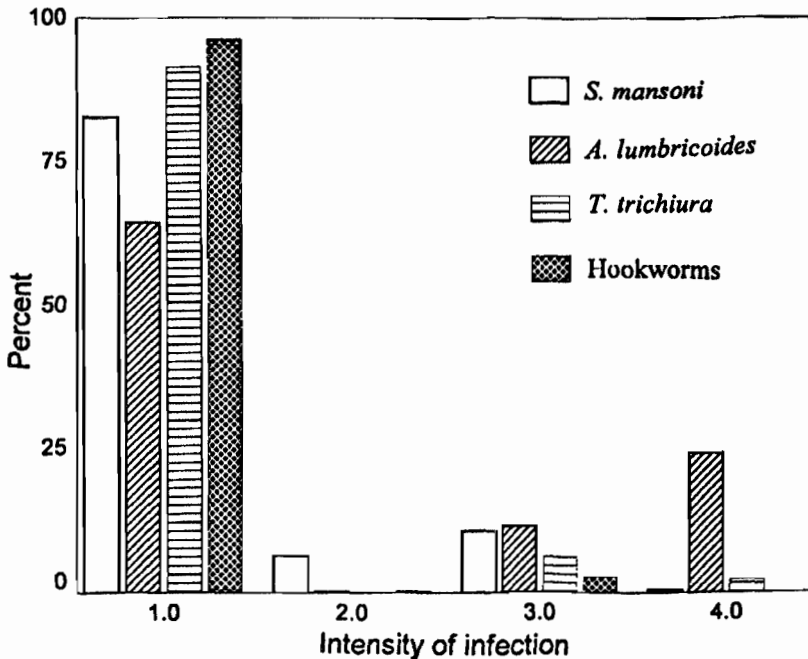


Fig. 2. Frequency distribution of egg output of intestinal helminths classified in terms of intensity of infection among school children in Gonder town and surrounding areas, Northwest Ethiopia, in 1995.

DISCUSSION

Prevalence, intensity and multiplicity of intestinal helminth infections in a group of school children from urban and rural areas were determined in this study. *A. lumbricoides* was found in almost all of the schools surveyed as compared to *T. trichiura*, the hookworms and *Schistosoma mansoni* which were registered from about half of the schools.

In this study, *A. lumbricoides*, *S. mansoni*, *T. trichiura* and hookworm infections were present, respectively, in 35.6%, 17.3%, 8.5% and 3.3% of the sample population. These were lower than the prevalence rates of 43.0%,

54.3%, 11.8% and 23.3% reported for *A. lumbricoides*, *S. mansoni*, *T. trichiura* and the hookworms, respectively, in schoolchildren in Adarkay District, Northwest Ethiopia (Leykun Jemaneh, 1997). Similar higher prevalence rates of 41.3%, 35.8%, 16.5% and 22.8% were recorded for *A. lumbricoides*, *S. mansoni*, *T. trichiura* and the hookworms, respectively, in the student population of the Dembia Plains, Northwest Ethiopia (Leykun Jemaneh, 1998). On the other hand, except for the hookworms, comparable rates of 34.7%, 17.1% and 13.5% have been registered for *A. lumbricoides*, *S. mansoni* and *T. trichiura*, respectively, in schoolchildren in Lay Armacho District, Northwest Ethiopia (Leykun Jemaneh, 1999). Higher and lower prevalence rates have been reported for these helminths elsewhere (McConnell and Armstrong, 1976; Zein Ahmed Zein and Mekonnen Assefa, 1985; Tilahun Woldemichael *et al.*, 1990, Gbakima *et al.*, 1994). These differences in prevalence may be attributable to factors such as the diagnostic techniques used, the geography and the local environmental conditions of the areas studied.

The results of this study showed higher prevalence of *S. mansoni*, *A. lumbricoides* and *T. trichiura* infections in children in the rural than in the urban areas. On the other hand hookworm infection, which is considered as a rural disease showed little contrast between urban and rural areas. Although a thorough investigation on the aetiology of this difference needs to be undertaken, practices regarding water use, waste disposal, use of medical care, hand washing, other aspects of personal hygiene and occupation could explain the apparent disparity in prevalence between the urban and rural areas. Similar findings have been reported in Kenya by Seo (1990).

The present data showed differences in the prevalence rates of males and females for *A. lumbricoides* and *T. trichiura* infections with preponderance among female children. Similar results, although not explained, have been reported from a number of surveys (McCullough, 1974; Shield *et al.*, 1980; Crompton, 1989). This effect of sex, however, is not always observed and various authors have reported sex unrelated prevalences of infection due to the two helminths (Annan *et al.*, 1986; Robertson *et al.*, 1989; Leykun Jemaneh, 1997; 1999).

Despite the high prevalence rate, the apparent absence of significant differences in *A. lumbricoides* infections between the age groups signifies the fact that in

areas where transmission is intense the difference in prevalence between the ages under consideration is less marked. The parasite is primarily transmitted by direct hand-to-mouth transfer of embryonated eggs. Children are generally known to have a lower personal hygiene than adults and are thus at high risk of infection. On the other hand the peak infection rate in the 12–16 age group for *S. mansoni* further strengthens the fact that the peak of prevalence in *S. mansoni* and *S. haematobium* infection is usually in the second decade of life (Hailu Birrie *et al.*, 1994).

Simultaneous infection by two or more types of helminths is more frequent in areas where various kinds of intestinal helminths are encountered. This may be related, among many factors, to particular patterns of environmental exposure, sanitary habits and susceptibility to a particular helminth parasite. Co-occurrence of *A. lumbricoides* and *T. trichiura* has been reported to be quite common in different geographical areas (Booth and Bundy, 1992). Although a similar situation is noted in the present study, *A. lumbricoides* tended to appear more with *S. mansoni*. This is probably due to the high prevalence of the two helminths in the study communities. However, further studies are necessary to assess the biological and environmental factors that predispose individuals to multiple infections in both urban and rural communities.

Although assessing intensity of infection using egg counts from stool has a number of drawbacks, it is still useful for samples collected from communities (Hall, 1982). In this study the frequency distribution of egg counts showed that the intestinal helminths under consideration are aggregated with the majority of the children producing none or few eggs. Similar patterns of over dispersion were reported from a study of intestinal helminth infections in Finchaa Sugar Plantation area, Western Ethiopia (Hailu Birrie *et al.*, 1997). The patterns of the egg output reflect not only the status of transmission in a community, but also the levels of compatibility in the host parasite relationship. Such patterns when considered in conjunction with prevalence curves have features which are useful for the assessment of intervention measures. The frequency of persons in each egg output category can also be a useful parameter when considering control measures and, in particular, when planning mass treatment schedules.

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REFERENCE

1. Annan, A., Crompton, D.W.T., Walters, D.E. and Arnold S.E. (1986). An investigation of the prevalence of intestinal parasites in pre-school children in Ghana. *Parasitology* 92:209-217.
2. Booth, M. and Bundy, D.A.P. (1992). Comparative prevalences of *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm infections and the prospects for combined control. *Parasitology* 105:151-157.
3. Crompton, D.W.T. (1989). Prevalence of ascariasis. In: *Ascariasis and its Prevention and Control*, pp. 49-69 (Crompton, D.W.T. Nesheim, M.C. and Pawlowski, Z.S., eds). Taylor and Francis, London.
4. Gbakima, A.A., Sheppard, M. and White, P.T. (1994). Intestinal helminth infections in rural school children in Njala, Sierra Leone. *East Afr. Med. J.* 71:792-796.
5. Hall, A. (1982). Intestinal Helminths of man: The interpretation of egg counts. *Parasitology* 85:605-613.
6. Hailu Birrie, Berhanu Erko and Shibru Tedla (1994). Intestinal helminth infections in the southern Rift Valley of Ethiopia, with special reference to schistosomiasis mansoni. *East Afr. Med. J.* 71:447-452.
7. Hailu Birrie, Tilahun Woldemichael, Abraham Reda and Tadesse Chane (1994). The status of *Schistosoma mansoni* and snail hosts in Tigray and Northern Wello Regions, Northern Ethiopia. *Ethiop. Med. J.* 32:245-254.
8. Hailu Birrie, Girmay Medhin, Berhanu Erko, Gedlu Beshah and Teferi Gemetchu (1997). Intestinal helminth infections among the current residents of the future Finchaa Sugar Plantation Area, Western Ethiopia. *Ethiop. J. Hlth Dev.* 11:219-228.

9. Kloos, H., Aklilu Lema, Belete Kirub, Assefa Gebre, Bahta Mazengia, Getachew Feleke and DeSole G. (1980). Intestinal parasitism in migrant farm labour populations in irrigation schemes in the Awash Valley, Ethiopia, and the major labour source areas. *Ethiop. Med. J.* 18:53-61.
10. Leykun Jemaneh (1997). Intestinal helminth infections in school children in Adarkay District, Northwest Ethiopia, with special reference to schistosomiasis mansoni. *Ethiop. J. Hlth Dev.* 11:289-294.
11. Leykun Jemaneh (1998). Schistosomiasis mansoni and geo-helminthiasis in school children in the Dembia Plains, Northwest Ethiopia. *Ethiop. J. Hlth Dev.* 12:237-244.
12. Leykun Jemaneh (1999). Some major intestinal helminthic infections in school children in Lay Armacho District, Northwest Ethiopia. *East Afr. Med. J.* In press.
13. McConnell, E. and Armstrong, M.C. (1976). Intestinal parasitism in fifty communities on the Central Plateau of Ethiopia. *Ethiop. Med. J.* 14:159-168.
14. McCullough, F. (1974). Observations on *Ascaris lumbricoides* infection in Mwanza, Tanzania. In: *Parasites in Man and Animals in Africa*, pp. 359-385 (Anderson, C. and Kilama, W.L. eds). East African Literature Bureau, Nairobi.
15. Robertson, L.J., Crompton, D.W.T., Walters D.E., Nesheim, M.C., Sanjur, D. and Walsh E.A. (1989). Soil transmitted helminth infections in school children from Cocle Province, Republic of Panama. *Parasitology* 99:287-292.
16. Seo, B.S. (1990). Epidemiology and control of ascariasis in Kenya. *Korean J. Parasitology* 28:49-61.
17. Shield, J.M., Scrimgeour, E.M. and Vaterlaws, A.L. (1980). Intestinal helminths in an adult hospital population in the Eastern Highlands of Papua New Guinea: Relationship with anemia, eosinophilia and asthma. *Papua New Guinea Med. J.* 23:157-164.
18. Shibru Tedla and Leykun Jemaneh (1985). Distribution of *Ancylostoma duodenale* and *Necator americanus* in Ethiopia. *Ethiop. Med. J.* 23:149-158.
19. Shibru Tedla (1986). Intestinal helminthiasis of man in Ethiopia. *Helminthologia* 23:43-48.
20. Tilahun Woldemichael, Tsehay Assefa and Tareke Seyoum (1990). Intestinal parasitism among the student population of the Wonji-Shoa Sugar Estate. *Ethiop. Med. J.* 28:45-52.
21. WHO (1987). Report of a WHO Expert Committee. Public health significance of intestinal parasitic infections. *Bull. Wld Hlth Org.* 65:575-580.

22. WHO (1990). Informal consultation on intestinal helminth infection, Geneva, WHO/CDS/IPi/90.1.9-12 July.
23. WHO (1992). Bench Aids for the Diagnosis of Intestinal Helminths. Geneva: Programme of Intestinal Parasitic Infections, Division of Communicable Diseases.
24. Zein Ahmed Zein and Mekonnen Assefa (1985). The prevalence of intestinal parasites among farming cooperatives, Gonder Region, Northwestern Ethiopia. *Ethiop. Med. J.* 23:159-167.